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Ruth Rice Puffer
Carlos V. Serrano

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Pan American Sanitary Bureau, Regional Office of the
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1973

PATTERNS OF MORTALITY IN CHILDHOOD

*Report of the Inter-American Investigation of Mortality in Childhood**

RUTH RICE PUFFER, Dr. P.H., and CARLOS V. SERRANO, M.D., Ph.D.

Prepared with the assistance of Ann Dillon, Statistician, in the analyses of data, and of the principal collaborators and others mentioned below:

Principal Collaborators	*Projects*
Dr. Rubén A. Castro, Professor of Hygiene and Social Medicine, University of the Northeast (Corrientes), and Statistical Adviser to the Director of Health of Chaco Province, Resistencia	ARGENTINA Chaco Province
Dr. Valois Martínez Colombres, former Director of Health of San Juan Province and Delegate of the National Health Ministry to the Province, San Juan	ARGENTINA San Juan Provin
Dr. Gregorio Mendizábal L., Professor of Preventive and Social Medicine, University of San Andrés Medical School, and Chief of the Department of Health Planning of the Ministry of Health, La Paz	BOLIVIA Project
Dr. Fernando Figueira, Professor of Pediatrics at the two Schools of Medicine in Recife, and Secretary of Health of the State of Pernambuco, Recife	BRAZIL Recife
Dr. José Romero Teruel, Department of Preventive Medicine, School of Medicine of Ribeirão Prêto, University of São Paulo, Ribeirão Prêto	BRAZIL Ribeirão Prêto
Dr. Ruy Laurenti, Professor of Vital Statistics, Department of Epidemiology, School of Hygiene and Public Health, University of São Paulo, São Paulo	BRAZIL São Paulo
Mr. Louis Munan, Professor and Chairman of the Department of Epidemiology, School of Medicine, University of Sherbrooke, Sherbrooke	CANADA Sherbrooke

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Principal Collaborators	*Projects*
Dr. Adela Legarreta, Professor, Department of Public Health and Social Medicine, School of Medicine, University of Chile, Santiago	CHILE Project
Dr. Francisco Villadiego, Professor and former Chief of the Department of Preventive Medicine and Public Health, School of Medicine, University of Valle, Cali	COLOMBIA Cali
Dr. Abel Dueñas P., former Dean of the Division of Health Sciences, University of Cartagena, and Director of Health, National Department of Planning, Bogotá	COLOMBIA Cartagena
Dr. Julio León Trejos, Professor of Public Health Administration, School of Public Health, Antioquia University, Medellín	COLOMBIA Medellín
Dr. Eduardo Suárez M., Professor and Chief of the Department of Pediatrics, School of Medicine, University of El Salvador, San Salvador	EL SALVADOR Project
Dr. Kenneth Standard, Professor and Head of the Department of Social and Preventive Medicine, University of the West Indies, Mona, Kingston	JAMAICA Kingston-St. Andrew
Dr. Dionisio Aceves S., former Chief of the Department of Preventive and Social Medicine, University of Nuevo León, School of Medicine, Monterrey	MEXICO Monterrey
Dr. Helen M. Wallace, Professor and Chairman, Division of Maternal and Child Health, University of California, Berkeley	UNITED STATES OF AMERICA California Project
Dr. Ira W. Gabrielson, former Clinical Professor, Division of Maternal and Child Health, University of California, Berkeley	UNITED STATES OF AMERICA California Project

The following rendered assistance in classifying multiple causes:

Dr. Darío Curiel	Caracas, Venezuela
Dr. Ruy Laurenti	São Paulo, Brazil
Dr. Valois Martínez Colombres	San Juan, Argentina
Dr. Roberto Nunes	Recife, Brazil
Dr. José Rojas García	Cartagena, Colombia
Dr. Carlos A. Sagastume	San Salvador, El Salvador

Foreword

Much remains to be learned about the natural history of health and disease in the Americas and in other Regions of the world. We do not know why diseases occur or do not occur at a given time and place. Even less do we know what conditions and circumstances cause them to spread within a country and between countries in the Hemisphere. Indeed, accurate knowledge of the etiology of a specific disease does not tell us about the sequence of events that produce it. Today we accept the fact that multiple causes are involved in the development of disease. To identify each one—in particular the causative agent—to determine how these causes interact or interfere with one another, is the task of modern epidemiology. The task is even more complex when the same disease is investigated in different societies, with a view to comparing the factors involved and their effects on morbidity and mortality, on health, and on well-being.

The last ten years have forced us all to think and act ecologically, that is, to consider the interrelationships of man and his immediate and mediate environment. In this way we can better interpret vital phenomena and many of the events of every day life and of social life. This approach is a true return to the past. In the middle of the last century Spencer, in his *Biology*, "takes for his keynote his conception of life, as having for its chief characteristic a continuous adjustment of the organism to its environment, of its internal to its external relations. So structure follows upon function and functional need, and hereditary transmission hands on to the next generation the advances that the past generation has made: life produces organization, and not organization life."*

These reflections may serve to introduce the Inter-American Investigation of Mortality in Childhood because they are pertinent to its purposes and its results. For many years we have said that mortality is due to a constellation of causes, predominant among which are infectious diseases, malnutrition, lack of basic sanitation, ignorance which often goes beyond illiteracy, and a low average family income which deprives individuals of the benefits that modern

* D'Arcy W. Thompson: "On Aristotle as a Biologist: with a Prooemion on Herbert Spencer." The Herbert Spencer Lecture delivered before the University of Oxford, 14 February 1913. *In: Toward Modern Science. Studies in Ancient and Medieval Science*, Vol. 1. Edited by Robert M. Palter. New York, The Noonday Press, 1961, page 62.

technology continues to contribute. We have pointed out that child mortality, and in particular infant mortality, is the most sensitive indicator of the degree of underdevelopment of a community. Furthermore, medical technology cannot be asked to resolve social situations on which it has no influence.

We recognize that these reflections bear on causes whose true magnitude and implications we were unable to evaluate. It was for that reason that we undertook this Investigation, the results of which we are now pleased to submit to the Governments, the universities, and students of child mortality—today the most important health problem in the Americas, where in most of the countries young persons under 15 years of age comprise no less than 40 to 50 per cent of the population, and mothers and children together, 63 per cent of the total.

Today, the Governments are aware that the progressive solution of this problem, based on its multiple causation, represents a very tangible contribution to well-being and economic development. Hence the great importance of this publication. It shows us objectively—using an ecological approach—the imperative need to analyze and to deal as a whole with the factors involved in the morbidity and mortality of mothers and children. Among the deaths analyzed nutritional deficiency appears to be the most serious health problem. When it accompanies low birth weight, the two together endanger survival and jeopardize the growth and development of the newborn child. The more serious the malnutrition of mothers, the more uncertain the future of their children. And the greater the number of offspring, the more serious the risk to the mother and her child.

This study undeniably confirms the synergism between infection and nutritional status, which highlights the priority of immunization programs against specific diseases. Moreover, breast feeding, the educational level of mothers, and the availability of water in the home directly influence the decline in the incidence of various diseases, mental retardation, and mortality. And it is only logical that there should be an inverse correlation between mortality in children and their perinatal care as well as prenatal care of mothers.

These circumstances further substantiate the need for rational family planning, founded on the parents' sense of responsibility for the well-being of their children.

As the study shows, official statistics do not completely disclose the true magnitude of health problems, a fact that is reflected in the plans, programs, and projects that are formulated. Through the training of statisticians and their auxiliaries, greater efforts should be made to improve the quality of data, to lay the foundation for the more rational use of resources, to evaluate the activities undertaken and the social effects achieved. The effectiveness of such a statistical system, however, will depend essentially on the medical profession's interest in bringing about improvement in the clinical records, through the registration of all data derived from medical diagnoses.

Once again, a significant difference is disclosed between rates of morbidity

and mortality in urban areas and rural areas, the latter being in a much more disadvantageous position. This fact should come as no surprise, for at least 37 per cent of the population do not have access to a minimum health service. There are about 100 million persons living in overcrowded conditions on the outskirts of the major cities, drawn to them by their mirage effect, or living in communities (some viable, some not) in rural areas. For the gradual solution of these problems a rational strategy has been drawn up and is set forth in the Ten-Year Health Plan for the Americas for the period 1971–1980.*

The publication of the findings of this Investigation could not be more timely because they give even greater relevance to the maternal and child health objectives the Governments have committed themselves to achieve together in this decade. What is more, the information collected and carefully analyzed will be of great importance for education in the health sciences of both professional and auxiliary health workers, in the sense of harmonizing theory and practice, with the active participation of students in the identification, elucidation, and solution of community problems.

This work represents a continuation of that devoted to the study of mortality in adults, the report on which was published in 1967 under the title *Patterns of Urban Mortality*.† Both are real studies in comparative epidemiology, essentially international in nature, whose methods have served as a model for other similar studies. Properly interpreted, the data give a truer picture of the natural history of the prevalent diseases in the Americas, in both the technologically advanced and the developing societies. They supplement the official statistics, provide guidance on the use of modern techniques and procedures, and contribute to social well-being.

We should like to express our appreciation to the Governments for their support and understanding, to the investigators who participated with such dedication in this important endeavor, and to the Agency for International Development of the United States of America, whose financial contribution made this undertaking possible.

We are confident that the valuable experience gained will serve as a basis for new studies in the Americas and in other Regions of the world, and will contribute to a reform of the teaching and learning process in the health field and to a better knowledge of actual conditions, in order that the goal of improving the well-being of mothers and children may be achieved.

ABRAHAM HORWITZ
Director, Pan American
Sanitary Bureau

* *Official Document PAHO 118* (1973).
† *Scientific Publication PAHO 151* (1967).

DEDICATED

TO

ROBERT GOODWIN FIELD

AND TO

THE MANY WHO MAY BENEFIT FROM

THIS RESEARCH

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Preface

In the 1880's Hirsch gave the following definition of *geographical pathology:*

> "A science . . . which will give: firstly, a picture of the occurrence, the distribution, and the types of the diseases of mankind, in distinct epochs of time, and at various points of the earth's surface; and, secondly, will render an account of the relations of those diseases to the external conditions surrounding the individual and determining his manner of life."
>
> Dr. August Hirsch
> *Handbook of Geographical and Historical Pathology*, London: The New Sydenham Society, 1883 (Vol. I, pp. 1–2).

Although this statement dates back to the last century, the definition applies well to our studies on the patterns of diseases in various parts of the Americas and their relationship to biological and socioeconomic conditions. Hirsch based his studies on data derived from information on deaths; we have obtained additional information of wider scope on the events leading to each death, on the reproductive history of the mother, and on social and environmental conditions affecting the family.

Coordinated international research, through geographic studies, is undoubtedly of fundamental importance for uncovering health problems as well as patterns and methods of spread of diseases. Much remains to be learned concerning the epidemiology of diseases; not only do problems need to be brought to light but also searches for causes must be extended in various parts of the world. What are the causes of congenital anomalies, especially those of the nervous system? Why do children develop leukemia? Students and health workers must be made aware of the need to gain the fullest possible knowledge of diseases in their own particular areas, in developing as well as developed countries. There is no uniformity in patterns and more than one cause or factor may be involved, as the host's susceptibility as well as the infectious agent are involved in the development of a disease.

The importance of directing research toward discovery of the exact nature of a specific health problem as a basis for planning effective preventive measures was impressed upon the first author some forty years ago in Tennessee, where Dr. Wade Hampton Frost was serving as consultant to the Commissioner

of the State Health Department in epidemiologic studies on tuberculosis. The tuberculosis death rate in Tennessee was one of the highest in the United States and the financial resources for combating the problem were low. Through the Williamson County Tuberculosis Study conducted with financial assistance from the Rockefeller Foundation, many aspects of the problem were analyzed in depth. The excessive calcification found in the lungs of residents of the area led to Dr. Amos Christie's discovery of sensitivity to histoplasmin. That community-centered research program, which combined a longitudinal study of tuberculosis with a preventive program, made unusual contributions. This same policy of community-centered research oriented toward prevention in specific areas and countries is one that should be developed in Latin America.

The Inter-American Investigation of Mortality in Childhood is the second large, coordinated research program undertaken by the Pan American Health Organization to gain a greater understanding of the epidemiology of diseases as the basis for health programs in the Americas. The marked geographic variations observed in death rates from the cardiovascular diseases, and in particular arteriosclerotic heart disease, prompted the Organization to carry out the first of these programs in 1962–1964 in twelve cities, eleven in the Americas and one in Bristol, England. The primary objective was to produce an accurate and comprehensive account of mortality in adults 15–74 years of age. The findings of that Investigation made it clear that there were wide and true differences in mortality from cardiovascular diseases and malignant neoplasms that could not be attributed to differences in nosology or classification. Many areas were pinpointed in which further research was needed in order to gain more knowledge of the epidemiology of cardiovascular diseases, malignant neoplasms, as well as others such as cirrhosis of the liver and diabetes mellitus.

The results of that Investigation showed that the additional information available in hospital and autopsy records, when combined with the clinical data, would make it possible to arrive at more precise determination of the causes of death. The selection of one single cause often proved difficult if not impossible. Suitable methods of handling multiple causes and combinations of causes therefore had to be devised. Moreover, it was recommended that modern computer techniques be tried for study of the epidemiology of diseases, not as isolated entities but as combinations of pathological states.

The Division of General Medical Sciences of the U.S. National Institutes of Health awarded a grant (No. GM-08682) to PAHO for the conduct of that first research program. The findings were reported in the volume *Patterns of Urban Mortality* (Scientific Publication PAHO No. 151, 1967), which appeared also in Spanish with the title *Características de la mortalidad urbana* (1968).

Fortunately, the opportunity was provided to utilize the experience gained in that first large geographic study of diseases in a much more ambitious program of research on mortality in childhood. Early in 1966 a protocol and procedures for a comprehensive investigation of mortality in infancy and early childhood in the Americas were developed by the Pan American Health

Organization, and Dr. Malcolm Merrill, the Director of Health Services of the U.S. Agency for International Development, encouraged the Organization to submit a proposal for its funding. Upon approval of the study design by the Committee of Research of that Agency, funds were awarded for the pilot testing phase. At that time Dr. Thomas D. Dublin, Research Adviser of the Agency, saw the great potential value of such research as a basis for programs in the fields of nutrition and child health. He participated in the initial planning and continued to lend his support to the Investigation throughout its several phases.

Pilot testing for the coordinated research program was conducted in 1966–1968 in five Latin American areas. Because of the seriousness of health problems in childhood in northeastern Brazil and the interest of health workers there in strengthening pediatric services and education, a project was established in Recife during that phase. The Recife pilot project proved of great value in demonstrating methods both for the selection of research staff and for the utilization of the research methodology and results in teaching programs in medical and nursing schools. The Organization's consultant in pediatric education stationed in Recife recognized the great benefits to be obtained from this research program and continued to participate throughout all phases of the Investigation. After assisting in the execution of the pilot phase in Recife, he was assigned to the staff of the Investigation in the Washington Office and is the joint author of this report.

In January 1968 the proposal for the investigation of approximately 35,000 deaths of infants and young children in widely separated areas of the Americas was approved and funds were granted for the first year of the program. Annual funding was provided for the major portion of the field work as well as for the processing and analysis of the data through 31 March 1973. As members of the staff of the Pan American Health Organization, we express our great appreciation to the U.S. Agency for International Development, and especially to Dr. Lee M. Howard and his staff.

The contract with the Agency for International Development covered, essentially, the 13 field projects in Latin America and the analyses in the Washington Office. In several of the projects the local universities or health agencies provided additional resources required for successful completion of the field work. In Medellín, Colombia, for example, the budget as originally allocated was too small and resources of the University of Antioquia, amounting to nearly two-thirds of the total cost, were added. In the other projects as well, the teaching staff and other personnel of the participating universities assisted in various ways in the execution of the work.

The Ministers of Health of each of the countries in which the Investigation was conducted have from the beginning demonstrated great interest in the program and given support to the individual projects. Their continued interest and support will ensure application of the results for the benefit of health in the Americas.

The original design of the program (as in the case of the Inter-American Investigation of Mortality in adults) called for the development of projects in areas of the Americas with distinctly different patterns of mortality. Two additional projects in Northern America were made possible by grants of funds from other sources. In California, a project was conducted by the Maternal and Child Health Division of the School of Public Health of the University of California at Berkeley, with the assistance of a grant (No. MC-R-060052-04-0) made by the U.S. Department of Health, Education, and Welfare (Maternal and Child Health and Crippled Children Services). In Canada, a project conducted by the new Medical School of the University of Sherbrooke was supported by two grants (Nos. 604-7-680 and 604-7-626) from the Department of National Health and Welfare of Canada. We appreciate the contributions of those agencies, as well as the cooperation of the principal collaborators of those projects and their staffs.

The Investigation profited greatly by the inclusion of these two projects, which brought the experience of areas where mortality has been reduced to very low levels and deaths in childhood are concentrated principally in the first few days of life. The many comparisons that can be drawn between patterns of mortality in these areas and those in Latin America are of great value not only to the Latin American areas but also to health workers concerned with mortality in childhood in Canada, the United States, and other countries that have low death rates. The analyses that were made of multiple causes and factors, for example, indicate clearly that understanding of interrelationships of causes—as they concern agent, host, and environment—must be gained through the study of associated as well as underlying causes of morbidity and mortality, so as to provide solid bases for health programs in the future.

Dr. Abraham Horwitz, the Director of the Pan American Sanitary Bureau, has given strong support for both of these Inter-American Investigations of Mortality. For the present Investigation resources of the Headquarters Office have been provided as necessary. The Health Statistics Department has rendered assistance throughout all phases of the work. The Computer Science Section assumed a major responsibility for the computer processing of the data of the Investigation, and in particular for programming the many tabulations used for each project in this report. Continuous administrative assistance was rendered by the Finance and Budget Sections. Finally, the publication of this book in English and Spanish has been made possible by the valuable assistance given by the staff of the Publications Services. Special appreciation is expressed to the clerical and secretarial staff for their dedicated services.

In addition to those already mentioned, the contributions made by the principal collaborators and other participants (listed on pp. ii-iii) and some 200 members of the field staff made it possible to bring the Investigation to completion.

The success of this Investigation will depend on maximum utilization of the results in three fields of action, namely: improvement and reorientation

of health programs; incorporation of methods, procedures, and findings in medical education as well as in the teaching of other health sciences and related disciplines; and the continued development of community-centered research as a joint endeavor of universities and health services to safeguard the health and well-being of populations.

RUTH R. PUFFER
CARLOS V. SERRANO

6 March 1973

FIG. 1. Location of 15 Projects in the Inter-American Investigation of Mortality in Childhood.

Chapter I

Origin and Initial Phases

One of the goals established by the nations of the Hemisphere in the Charter of Punta del Este (1961) was to reduce mortality in children under 5 years of age by one half in a 10-year period. This has proved to be a great challenge in the years since the Charter was signed.

The Inter-American Investigation of Mortality in Childhood, a collaborative research project coordinated by the Pan American Health Organization on a continental scale, has provided an excellent mechanism for exploring in depth the causes of excessive mortality in infancy and early childhood in the Americas, as well as the interrelationships of multiple causes and associated factors. The principal findings of this extensive community-centered program, carried out in the period 1968-1972, should serve as the basis for renewed efforts to improve health conditions in a major segment of the population of the countries.

The predecessor of this program—the Inter-American Investigation of Mortality (Puffer and Griffith, 1967), conducted in 1962-1964—was planned with one primary objective: to provide a comprehensive account, as accurate and as comparable as possible, of the causes of mortality in adults in highly diverse and widely separated populations. The patterns of mortality were shown to vary widely, and surprising and intriguing differences in the death rates were revealed. In addition to pointing up specific fields for preventive action, the results served to define the needs and opportunities for further epidemiologic research. They indicated clearly that hospital and autopsy records contained additional information which, when combined with the clinical data, made possible more precise definitions of causes of death. Moreover, since the selection of one underlying cause governed by arbitrary rules meant that valuable information was discarded, one of the recommendations was that suitable methods be developed for handling multiple causes and combinations of causes, that is, for discovering etiologically significant associations. Experimentation with modern computer techniques for studying the epidemiology of diseases on the basis of combinations of pathological states was also recommended.

That first collaborative research program was of necessity carried out in urban areas in order to obtain complete information on all deaths, but it was recognized that differences in mortality patterns in rural populations also needed to be investigated. Moreover, while the health problems of adult life are of paramount concern in developed countries, those of infancy and childhood continue to be of primary importance in over half the world's population. And in an era when population pressures

are of major interest, planning for healthy and intelligent infants and elimination of biological wastage have especially high priority. Thus the principal collaborators of the first study on adult mortality recommended that a similar investigation of the problems in childhood be undertaken, using as a foundation the experience gained in the first program and implementing the recommendations with respect to study of multiple causes and experimentation with modern computer techniques. In this way, much more ambitious objectives were set for the new continental research program.

OBJECTIVES

The overall objective of the Investigation was to carry out in selected communities of the Americas research projects designed to establish death rates for infancy and childhood that would be as accurate and comparable as possible, taking into account biological as well as nutritional, sociological, and environmental factors. In order to analyze both underlying and associated causes of death and to study interrelationships of diseases and other conditions, complete data were to be obtained on deaths in children under 5 years of age in accordance with standard definitions and procedures. To relate mortality to biological and other factors, considerable information was required regarding the home, the environment, the parents, practice of breast feeding, and provision of health care.

As a basis for evaluating the many factors involved, a specific objective was to study the reproductive history of mothers, ascertaining the relationships of variables such as age of mother, birth order of deceased infant, and previous reproductive wastage. Another was to study and compare biological and social differences in those who die in early life and those who live, through probability sampling of households and of living children under 5 years of age.

Because of the known variations in usage of medical terminology and the difficulties that have been encountered in obtaining comparable classifications of causes, one of the objectives was to make an intensive study of assignment and classification problems in order to develop improved procedures for incorporation into the 1975 Revision of the *International Classification of Diseases* of the World Health Organization. This study involved assignments of associated as well as underlying causes.

In order to better understand and plan for the solution of problems in childhood in the Americas, one of the goals was to study mortality in rural as well as urban areas.

In keeping with the new emphasis placed by health authorities on strengthening medical research, one of the aims was to stimulate the interest of schools of medicine and public health and involve them in the studies.

By setting this series of objectives the Investigation sought to gain fuller knowledge of health problems of the child population and thereby develop solid bases for new approaches and integrated action. The findings reported at this time are from the study of deaths under 5 years of age.

Chapters II and III which follow describe the steps taken to include all deaths that occurred and to obtain clinical and other diagnostic information in order to reach the goal of "data as complete and comparable as possible." An overall view

of mortality is then presented (Chapter IV), with comparisons drawn between data developed in the Investigation and those in official publications. Mortality in infancy (under 1 year) and in early childhood (1-4 years), which is analyzed in Chapters V and VII, shows wide variations and the information compiled indicates the great reductions that could be achieved in Latin America, as illustrated by the levels attained in two of the study projects. Because of the special health problems characteristic of the first few days of life –a period that determines survival—mortality in the neonatal period is analyzed in depth in Chapter VI.

Following the study of mortality by age group, a complete analysis is made of the data on infectious diseases, nutritional deficiency, congenital anomalies, and other important diseases and conditions such as malignant neoplasms and sudden death (Chapters VIII-XI).

Birth order of the deceased child and age of the mother, which influence the level of infant mortality, are analyzed in Chapter XII, dealing with reproduction and reproductive wastage.

In the evaluation of other factors responsible for or contributing to serious health problems, attention is given to limited use of breast feeding as an obstacle to the improvement of child health (Chapter XIII). The educational level of the mother was found to be a satisfactory overall measure of socioeconomic status, and its relation to childhood mortality is discussed in Chapter XIV.

The medical and health care provided and certain environmental factors are considered in Chapters XV and XVI, and the data clearly indicate the need for extension of programs in these fields.

Chapter XVII describes the extent to which additional information available in hospitals and from autopsy protocols contributed to improved assignment of underlying causes.

Complex health problems affecting the mother may be leading to low birth weights and lack of growth and development of the child, and hence to high vulnerability to infectious diseases in infancy and childhood. Thus the final chapter outlines steps for improving the health of mothers, as well as infants and children, and for reducing mortality through planning of health programs on a multidisciplinary basis. Also, attention is drawn to the need for orienting teaching in the health sciences toward the solution of local problems that were revealed in the specific projects.

The patterns of mortality shown to exist in 15 widely separated areas of the Hemisphere are so diverse and surprising that there can be no doubt as to the need for further development of community-centered research as a tool for uncovering health problems and planning actions for their solution.

This publication is the first in a series of reports on the findings; others presenting the data derived from samples of the population, with information regarding living children under 5 years of age, will follow. Also, specific aspects of the results will receive intensive analysis. The important contributions made by the principal collaborators and their staffs and the need to make this information available to them, as well as to international agencies, justify the immediate release of this present account of mortality in childhood, so that it may be used as a basis for action to deal with the problems uncovered.

PILOT TESTING AND PLANNING CONFERENCES

An important feature of the Investigation was the planning phase, which included pilot testing of questionnaires and procedures in several areas, rural as well as urban, and meetings with local collaborators. The original proposal stipulated an 18-month period for this phase, funding for which was awarded by the U.S. Agency for International Development in July 1966.

After a search was made for possible pilot testing sites and local collaborators, the first working group was convened in Washington, D.C., on 19 and 20 October 1966, to review a draft questionnaire and discuss testing procedures. Twelve participants from Brazil, Colombia, Guatemala, Jamaica, the United States of America, and Venezuela agreed on the trial questionnaire and procedures to be followed in five areas: Recife and Ribeirão Prêto in Brazil, an urban area in Jamaica, and rural and urban areas in Colombia and Guatemala. Field work for the testing commenced in January 1967. Also in 1967 interviewers of the U.S. National Morbidity Survey tested the questions in North Carolina.

The first 700 completed questionnaires from the five Latin American pilot projects were analyzed in 1967. The analysis revealed incompleteness of registration of deaths in the first day of life in two areas, thus indicating the need for introduction of the World Health Organization's definition of a live birth. In several areas relatively high proportions of the deaths and also of the births of the deceased children had occurred in hospitals, where clinical data could be expected to be available. However, deficiencies in the completeness of these data pointed to the need for improving the records systems of hospitals in areas where the Investigation was to be carried out, and also for providing short courses for personnel in charge of such records.

Difficulties were encountered in regard to quality of the field work in two rural areas, principally due to the lack of diagnostic evidence and medical attention. The findings indicated that, with the staff planned, the inclusion of rural areas in which medical attention was lacking was not advisable. Medical interviewers would be needed to make a thorough investigation of the causes leading to death. Even if physicians could be employed for such work, they would not be able to obtain any laboratory and pathological evidence to support their diagnoses. It was clear that the plan of the Investigation necessitated selection of rural areas that had local health services and were in close proximity to medical centers so that satisfactory clinical data would be available for a high proportion of the deaths. Areas at great distances from cities could not be included and thus the rural sites selected could not be truly representative of the rural population in the corresponding countries. Nevertheless, even though the areas selected near cities had greater health facilities, the data they provided served to show the nature of differences in mortality patterns between rural and urban populations.

On the whole the interviewers obtained complete histories of pregnancies of the mother, a fact indicating the competency of public health nurses and social workers in this phase of the Investigation. Birth weights were obtained for more than three-fourths of births of the deceased children in Recife and Ribeirão Prêto but were not available for a sufficient number in the other areas. Therefore, efforts had to be

made to introduce weighing of infants as a routine practice in the hospitals.

Although the data collected on degree of malnutrition proved useful, standard procedures for the assessment of nutritional status had to be devised. This was important, as the Investigation sought to clarify the role of nutritional deficiency as a contributor to mortality.

The plans for the probability samples of households were revised and a practical sampling program was developed to obtain a record of all household members and collect data on living children under 5 years of age. Primary sampling units, usually from two to four per month, were to serve as the basis for studies conducted over 24 consecutive months. Three exceptions were made, with eight units per month selected for São Paulo and Ribeirão Prêto and 15 per month for the project in Santiago, Chile.

A small working group whose members had participated in the field work reviewed the results of the pilot testing at a meeting held in Washington, D.C., from 4 to 8 December 1967, and made minor revisions in the questionnaire for further testing early in 1968. The group also drew up several sections of the proposed Manual of Procedures in order to assure rapid development of the projects once funds became available. The planning and pilot testing phase thus resulted in valuable contributions to the design and operation of the research program.

Early in 1968 the U.S. Agency for International Development approved the plans for the program as proposed for the four-year period 1 April 1968 to 31 March 1972, and awarded funds to the Pan American Health Organization for the first year. The program called for 27 months of field work for collection of data on deaths occurring in 24 consecutive months and for sampling of households for the same 24 months. Projects were designed for 13 areas of Latin America. Although one of them was in Jamaica, in the Caribbean, for simplicity's sake these 13 projects will be referred to in this report as Latin American. Since projects were desired also in Northern America,* other sources of funds were sought by research workers in the United States and Canada who wished to participate in this collaborative program, and projects were carried out in two additional areas, one in California in parts of 1969 and of 1970 (one full year) and the other in Québec Province in 1970 and 1971. Thus, the Inter-American Investigation of Mortality in Childhood comprised research projects in 15 different, widely separated areas in 10 countries of the Americas.

To reach agreement on procedures for the conduct of the Investigation, a Planning Conference of the principal collaborators was held from 25 to 28 March 1968 at the Medical School of the University of Valle in Cali, Colombia. The group reviewed the questionnaires for collection of data on deaths, as well as several sections of the Manual of Procedures. The plans for sampling of households and of living children under 5 years were outlined by a consultant on sampling. In addition, specialists in pathology, pediatrics, nutrition, preventive medicine, epidemiology, and statistics participated in the discussion of specific phases of the program, outlining the contributions to be made in those fields.

The Planning Conference directed special attention to standards for assessment of nutritional status, an important phase of the Investigation. It was agreed that the

* Northern America (the term used by the United Nations to designate the region of the Hemisphere lying north of Mexico) is used in this report when referring to the projects in California and Canada.

degree of malnutrition, based on body weight and clinical and pathological observations, would be classified by the scale proposed by Gómez *et al.* (1955) and used by co-workers Ramos-Galván *et al.* (1958), and the weight standards from Harvard published by Nelson *et al.* (1969). *The Assessment of the Nutritional Status of the Community* by Jelliffe (1966) was furnished to each collaborator as a reference.

Medical interviewers from six of the projects attended the Planning Conference in Cali, and those from five other projects, along with three principal collaborators, participated in a meeting on interviewing held at the Department of Preventive Medicine of São Paulo University in Ribeirão Prêto, Brazil, from 3 to 9 April 1968. Both meetings proved very useful for establishing the standard interviewing procedures.

One of the Investigation's objectives was to develop procedures for the classification of multiple causes of death. To ensure uniformity and comparability, it was decided that the assignments would be made in the central office of PAHO in Washington, D.C., although important contributions would be made by the principal collaborators in providing complete diagnostic information for such assignments. The collaborators would have important roles also in the development of statistics on multiple causes, not only for the Investigation itself but also for subsequent application in the participating cities and countries. A second Planning Conference of the principal collaborators was convened from 6 to 10 October 1968 in Caracas, Venezuela, to discuss the provisional rules for classification and coding of multiple causes according to a new Manual specifically covering these procedures. In addition to the collaborators from the 13 Latin American projects, the director and the former director of the Latin American Center for Classification of Diseases participated in this meeting, at which additional principles and recommendations were formulated. Through these discussions the importance of complete diagnostic information became clear.

In the original plans a timetable for the research program was established. During 1968 agreements for the 13 field projects of the Investigation were signed by the Ministers of Health of the participating countries, the deans of the participating medical schools, and the Director of the Pan American Sanitary Bureau. The field work was started in all the Latin American projects during 1968, with the first month of recorded deaths varying from June to September. The timetable called for completion of all field work in 1970 and analyses in 1971. Because of difficulties in obtaining information on deaths in early life, the field work was completed somewhat later in nearly all projects, so that processing of the entire data was not completed until 1972. The problems encountered in this regard, as well as the solutions applied, are explained in Chapter II. The delay in preparation of this report until 1972 made it possible to include the two Northern American projects, which were late in starting the field work.

The experience gained in the planning phase clearly demonstrated the key importance of this phase to the achievement of high standards of operation and high-quality results. The problems that arose in this Investigation indicate that future research of this type should have an even longer preparatory phase and more extensive pilot testing in each area. Such preparatory work would be highly useful in providing solutions for the many and varied difficulties encountered.

SELECTION OF AREAS

The original proposal provided for a study of approximately 35,000 deaths in a two-year period in 13 widely separated areas in Latin America. From 650 to 2,000 deaths for each of two years were to be investigated in each project. High-altitude communities, areas with serious health problems, and rural as well as urban populations would be studied. The projects were distributed in Middle and South America so that all types of problems would be represented and the results would be of value to health authorities in all parts of the Region.

In the selection of study areas, the first consideration was to find a suitable health leader to serve as principal collaborator and assume responsibility for the direction and conduct of the field work and later for utilization of the results by both health services and schools of health sciences in the area concerned. The requisite qualifications included professional standing, to enable the collaborator to enlist the medical profession's collaboration, and experience in the direction of field work. Because of the value of community-centered research in medical education, a faculty member of a medical or public health school would be especially well qualified to serve as principal collaborator, for he could involve other members of the faculty in this research project and they in turn could make continuous use of the results in their teaching programs. The staff of the Pan American Health Organization succeeded in finding well-qualified collaborators in suitable areas of the Region. The design of each project, planning of its activities, and preparation and implementation of its budget for the 27 months of field work were essentially the responsibility of the principal collaborator. These plans were combined into the original proposal which was submitted for funding in July 1967. With only few exceptions, the projects were carried out in accordance with the programs in the original plans.

The names and positions of the principal collaborators of the 15 projects of the Investigation are listed on page ii. The variety of their positions, as well as of their interest and contributions, is noteworthy. All shared an interest in the health of children in the Hemisphere, and all contributed with their time and energy in many different ways to the success of the undertaking. They were assisted by local authorities and institutions, and they served as leaders of the multidisciplinary team working in each project.

More than 200 persons participated in the collection of data in the field (without counting other personnel for administrative, clerical, transportation, and related activities, who also made valuable contributions). Of that group, 120 were physicians, including the principal collaborators, pathologists, consultant obstetricians, pediatricians, and 68 interviewing physicians; 80 were public health nurses and social workers who gathered data from families of deceased children, civil registry offices, families included in the household samples, etc.; and a few were other professionals, among them statisticians and epidemiologists attached to several of the local project teams. All this personnel worked intensively in collecting data as well as in introducing procedures for improving the quality of information. The training and experience acquired by them during the field work was an excellent by-product of the Investigation that will be of benefit to future health activities.

THE FIFTEEN PROJECTS

The Investigation was conducted in 13 projects in Latin America during the period 1968-1971, in an additional project carried out in the United States in California in 1969-1970, and another in Canada in Québec Province in 1970 and 1971. Six of the projects were strictly urban while the other nine encompassed rural and/or suburban as well as urban areas. Because of the wide variety in topography and environmental conditions in these areas, an idea of the nature and characteristics of each of them is necessary for interpretation of the results. Therefore each one is described in some detail, and the locations and population concentrations are indicated on the accompanying maps.

The importance of accurate data for health planning in rural areas of the Region is so great that special attention is given wherever possible to presentation of the findings in the rural sectors. Some of the rural and suburban areas are too small to permit conclusive results and thus caution is necessary in interpreting the findings. However, the variety of the mortality patterns as well as the many sociological and biological factors found to be involved indicate the richness of the material compiled and the opportunities for further research wherever the results are inconclusive.

The wide distribution of the 15 projects over the Americas can be seen on the map in Figure 1 (frontispiece). The Sherbrooke project in Québec Province has the northernmost location, while the Chilean project has the southernmost, lying at the other end of the Hemisphere. The six projects shown by circles are confined to cities, while the other nine shown by squares include suburban and/or rural areas.

The projects are described below, in alphabetical order of the countries in which they are situated, this same order being maintained for the presentation of data throughout the report. Three countries—Argentina, Brazil, and Colombia—had more than one project. Table 1 lists the areas included in each project and the estimated populations and live birtns used for the calculation of rates. For the rates under 5 years of age, the population under 5 years serves as the basis (denominator). For infant mortality, live births are used as the denominator. The term urban is used in this report to signify a city in classifying areas of the projects. However, a few of the cities' small suburban or rural populations are included. In the Ribeirão Prêto project it was necessary to use the term city to make the distinction between the name of the project, the city of Ribeirão Prêto, the interior city of Franca, and the communities.

The size of the cities, small communities, and rural districts (in square kilometers) is specified to aid in understanding the wide diversity of the material. For example, the city of San Francisco covers 123 km^2 while the city of São Paulo extends over a much larger area—842 km^2. San Juan Province in Argentina has 96,493 km^2, the largest geographic area in the Investigation, and the Sherbrooke project in Canada was also extensive, covering 20,200 km^2.

ARGENTINA

Two areas of Argentina—a portion of the Province of Chaco and all of San Juan Province—were selected for inclusion in the Investigation, in part because of the availability of suitable principal collaborators and

TABLE 1. Specific Areas, Method of Selection of Deaths, Time Period, and Estimated Population Bases for Two Years[a] for 15 Projects.[b]

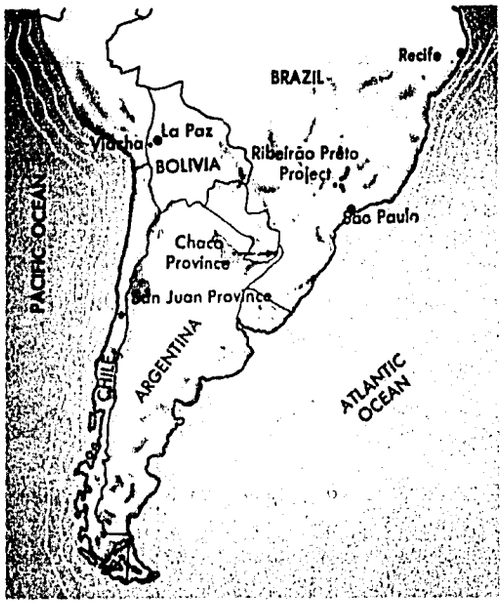
Country, central city, and other area	Selection of deaths of residents	Time period[a]	Estimated population base (two years)				
			Under 5 years	1–4 years			Live births
				Total	1 year	2–4 years	
ARGENTINA							
1. **Chaco Province Project**—Total	.....	.....	76,800	60,320	15,940	44,380	17,600
Resistencia (urban), San Fernando Department	All	Aug. 1968—July 1970	41,740	32,530	8,940	23,590	9,800
Rural departments: Comdte. Fernández, Genl. Donovan, Libertad, Presidencia de la Plaza, 1 de Mayo, Quitilipi	All	Aug. 1968—July 1970	35,060	27,790	7,000	20,790	7,800
2. **San Juan Province Project**—Total	.....	.....	104,460	84,180	21,040	63,140	23,360
San Juan (urban), Capital Department	All	Aug. 1968—July 1970	25,240	20,220	5,060	15,160	5,820
Suburban departments: Chimbas, Rawson, Rivadavia, Santa Lucia	All	Aug. 1968—July 1970	35,540	28,620	7,160	21,460	7,920
Rural departments: Rest of Province	All	Aug. 1968—July 1970	43,680	35,340	8,820	26,520	9,620
3. **BOLIVIA Project**							
La Paz (urban)	All	July 1968—June 1970	154,700	120,100	33,100	87,000	36,760
Viacha (rural community)	All	July 1968—June 1970	3,350	2,580	710	1,870	850
BRAZIL							
4. **Recife Project**—Three urban districts: Beberibe, Casa Amarela, Encruzilhada	All	July 1968—June 1970	123,910	95,810	26,820	68,990	30,400
5. **Ribeirão Prêto Project**							
Ribeirão Prêto (city)	All	July 1968—June 1970	42,630	33,670	8,810	24,860	9,310
Franca (interior city)	All	July 1968—June 1970	22,340	17,550	4,650	12,900	5,090
Communities (suburban-rural): Batatais, Brodosqui, Cravinhos, Jardinópolis, Sertãozinho	All	July 1968—June 1970	17,530	13,850	3,610	10,240	3,840
6. **São Paulo Project** (urban)	1 in 4.25	June 1968—May 1970	243,710	188,400	54,140	134,260	58,160
CANADA							
7. **Sherbrooke Project**[c]	All	Jan. 1970—Dec. 1971	91,060	74,320	17,000	57,320	16,970
8. **CHILE Project**							
Santiago (urban)	1 in 5	July 1968—Feb. 1969					
	1 in 3	Mar. 1969—June 1970	191,650	154,500	37,130	117,370	40,180
Comunas (suburban-rural): Colina, Lampa, Quilicura, Til-Til	All	July 1968—June 1970	16,120	13,000	3,120	9,880	3,400
COLOMBIA							
9. **Cali Project** (urban)	1 in 2	July 1968—June 1969					
	1 in 3	July 1969—June 1970	101,200	80,900	20,200	60,700	21,100
10. **Cartagena Project** (urban)	All	July 1968—June 1970	86,000	68,800	17,200	51,600	17,900
11. **Medellín Project** (urban)	1 in 3	July 1965—June 1970	93,300	74,600	18,600	56,000	19,400
12. **EL SALVADOR Project**							
San Salvador (urban)	All	Sept. 1968—Aug. 1970	103,860	80,040	22,850	57,190	25,620
Rural municipios: Apopa, Nejapa, Quezaltepeque	All	Sept. 1968—Aug. 1970	21,430	16,550	4,510	12,040	5,400
JAMAICA							
13. **Kingston-St. Andrew Project**—Total	.....	.....	183,240	143,570	39,110	104,460	40,960
Metropolitan Kingston (urban)	All	June 1968—May 1970	167,530	131,260	35,770	95,490	37,450
St. Andrew, rural	All	June 1968—May 1970	15,710	12,310	3,340	8,970	3,510
MEXICO							
14. **Monterrey Project** (urban)	All	Aug. 1968—July 1969					
	2 in 3	Aug. 1969—Jan. 1970					
	1 in 2	Feb. 1970—July 1970	217,940	169,820	45,020	124,800	53,010
UNITED STATES							
15. **California Project**							
San Francisco (urban)	All	June 1969—May 1970	43,050	32,800	8,500	24,300	11,310
Suburban sections of Alameda, Contra Costa, and San Mateo counties	All	June 1969—May 1970	160,610	128,180	31,530	96,650	33,430

[a] Two years, except for the California project (one year).

[b] The 15 projects are listed by the name (shown in bold face in this table) that will be used in referring to them throughout this report. For four projects—the Bolivia project, Chile project, El Salvador project, and California project—these names will be used when reference is made to the combination of urban, suburban, and rural areas included in those projects.

[c] The Sherbrooke project includes a large rural area but the number of deaths is too small for subdivision and the project is included with the cities.

FIG. 2. Location of Projects in Argentina, Bolivia, Brazil, and Chile.



in part to include large rural areas having distinctly different characteristics. These two projects contribute the largest rural populations in the Investigation. They also include small central cities, thereby permitting comparisons of childhood mortality patterns in urban and rural populations. The large geographic areas covered by the two projects and their location in Argentina are shown in Figure 2. The situation of projects in the neighboring countries of Bolivia, Brazil, and Chile is shown on this same map of southern South America.

Chaco Province Project

The Province of Chaco touches on the Republic of Paraguay, to the east, and is bounded by the Argentine Provinces of Formosa, Corrientes, Santa Fe, Santiago del Estero, and Salta (Figure 2). It is part of the Great Chaco Region, which embraces adjoining lands of Paraguay and Bolivia to form a large lowland plain extending over 99,633 km². It borders on the tropical zone and in the summer season, which is hot and humid, heavy rains in combination with flat terrain produce widespread floods. Winters are mild and dry. Economic development of Chaco has been retarded by the unfavorable climate and by inadequate marketing and transportation facilities, as well as by tropical pests, notably the locust. Assets of the region include the quebracho tree (source of tannin), cotton, and cattle.

At midpoint in the project (1 August 1969) the Province had an estimated population of 564,091. Of the Province's 24 departments, seven were included in the project (Figure 3), which in all covered 13,257 km² with an estimated population of 260,920 (46.3 per cent of the Province's total inhabitants). The provincial capital is Resistencia, which contains nearly all the population of San Fernando Department, essentially an urban district. Thus in this report a division is made between the urban area (principally Resistencia, with an estimated 151,620 inhabitants) and the rural area (the other six departments, with 109,300 inhabitants). Although these other departments do have small cities, division of data for the two-year period could be made only for these two areas.

The principal collaborator held the post of professor of hygiene and social medicine at the University of the Northeast, and was also statistical adviser to the Director of Health of Chaco Province. The project headquarters was in Resistencia, while the School of Medicine of the University of the Northeast is situated across the Paraná River in Corrientes.

San Juan Province Project

San Juan Province, in the central-western region of Argentina (Figures 2 and 4), is

FIG. 3. Seven Departments in the Province of Chaco, Argentina, Included in the Investigation.

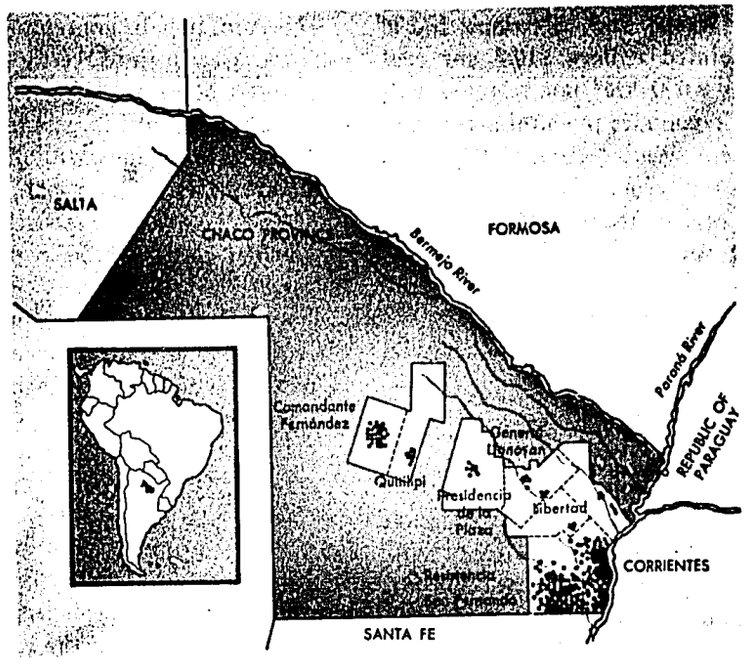
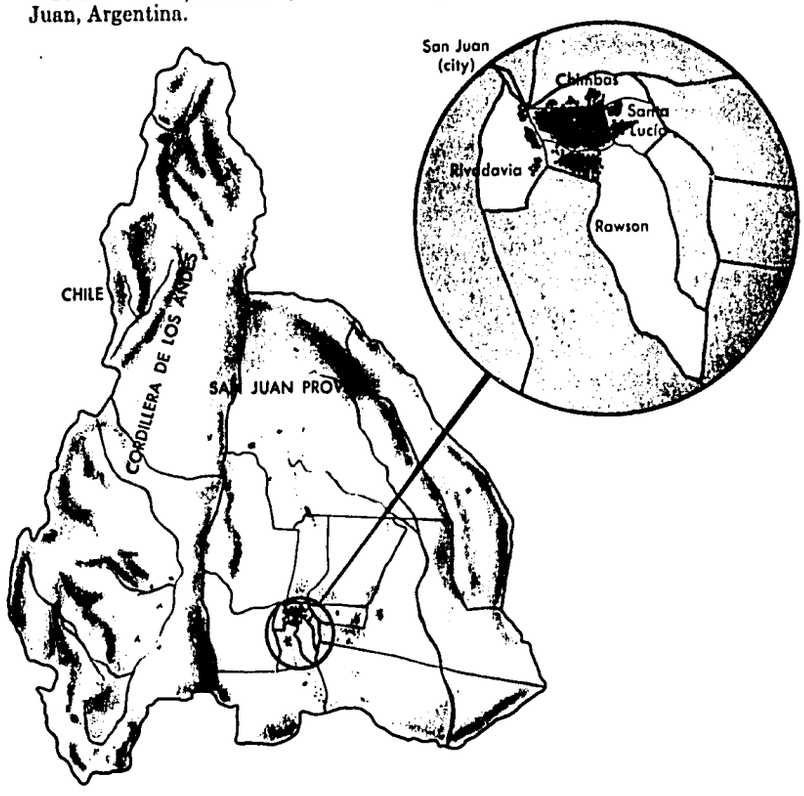


FIG. 4. Urban, Suburban, and Rural Departments of the Province of San Juan, Argentina.



separated from the Republic of Chile by the Cordillera of the Andes. The Province extends over 96,493 km^2, of which 10,228 km^2 are inhabited valleys (10.6 per cent of the total), 8,000 km^2 nonirrigated valleys, and the remainder mountainous zones. The valleys are situated from 600 to 3,000 meters above sea level.

Although precipitation is scarce (less than 100 mm annually), the Province has a basically agricultural economy. The irrigated valleys—in which 98 per cent of the population of the Province lives—depend principally on the San Juan and Jackal Rivers and their tributaries; the hydraulic system, which draws water from more than 4,000 wells, covers 1,500 km^2 of this zone.

Among the main agricultural products are grapes, which are grown for export and for the wine industry. The favorable climate and soil conditions have led to a vigorous expansion of olive cultivation. Mining is conducted on a relatively small scale, but has been expanding in recent years.

The National University of Cuyo, in the neighboring Province of Mendoza, has its School of Engineering and Exact Sciences in the city of San Juan. Medical and health establishments in the Province are well distributed in the cities, suburban localities, and small communities. A large general hospital provides services for the provincial capital and suburban departments as well as for some of the rural areas.

The estimated population of the Province (1 August 1969) was 384,020. For this Investigation, three subdivisions of the 16 departments were made: the Capital Department, comprising the city of San Juan with 111,740 inhabitants; four suburban departments around the capital (Chimbas, Rawson, Rivadavia, and Santa Lucía) with 130,750 inhabitants; and the remaining seven departments, considered rural, with a population of 141,530.

This rural population represents the largest rural area in the Investigation, the second largest being in Chaco (109,300 inhabitants) and the third largest in El Salvador (three rural *municipios* with 61,590). Population estimates for the San Juan and Chaco projects are based on censuses taken on 30 September 1960 and 30 September 1970, respectively.

The principal collaborator was the Director of Health of the Province and delegate of the National Health Ministry to the Province. Consequently, the contributions of this project differed from those of the others, for which faculty members of universities were responsible. For example, regulations governing improved procedures could be introduced immediately to overcome deficiencies in registration uncovered during the first year of the Investigation.

BOLIVIA *Project*

The project in Bolivia was selected in order to include a high-altitude area with its distinct problems and characteristics. The city of La Paz is situated at an altitude of 3,632 meters in a valley of erosion at the edge of snow-capped Mount Illimani. The highest international airport in the world—at 4,020 meters above sea level—is found nearby. In recent years the city has grown outward toward the highland plateau, into new areas numbering more than 100,000 inhabitants. It has extended to and beyond the community of Obrajes, and at present covers 51 km^2. Conditions in the area are governed by its irregular and abrupt topography. Average temperatures vary between 18.8°C maximum in summer and 2.0°C minimum in winter.

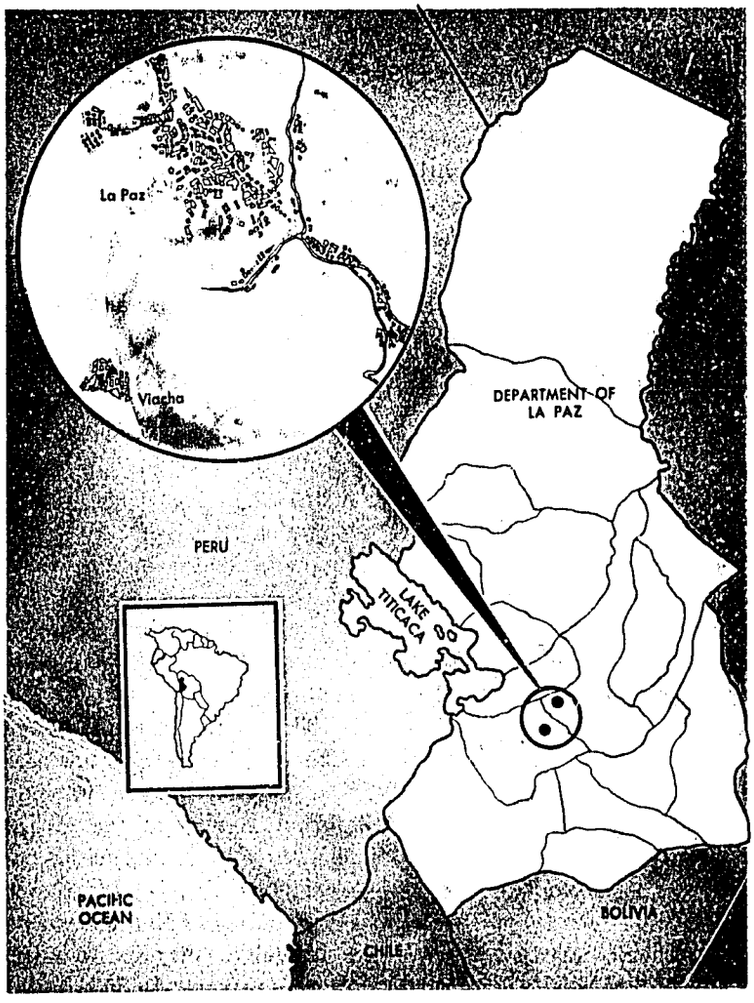
The estimated population of La Paz at midpoint in the project (1 July 1969) was

539,400, a figure based on the 1950 census and an official estimate for 1971 of 562,600 population.

The city is the capital of La Paz Department and the seat of the Bolivian Government, and constitutes the most important administrative and commercial center of the Republic. It has no heavy industry but does have textile, beer, tobacco, and manufacturing industries as well as handcrafts.

The small city of Viacha, capital of Section I of Ingavi Province in La Paz Department, was included in order to provide data from a rural community typical of those lying outside the large city (Figure 5). It is situated 32 km from the city of La Paz on the highland plateau, at 4,020 meters above sea level, and is connected to the city by highway and railway. Two important military units, a cement factory, and the main railway station of the Department are located in this community, and it is the

FIG. 5. La Paz and Viacha, in the Bolivia Project.



center of commercial attraction for about 15 outlying rural localities. Its population is almost entirely indigenous and mestizo. Estimated populations for Viacha for the two years of the Investigation were provided by the Ministry of Social Welfare and Public Health on the basis of the 1950 census. For the midperiod (1 July 1969) the estimate was 10,320 inhabitants.

Both the Department of Preventive Medicine of the San Andrés University Medical School and the Ministry of Health were involved in this project in Bolivia, as the principal collaborator held appointments in both agencies (chief of the aforesaid Department and of the Ministry's Health Planning Office).

La Paz city had 14 official and semiofficial hospitals and 29 private hospitals, with a total of 2,416 beds, 308 of them for pediatrics. In 1971 there were 678 physicians, including 50 pediatricians. There were also 112 nurses and 96 auxiliary nurses. Viacha had one health center-hospital with 20 beds, 4 physicians, 2 nurses, and 4 auxiliary nurses.

BRAZIL

From the outset of planning for the Investigation, it was considered advisable to include a project in northeast Brazil because of the serious health problems affecting that large developing area. This region was receiving considerable attention in Brazil's plans for economic and social development, and a well-qualified collaborator was available there, a professor of pediatrics in the new Institute of Child Medicine of Pernambuco (IMIP, Instituto de Medicina Infantil de Pernambuco). Infant mortality was reported to be excessively high in the area.

The Inter-American Investigation of Mortality in adults had been conducted in the cities of Ribeirão Prêto and São Paulo in the State of São Paulo and there were likewise well-qualified collaborators in both places. Thus two large projects—one in Recife and one in São Paulo—and a small project in Ribeirão Prêto were developed to provide varied experiences of this large country, which numbered more than 94 million inhabitants in 1970.

The location of the three projects is shown in Figure 2. A census was conducted in Brazil on 1 September 1970 and provisional population figures were available for use in the Investigation.

Recife Project

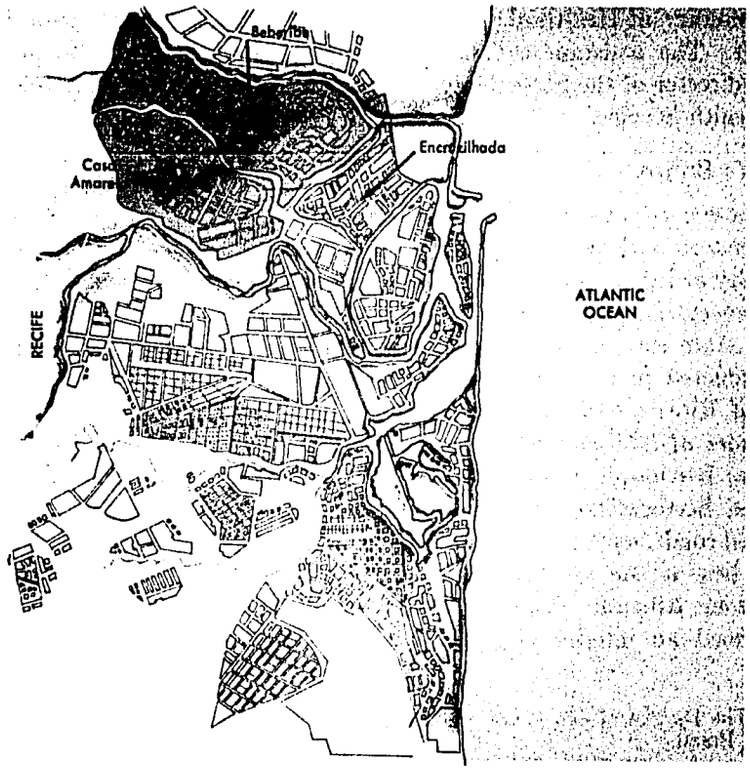
Recife is the capital city of Pernambuco, one of the principal states of the northeast region (Figure 2). The city covers an area of 209 km^2 on the Atlantic coast and is bisected by two rivers and by sea channels (Figure 6). The average temperature is 22-23°C, with ranges between 17° and 33°C. Precipitation is very high, measuring from 1,700 to 2,300 mm per annum.

In 1969 the city had an estimated population of 1,060,542, and a density of 5,074 inhabitants per km^2. In that year the estimated number of living units was 202,000, of which 31.4 per cent had piped water supplies. The remainder of the units obtained water from 180 public piped-water taps and from other sources. Only 29 per cent of the houses had sewage disposal facilities.

Recife is considered to be one of the main commercial centers of northeast Brazil and is undergoing very rapid industrial development, having at the present time some 595 major industrial plants. Per-capita income, however, is low, the average being estimated at 1,630 cruzeiros per year.

In 1969 the city had 45 hospitals, of which 25 were private. In 36 hospitals both adults

FIG. 6. Three Districts in the Project in Recife, Brazil.



and children were attended and in the remaining nine, only children. Of the 7,796 hospital beds, approximately 600 were pediatric. Only 18 hospitals had outpatient departments.

The Health Service maintains, in addition, four health centers and 17 maternal and child care centers. A large portion of acute pediatric morbidity is attended in specialized emergency and rehydration centers operated by the Service. The city had approximately 2,000 physicians, 200 nurses, 450 auxiliary nurses, 150 social workers in active professional service, and a large number of other health personnel, both professional and nonprofessional. In 1969 there were 61 registered midwives working in hospitals, and an estimated 500 empirical midwives in the city.

The Investigation was conducted in three heavily populated districts—Beberibe, Encruzilhada, and Casa Amarela, which on 1 July 1969 had an estimated 365,680 inhabitants, or 34 per cent of the city's total. These districts were considered to have socioeconomic and cultural conditions representative of those in the rest of the city, and their populations had access to all the health services available in the city.

The new Institute of Child Medicine and the Department of Pediatrics of the Federal University of Pernambuco served as the project headquarters. The principal collaborator was professor of pediatrics at the

two schools of medicine in Recife, and was appointed Secretary of Health of the State early in 1971. The assistant collaborator is at present director of the State Maternal and Child Health Service.

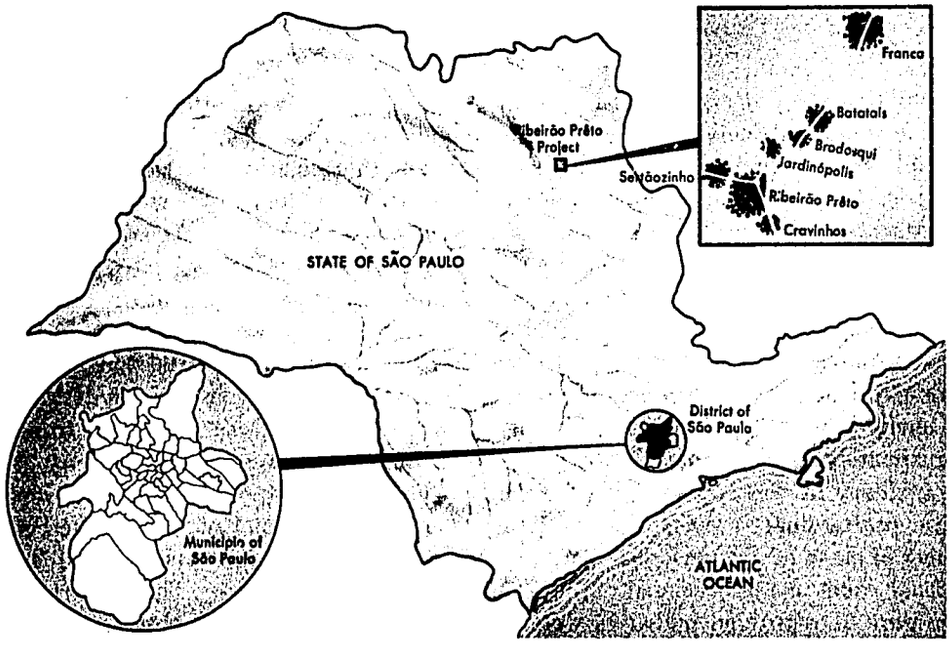
Ribeirão Prêto Project

This project was situated in south Brazil, in the northeastern part of the State of São Paulo. The city of Ribeirão Prêto, principal site of the project, lies at a distance of 300 km from the state capital. The Investigation was conducted in the urban portions of the city of Ribeirão Prêto and Franca as well as those of five smaller communities: Batatais, Brodosqui, Cravinhos, Jardinópolis, and Sertãozinho. All are connected by good roads, as shown in Figure 7, and Franca lies at the greatest distance (200 km) from Ribeirão Prêto. Franca has been termed an interior city to distinguish it from the city of Ribeirão Prêto, the central city of the project. The estimated populations at midpoint in the project (1 July 1969) were 182,180 for Ribeirão Prêto (city), 82,450 for Franca, and 67,290 for the other five communities.

The climate of the region is mild and the rolling terrain is well suited to agricultural activities. The main products are coffee, sugar cane, and cattle. In Franca shoe manufacturing is the main industry and has attracted a large number of immigrants from neighboring states.

Ribeirão Prêto is the site of one of the medical schools of the University of São Paulo, with its attached general hospital, and has a concentration of health facilities that serve the surrounding region. The five small communities have access to these services, although they have their own health institutions. Franca, however, must

FIG. 7. The District of São Paulo, and Areas of the Ribeirão Prêto Project in the State of São Paulo, Brazil.



rely on its own medical care resources because of the long distance from Ribeirão Prêto. In 1968 the city of Ribeirão Prêto had 439 physicians and nine hospitals with 1,495 beds. Franca had two hospitals with 413 beds, an emergency center, and 54 physicians in 1966; the other five communities had one hospital each and a total of 349 beds and 29 physicians.

The headquarters of the project was the Department of Preventive Medicine of the São Paulo University Medical School in Ribeirão Prêto. The principal collaborator was professor of that department.

São Paulo Project

The city of São Paulo has experienced extraordinary changes in recent decades. From a small commercial center at the end of the last century, it has grown to form a large industrial and commercial complex and a major scientific and cultural community. The population expanded from some 30,000 in 1870 to a total of 2,198,096 in the 1920 census and to more than 5.9 million in the census of 1 September 1970.

The *Municipio** of São Paulo, capital of São Paulo State, has eight districts, one of which, the District of São Paulo, was the area selected for the Investigation (Figures 2 and 7). The District's estimated population at midpoint in the project (1 June 1969) was 4,979,740 and its area 842 km^2, or 56 per cent of the total area of the *Municipio* (1,516 km^2). This District was selected for four reasons: it had been included in the Investigation of Mortality in adults; it contained some 90 per cent of the *Municipio's* total population; infant mortality and the total birth and death rates there had the same characteristics as those for the *Municipio;* and the other districts were not as well provided with highways, so that home visits would have been more difficult. A sample of deaths (1 in 4.25) was selected systematically and the estimated population base at the midpoint was 1,171,700.

The excessive growth of the District, with influx of population from diverse and varied regions of Brazil, was not accompanied by a corresponding increase in facilities, principally those for water supply, sewerage, and housing. Obviously, this situation had serious repercussions in the health sector, with the high population density and lack of sanitation adversely influencing many health aspects in certain areas.

There are many types of industries in São Paulo—metallurgical, textile, pharmaceutical, chemical, food, and others—thus providing many employment opportunities for workers, both skilled and unskilled. At the same time, rapid growth of the city resulted in heavy construction work—houses and large buildings, roads, bridges and viaducts, a subway, etc.—which required a large body of unskilled workers, principally laborers. These workers came mostly from northeast Brazil or from rural zones in the interior of São Paulo State. Many live in the periphery, or outlying sections of the city, where good housing, sanitation, and other facilities are lacking. This population contributes greatly to the city's high infant mortality.

The city is situated at an altitude of 810 meters, 50 km from the Atlantic coast. The climate is temperate, with relatively dry winters. The coldest months are June to August, with minimum temperatures of 5° to 8°C. The summers are humid and temperatures reach 30° to 34°C.

The District of São Paulo has 48 subdistricts, each of which has a civil registra-

* The term *municipio* (municipality), as used in Brazil and in Latin America, refers to a political division with well-defined limits and containing urban and rural portions.

tion office (*cartório*) where vital events are registered according to the place of *occurrence*. The official data have not been corrected for residence.

The School of Hygiene and Public Health of the University of São Paulo was the headquarters of the project. The principal collaborator, a full-time professor of vital statistics at that School, had formerly been a staff member of the School of Medicine as well.

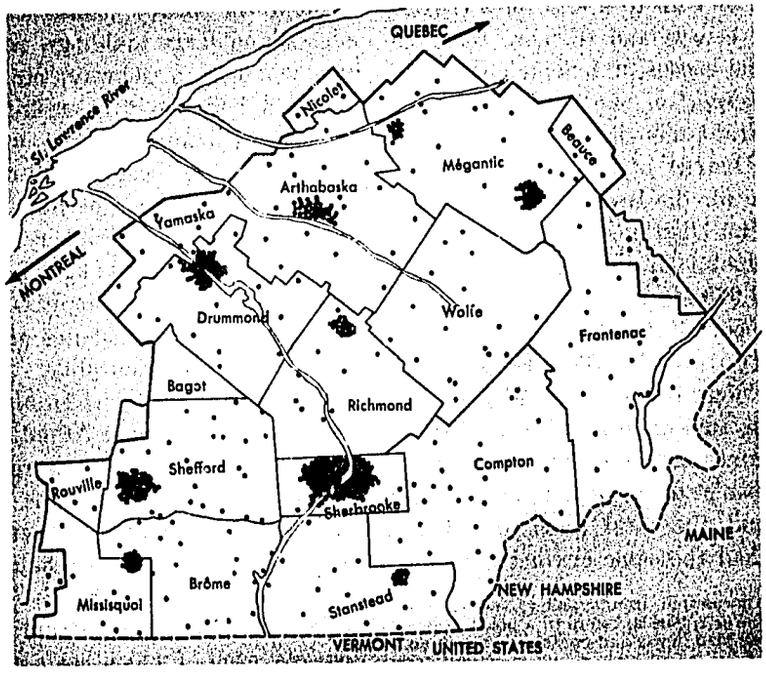
CANADA, *Sherbrooke Project**

In the southeastern part of Québec Province, the Eastern Townships cover an area of 20,200 km^2, south of the St. Lawrence River. The area is bordered on the south by the States of Maine, New Hampshire, Vermont, and New York in the United States (Figure 8). Rivers and lakes are abundant in the region, which lies at the foot of the Appalachian Mountains in the temperate cold zone. The estimated population included in the project area was 559,490 on 1 January 1971, the midpoint of the two-year period. Ninety per cent of the inhabitants are French-speaking.

The region as a whole is agricultural, but a third of the population lives in commercial and industrial centers (Figure 8). The city of Sherbrooke is the largest, with an estimated population of 84,100 on 1 January 1971. It is situated approximately halfway between and to the south of the urban centers of Montreal and Québec, and is a university center. Industries include paper mills, textile plants, and furniture and snowmobile manufacturing. The region also

* This project is always treated as a whole (and as a city) since it is too small for division into urban and rural areas.

FIG. 8. Eastern Townships of Sherbrooke Project in Québec Province, Canada.



has important mineral deposits, notably asbestos (40 per cent of the world supply being produced in the Thetford Mines).

According to the Research Service of the Eastern Townships, in 1970 there were 523 physicians in the entire region, or 91.8 per 100,000 population. The number of nurses, 2,312, was more than four times the number of physicians. In addition, 791 attendants and auxiliary nurses were known to practice in the region.

The Investigation was carried out by the Department of Epidemiology of the University of Sherbrooke Medical School, a new school that conducts its courses in French. The principal collaborator was the professor and chairman of that Department.

CHILE *Project*

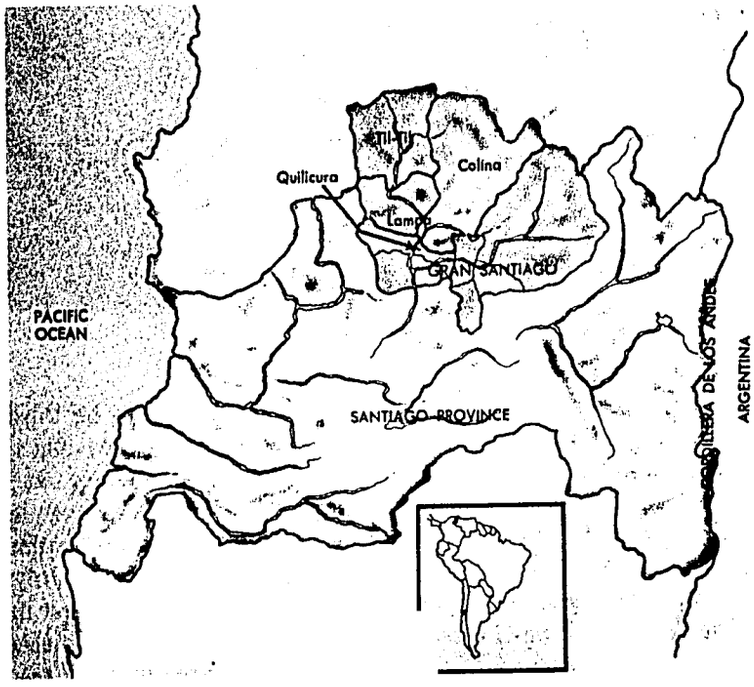
The project in Chile was carried out in the metropolitan area of Santiago (Greater Santiago) and in four *comunas:** Colina, Lampa, Quilicura, and Til-Til, to the north and west of the city (Figure 9). The population of Greater Santiago† increased from 1,933,453 in the census of 29 November 1960 to an estimated 2,638,110 on 1 July 1969 (midpoint of the project). The estimated population of the four *comunas* was 61,990.

Santiago, the capital of Chile, is situated in the north-central region of the Province of Santiago, at an altitude of 500 meters. In recent years the city has grown rapidly toward the northeast. The seasons are well-

* The term *comuna* (commune), as used in Chile, refers to a political subdivision of the Departments, which are subdivisions of the Provinces.

† The 18 *circunscripciones* comprising Greater Santiago are: Recoleta, Portales, Moneda, Universidad, Estación, Independencia, Franklin, Conchali, Providencia, Ñuñoa, San Miguel, Quinta Normal, Renca, Barrancas, La Cisterna, Los Condes, La Granja, and La Reina.

FIG. 9. Location of Santiago and Four *Comunas* Included in the Investigation in Santiago Province, Chile.



defined. Summers (October-March) are warm, and winter temperatures, though not very low, combine with high relative humidity to produce penetrating cold. Fog is common in winter and atmospheric pollution (smog) is noticeable in the city throughout the year. Precipitation occurs mainly in winter, with abundant snowfall in the neighboring Cordillera of the Andes. The water supply is from river and surface sources, supplemented by deep wells. The major industries are metallurgy and manufacture of textiles, clothing and footwear, chemicals, and food products.

Medical care is delivered principally by the National Health Service, which provides 9,647 of the 11,026 hospital beds and most of the outpatient and community services. The project area had 2,204 beds for pediatric care.

The principal collaborator was on the faculty of the Department of Public Health and Social Medicine of the School of Medicine of the University of Chile, the headquarters of the project. She had also served as principal collaborator in the earlier Investigation of Mortality in adults.

COLOMBIA

The three projects in Colombia were designed to provide data for three distinct regions of the country: the Pacific, the Caribbean, and the central regions (Figures 10 and 11). They were conducted, respectively, in the urban sectors of the cities of Cali, Cartagena, and Medellín. The selection of these sites enabled the medical schools in the first two cities and the school of public health in the third to participate actively in the Investigation, thereby enhancing the value of the findings for teaching purposes.

FIG. 10. Location of Three Projects in Colombia: Cali, Cartagena, and Medellín.

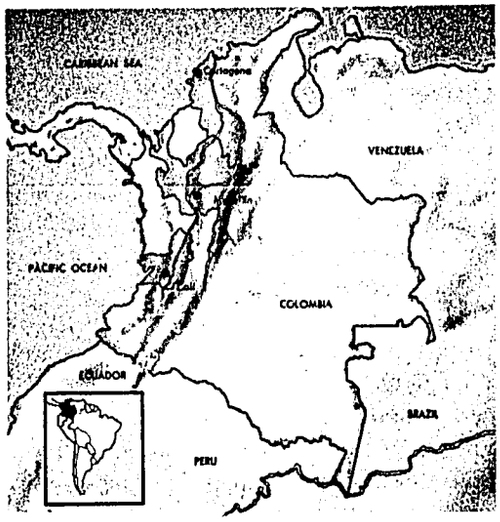
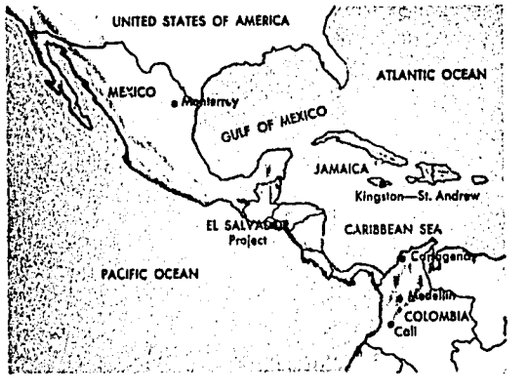


FIG. 11. Location of Projects in Colombia, El Salvador, Jamaica, and Mexico.



Cali Project

Cali, considered to be third in order of importance among Colombia's cities, lies in the fertile Cauca Valley, at 1,000 meters above sea level. Its average temperature is 24°C, with maximum readings occurring during the dry months of July and August. One of the country's largest industrial conglomerates has been established here, which accounts in large part for the heavy influx

of workers and the highly accelerated population increase. In fact, while it took almost four centuries to reach a population of 25,000 (early 1900's), on 1 July 1969 (midpoint in the project) the estimated total was 818,880 inhabitants. This excessive growth has led to imbalance between the needs and the availability of resources for health.

The Public Health Divisions of the National Ministry of Health in the Department and the city, and the Social Security Service deliver most of the preventive and curative care. The University Hospital provides services for more than 50 per cent of Cali's population.

The principal collaborator was professor at the Department of Preventive Medicine of the University of Valle School of Medicine, the headquarters of the project.

Cartagena Project

The Caribbean region of Colombia comprises seven departments with a population numbering more than 3 million in 1964. The region's ethnic, geographic, ecological, and cultural characteristics have served to define its inhabitants *(costeños)* as distinct from those in the rest of the country. Cartagena, an important seaport and capital city of Bolívar Department, lies in this region. The old part of the city, which is typically colonial with surrounding walls and castles, is an important tourist center. The temperatures range from 23° to 32°C. The rainy season, May-October, is the time of major health hazards for the child population.

Cartagena's urban zone had an estimated population of 275,500 at midpoint in the project (1 July 1969), of which 45 per cent were under 15 years of age. The city has experienced rapid growth as a result of high birth rates and immigration. The distribution of inhabitants by socioeconomic bracket in 1965, according to a local classification, was 7.5 per cent in the high bracket, 27.7 per cent in the middle, and 64.8 per cent in the low. The main occupation sources are public administration, commerce, tourism, construction, fishing, general and extractive industries, and port activities.

The city constitutes a health district which provides integrated preventive and curative services and is divided into eight sectors, each one with health posts or centers that act as outpatient services for the City Hospital (which serves as the university hospital). There are also specialized centers such as a maternity hospital and a children's hospital, both affiliated with the University.

The principal collaborator, former dean of the Health Sciences Division of the University of Cartagena (site of the project) and president of the Colombian Association of Medical Schools, is at present the Director of Health in the National Department of Planning of Colombia.

Medellín Project

The city of Medellín, capital of Antioquia Department, is situated at an altitude of 1,450-1,700 meters. It covers an area of 58 km^2 on both sides of the Medellín River in the Aburrá Valley, extending along the river banks in terrain sloping toward the mountains. Precipitation in 1966 was 1,261 mm and the average relative humidity 65 per cent.

The project area was the city's urban zone, comprising 938,900 inhabitants or 93.5 per cent of total population of the *Municipio* of Medellín;* 54 per cent were women. Annual demographic growth aver-

* Estimate for July 1969, provided by DANE (National Administrative Department of Statistics).

aged 6.0 per cent between the 1951 and 1964 censuses, while Antioquia Department's growth was only 3.5 per cent. On the other hand, the city's natural growth was 2.9 per cent, compared with 3.1 per cent for the Department. This indicates a population increase determined mainly by immigrating labor force attracted by the great industrial activity (Medellín is the country's second most important industrial and commercial center).

According to the 1964 census, there were close to 110,000 living units in the city's urban zone. This number increased in 1968 to about 116,400, of which approximately 85 per cent had piped water inside the house and 80 per cent were connected with the sewerage system.

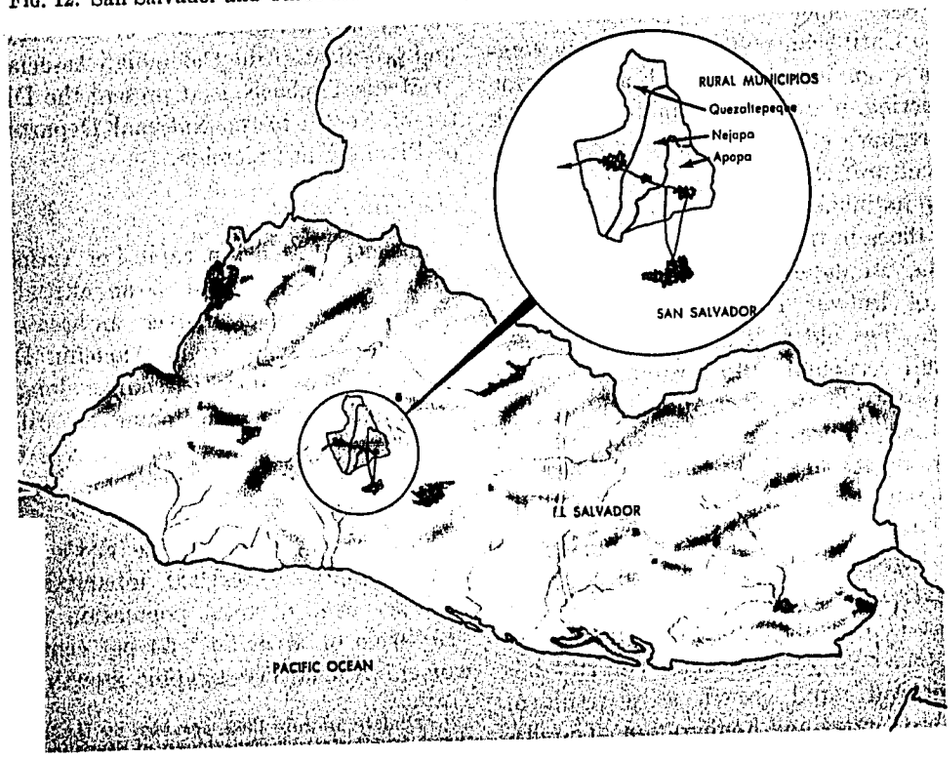
The Public Health Division and the Social Security Service provide preventive and medical care. There were 19 health centers and 18 hospitals.

The project headquarters was the School of Public Health of Antioquia University, the principal collaborator being a professor of public health administration at the School.

EL SALVADOR *Project*

The project in El Salvador was carried out in the *Municipio* of San Salvador, an area covering 62.4 km² in which the population is practically all urban, and in three rural *municipios* (Apopa, Nejapa, and Quezaltepeque) extending over 273.3 km² (Figure 12). Provisional population data were available from the census conducted on 27 June 1971.

FIG. 12. San Salvador and Three Rural *Municipios* in El Salvador.



The *Municipio* of San Salvador, which had 322,550 inhabitants at midpoint in the project (1 September 1969), forms part of a larger metropolitan area that comprises six *municipios*. It is located in a valley at 682 meters above sea level. The climate is warm, with temperatures varying between 22° and 29°C. Most of the country's industry and commerce, which has been growing at an accelerated pace, is concentrated in the city of San Salvador, capital of the Republic.

San Salvador has the country's best health care institutions, including the 743-bed Rosales Hospital which provides both general medicine and all the specialties except pediatrics, obstetrics, tuberculosis, and psychiatry. The Benjamin Bloom pediatric hospital has a capacity of 400 beds. Also there are six peripheral health units for outpatient care. In addition to these institutions of the Ministry of Public Health and Social Welfare, there are the general hospital, maternity hospital and clinics of the Social Security Institute, as well as the military hospital and private hospitals.

The rural *municipios* of Apopa, Nejapa, and Quezaltepeque had a total of 61,590 inhabitants at midpoint in the project. They are situated close to San Salvador, the most distant one being 20 km from the capital (Figure 12). They have good roads, except in the interior portions, where heavy traction vehicles are required. In the capitals of the *municipios* there are health units attended by physicians, nurses, and sanitary inspectors; in addition there is a social security clinic in each of them.

The principal collaborator was the head of the Department of Pediatrics of the University of El Salvador School of Medicine (headquarters of the project), and the associate collaborator was chief of the Statistics Division of the National Health Service.

JAMAICA, *Kingston-St. Andrew Project*

The Caribbean island of Jamaica covers an area of 4,411 square miles (10,962 km^2), its greatest length being 146 miles and greatest width 51 miles (Figure 11). The island is divided into three counties and 14 parishes. The terrain is mountainous and there are numerous rivers and streams. Average rainfall is about 77 inches, with ranges from 30 inches in the mid-south to more than 100 in the northeast. Mean daily temperatures vary from 80°-90°F in the coastal region to 40°-50°F on the mountain tops.

A large proportion of Jamaica's labor force in the fields of manufacturing, commerce, and transportation reside in Kingston-St. Andrew, on the southwest coast.

The project area included metropolitan Kingston, the capital city, and the rural portion of St. Andrew, which together cover 192 square miles (497 km^2). The city of Kingston is only 10.1 square miles in area, but due to its rapid growth the boundaries of the urban zone have extended beyond the original city limits into St. Andrew, as can be seen in Figure 13. The remainder of St. Andrew Parish is rural, with largely hilly terrain.

The population estimates at midpoint in the project (1 June 1969) were 492,740 for metropolitan Kingston and 46,210 for rural St. Andrew, the combined total of 538,950 representing 29 per cent of the estimated total for Jamaica (1,837,000).

The large maternity hospital (Victoria Jubilee) provides facilities for a very high proportion of births in the area. Other main centers for pediatric care are the Children's Hospital and the General Hospital of the University of the West Indies.

FIG. 13. Metropolitan Kingston and Rural St. Andrew, Jamaica.

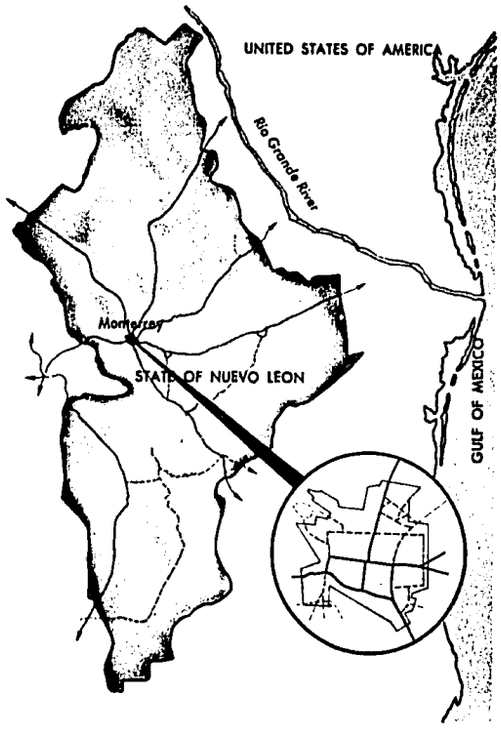
The project was conducted by the University of the West Indies, with the professor and head of the Social and Preventive Medicine Department serving as principal collaborator.

MEXICO, *Monterrey Project*

Monterrey is the third city of Mexico in order of population size and commercial importance, and second to the nation's capital in industrial development. It is situated at an altitude of 538 meters at the foot of the Western Sierra Madre and of the Cerro de la Silla, in the State of Nuevo León (Figure 14). The city strides the Santa Catarina River, now usually dry but famed because of floods in the past. Temperatures range between 41.5° and 5.4°C and the rainy season is in autumn. The main water sources for the *Municipio* of Monterrey are deep and superficial wells.

The city is modern, with all the conveniences of a metropolis; it has undergone very rapid development and little of the indigenous culture remains. As the capital of Nuevo León State, it has excellent road,

Fig. 14. Location of Monterrey in the State of Nuevo León, Mexico.



railroad, and air communications with the rest of the country and with the neighboring United States. One of the most energetic and up-to-date industrial complexes in the Hemisphere, Monterrey has been called "the Pittsburgh of Mexico." Besides its heavy industries, it has hundreds of manufacturing plants which produce automobiles, chemicals, pottery, glass, textiles, cement, processed foods, etc.

The Technological Institute of Monterrey and the University of Nuevo León are the main higher education institutions. The State Health Department and the Social Security Service provide medical care for most of the population. The principal pediatric services are in the Children's Hospital (affiliated with the School of Medicine) and the University Hospital.

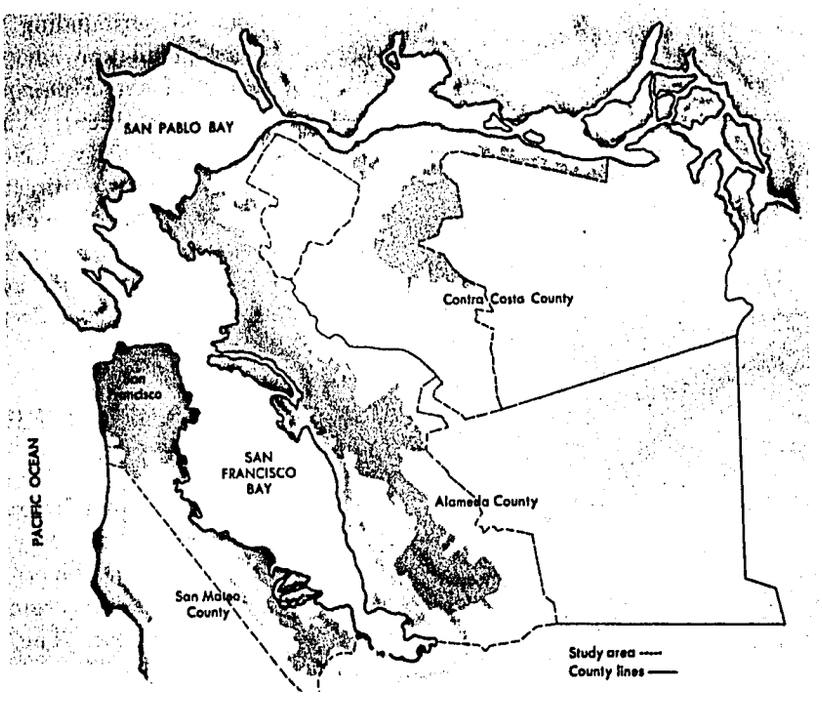
The project was carried out in the entire *Municipio* of Monterrey, which includes the city itself and 40 surrounding localities, where the rural population comprises less than 1 per cent of the *Municipio*'s total of 844,990 (1 August 1969). The project had its site at the University of Nuevo León School of Medicine and was directed by the chief of the School's Preventive and Social Medicine Department (who is at present chief of the Department of the same name at the State Workers Social Security and Services Institute).

UNITED STATES OF AMERICA, *California Project*

The project in the United States of America was conducted in the Bay Area of Northern California. The climate is moderate, with temperatures averaging 50° to 60°F throughout the year. The area contains the seaport of San Francisco and is an important commercial center, though there is little heavy industry. The population is heterogeneous, with great ethnic diversity and a good representation of all socioeconomic groups. San Francisco was one of the 12 cities included in the first Investigation of Mortality in adults.

The San Francisco-Oakland Bay Area comprises the city of San Francisco and the four surrounding counties. The Investigation covered San Francisco and the urban and suburban areas of Alameda, Contra Costa, and San Mateo Counties (Figure 15), which made up 89 per cent of the Area's total population. At midpoint in the project (1 December 1969) the estimates were 716,500 inhabitants for San Francisco and 2,027,900 for the suburban areas in the three counties. The cities of San Francisco and Oakland and urban fringe extend over 287.35 square miles (744 km^2). San Fran-

FIG. 15. San Francisco and Parts of Three Counties Included in the Project in California, U.S.A.



cisco (123 km²) is surrounded on three sides by the Pacific Ocean and the Bay.

The project was conducted by the Maternal and Child Health Department of the School of Public Health at the University of California in Berkeley, and the head and one staff member of that Department served as principal collaborators.

Chapter II

Collection and Quality of Basic Data

The basic goal of obtaining mortality statistics as accurate and comparable as possible proved a far greater task than was expected. Many deficiencies in hospital records and procedures and in registration systems were uncovered. Also the lack of standardization in use of terms such as abortion, stillbirth, and live birth was found to be serious enough to invalidate many previous comparisons of neonatal and infant mortality and likewise of life expectancy for countries of the world.

The widespread misuse of terminology indicates the need for international agencies and the medical profession in general to assume a role of greater leadership in both establishing definitions and promoting their application. Community-centered research such as that carried out in this Investigation is therefore of great importance for uncovering problems and laying the bases for sound planning of health services, as well as for setting the stage for continued research in the future.

One of the early actions of the World Health Organization was the creation of an Expert Committee on Health Statistics. At its second meeting, in 1949, the Committee approved the following definitions of *live birth* and *fetal death* (WHO, 1950), which were adopted by the World Health Assembly under the terms of Article 23 of the WHO Constitution:

"*Live birth* is the complete expulsion or extraction from its mother of a product of conception, irrespective of the duration of the pregnancy, which, after such separation, breathes or shows any other evidence of life, such as beating of the heart, pulsation of the umbilical cord, or definite movement of voluntary muscles, whether or not the umbilical cord has been cut or the placenta is attached; each product of such a birth is considered live born."

"*Fetal death* is death prior to the complete expulsion or extraction from its mother of a product of conception, irrespective of the duration of pregnancy; the death is indicated by the fact that after such separation the fetus does not breathe or show any other evidence of life, such as beating of the heart, pulsation of the umbilical cord, or definite movement of voluntary muscles."

To obtain comparable death rates in infancy, these definitions were to be introduced by the principal collaborators and followed strictly in all areas of the Investigation irrespective of local or national laws and regulations. Fetal deaths were to be investigated, and if there was evidence of life after complete expulsion the product was to be included as a live birth and a neonatal death. Implementation of this standardization requirement not only necessitated careful review of the available information regarding fetal deaths, but midwives and obstetricians in the project areas had

to be aware at all times of the distinction and seek clinical evidence of condition of the product of pregnancy at birth.

In Jamaica the problem in this regard was uncovered during the planning phase, when it was found that products of conception under 2 pounds were considered nonviable and all were recorded as fetal deaths. The WHO definition was explained by a consultant of PAHO at a seminar held in 1968 in the large maternity hospital in Kingston, and thus the distinction between live birth and fetal death was introduced in time for its acceptance and use by obstetricians and midwives in that project. Ideally an educational program covering these specific points should have been conducted in all projects in a planning phase. However, efforts were exerted to make the data as complete and comparable as possible in each project. In this chapter the procedures for collection of data on all deaths, the difficulties encountered, and the solutions applied are explained.

COLLECTION OF DATA

In each project the principal collaborator directed a team of medical interviewers, public health nurses or social workers, and others who assisted in the field work. (In São Paulo health educators who had interviewed women in a previous study of fertility were used.) Each collaborator determined his own needs in terms of personnel for the conduct of the Investigation.

The 27-month schedule for field work was divided as follows: one month of preparatory work and trial interviewing; 24 months for collection of data on deaths and sampling of households; and two months for completion of the program. The three types of data collected were: (1) information on deaths under 5 years of age among residents of the area for 24 consecutive months, recorded on questionnaires; (2) samples of households, using questionnaires for data on families and on living children under 5 years, with two to four sampling units completed per month for the same 24 consecutive months; and (3) complete file of live births among area residents for the same two years. The first category of data required the major portion of the staff's time and is the one that produced most of the information for this report.

In 10 projects all deaths occurring under 5 years of age in the project areas were investigated, and the corresponding questionnaires were completed. In the other five projects, because of the size of the areas and the large number of deaths, samples were selected for investigation. In Medellín one out of each three deaths was selected and in São Paulo 1 in 4.25, for the 24 months. In three projects the sampling procedures were changed during the course of the study: in Santiago the sample was increased from 1 in 5 deaths in the first eight months to 1 in 3 in the following 16 months; in Cali and Monterrey the number of deaths proved too large for the staff to handle, and thus the number investigated was reduced in the second year. Table 1, in Chapter I, lists the sampling ratios.

As soon as a death occurred and was known to the project staff, a nurse or social worker made a visit to the household concerned to obtain data regarding housing

conditions, members of the family, parents of the deceased child, mother's reproductive history, prenatal care, delivery, breast feeding, and provision of foods and medical attention to the index child. After this portion of the questionnaire (the first three pages) was completed, a medical interviewer sought clinical and pathological information in the hospitals, health centers, or private physicians' offices where medical attention had been provided (pages four through nine). If information was not available or was unsatisfactory, the medical interviewer visited the home to obtain the history of illness, usually from the mother, in order to complete the pertinent part of the questionnaire (pages six and seven). The questionnaire is reproduced in Appendix 1.

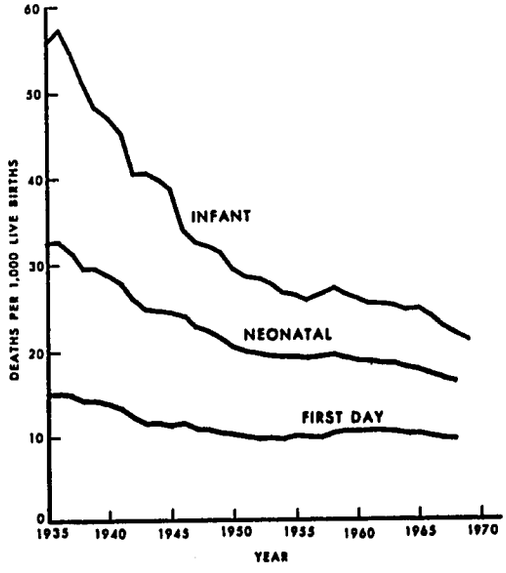
Usually the death certificate was the starting point for the investigation. In the Kingston-St. Andrew project, the public health nurse obtained information daily on deaths occurring in the hospitals so that home visits could be made promptly and before death certificates were filed. Also in Sherbrooke deaths were investigated before death certificates were available to the project staff.

Early in the program, deficiencies in registration of deaths occurring in the first day of life were noted in several projects. In one of them the principal collaborator thought he had a "clandestine cemetery" in his area, owing to the large number of such deaths that were missing. To his amazement he found that it was in his own large central hospital. Immediately he improved the procedures in that hospital and more complete registration was achieved in the second year of his project.

Difficulties were encountered in all three projects in Colombia owing to a change in the registration procedures made by the National Administrative Department of Statistics (DANE). Beginning in 1969 local supervision of registration was eliminated and only regional supervision was provided. Registration of deaths in early life was incomplete in all three projects. Although the principal collaborators searched for unreported deaths and found many, several probably were missed.

Measures for evaluating the completeness of registration were introduced early in the Investigation. Shapiro, Schlesinger, and Nesbitt (1968) showed that the death rate in the first day of life in the United States declined from 15.0 per 1,000 live births in 1935 to 10.2 in 1950 and remained around 10 per 1,000 from 1950 to 1964 (Figure 16). This death rate of 10 per 1,000 live births served as a measure for judging completeness of inclusion of deaths occurring in the first 24 hours of life, the critical period and probably the one providing the best indicator of completeness of registration and

FIG. 16. Infant and Neonatal Mortality and Mortality in the First Day of Life in the United States, 1935–1969.



utilization of the WHO definition of live birth. For the analysis of infant mortality another standard based on past experience in developed countries was used: if the infant death rate was in excess of 50 per 1,000 live births, the neonatal rate could be expected to be at least 30 per 1,000 live births (usually postneonatal mortality declines before neonatal mortality).

Also, tabulations from the completed household sampling units were used for evaluating local birth and death rates. This use of samples for calculating rates requires sufficient population (number of households), births, and likewise deaths. In several projects (such as those in Monterrey, Recife, and São Paulo) current analysis of the samples proved valuable in various ways. In view of the problems uncovered in this Investigation, greater use of such sampling is being recommended (PAHO, 1971-a) as a means of improving the vital statistics so urgently needed for health planning.

In nearly all projects the registered fetal deaths were investigated routinely to distinguish those with evidence of life after birth. In La Paz deaths in the first day of life were termed *mortinatos* (stillbirths), for legally they were not considered live births; each of these was investigated. In São Paulo registered fetal deaths were used as the source of infant deaths, which were investigated in accordance with the sampling ratio of 1 in 4.25 fetal deaths.

Even though intensive efforts were exerted to secure information on all deaths in early life, provisional analyses indicated the incompleteness of the data in many projects. Additional searches were made to discover deaths that had escaped the registration process. The clinical records for women admitted to obstetrics wards of hospitals and the "delivery books" proved to be excellent sources for discovering deaths that occurred soon after birth. Unfortunately, local registration practices were lax in several places. The term "abortion" was being misused in many areas; at times a diagnosis of abortion was given even though the product had lived a few hours. Moreover, certain hospitals buried unclaimed bodies without official death certificates being filed. In at least two areas, hospitals would complete the death certificates but sometimes these were not filed in the civil registry office. At times it was difficult to ascertain whether the death certificate was official or not.

The local teams of the Investigation were alert to these problems, and as a result of their efforts mothers knew in advance that nurses would be visiting homes to obtain information on deceased infants and children under 5 years. In one project, for example, two mothers commented to the public health nurse that she had failed to visit them—that they too had suffered the loss of a baby recently and thus should have visits by the nurse. These as well as all other known unregistered deaths were included.

The analysis of neonatal mortality on the basis of birth weight provided another method of evaluating the comparability of results. It was expected that the proportion of deaths in the lowest weight group (1,000 grams or less) would be at least 10 per cent. Thus the findings on birth weight furnished additional clues for discovering deaths that had not been included. A detailed discussion of birth weight is presented in Chapter III.

A systematic search was conducted to uncover information on all products of multiple pregnancies. Often it was found that when both twins died within a short interval only one death certificate was filed. The

search proved effective and relatively simple, though its use was essentially limited to those projects in which all deaths were included in the Investigation.

These measures for evaluating the completeness of death registration are described here because of their usefulness in achieving vital statistics of higher quality and comparability. Methods of accurately recording the outcome of each delivery must be established, and births and deaths processed in both hospitals and registration offices in accordance with accepted definitions. Even for purposes of comparison of life expectancy at birth, all infant deaths must be registered.

The efforts made by the staff to obtain results as complete as possible were extensive and rewarding. The additional efforts in 1971 and early 1972—even though they delayed completion of the field work and hence this report—were fully justified, providing the most realistic presentation possible of mortality in the neonatal as well as the postneonatal and early childhood periods. The solutions applied and recommended for implementation can find application throughout the Americas and probably in many other regions of the world.

In future research programs in which infant mortality is to be studied, a method of obtaining data on the outcome of each pregnancy should be introduced in the planning phase. In the research projects being conducted by WHO in Africa, patterned in part on the Inter-American Investigation of Mortality in Childhood, interviews in the homes are being scheduled at three-month intervals. Thus pregnancies and the outcomes—live births and infant deaths—as well as the total population in the households can be recorded routinely. Many of the difficulties encountered in the Investigation will thus be overcome.

Studies on nutritional status of the mother in relation to the product of pregnancy can be greatly facilitated by instituting methods for obtaining data on the outcome of each pregnancy, including status and condition at birth, birth weight, and other basic parameters. Moreover, administrative evaluations of a hospital's operations can be facilitated by reporting the outcome of each pregnancy, whether fetal death or live birth, and also the condition and survival of those born alive. The standard of 10 deaths per 1,000 live births, used in this study, could be utilized in hospitals for evaluating mortality in the first day of life.

When measures are planned to assure healthy products of reproduction and to eliminate the hazards and complications of nutritional deficiency and unfavorable environment, emphasis can well be placed on quality of natality and mortality statistics.

REGISTRATION OF DEATHS

For the two years of the Investigation, 35,095 deaths of infants and other children under 5 years of age were studied in the 15 projects. The most significant findings derived from analyses of the data on those deaths are presented in this report principally to make the facts available to health authorities and educators in the health sciences for their immediate use.

The number of deaths in the 15 projects varied from 371 in Sherbrooke to 4,312 in São Paulo and 4,276 in Bolivia (Table 2).

TABLE 2. Deaths Under 5 Years of Age and Number and Percentage Registered in 15 Projects.

Project	Deaths under 5 years	Registered	
		No.	%
Total	35,095	32,700	93.2
ARGENTINA			
Chaco Province	1,701	1,616	95.0
San Juan Province	2,156	1,934	89.7
BOLIVIA project	4,276	3,778	88.4
BRAZIL			
Recife	3,635	3,534	97.2
Ribeirão Prêto	1,126	1,122	99.6
São Paulo	4,312	4,286	99.4
CANADA			
Sherbrooke	371	350	94.3
CHILE project	2,714	2,370	87.3
COLOMBIA			
Cali	1,627	1,567	96.3
Cartagena	1,255	1,002	79.8
Medellín	1,348	1,297	96.2
EL SALVADOR project	3,820	3,494	91.5
JAMAICA			
Kingston-St. Andrew	1,903	1,687	88.6
MEXICO			
Monterrey	3,953	3,765	95.2
UNITED STATES			
California project	898	898	100.0

The size of the project as well as the differences in birth rates and infant death rates account for these variations in numbers of deaths. For example, the Sherbrooke project covered a large geographic area in the Eastern Townships of Québec Province in Canada; since the birth rate was low and likewise the infant death rate, the number of deaths was small. In contrast, the Recife project (where there were 3,635 deaths) was limited to three districts of the city and the birth rate was nearly three times that in Sherbrooke and the infant death rate about five times higher. Thus, throughout this report these variables must be taken into account in interpreting the results.

In addition to São Paulo, Bolivia, and Recife, two other projects produced more than 3,500 deaths: Monterrey with 3,953 and El Salvador with 3,820. In only two projects were there less than 1,000 deaths: Sherbrooke and California, which had the lowest birth rates and infant death rates and yet relatively large geographic areas. For the California project data for only one year were collected. In accordance with the approved plan, the projects in Ribeirão Prêto, Cali, Cartagena, and Medellín were relatively small, with the numbers of deaths varying from 1,126 to 1,627.

Of the total of 35,095 deaths, 32,700 or 93.2 per cent were believed to have been registered* and thus included in the official statistics (Table 2). In the 13 Latin American projects the percentages varied from 79.8 to 99.6, with five projects having less than 90 per cent registered. Each principal collaborator uncovered deaths that had not been registered; several introduced intensive searches to find such missing deaths. In Sherbrooke 94.3 per cent of deaths were registered, and in California death certificates were the only source of information used since a search for unregistered deaths was considered unnecessary. The present report includes all deaths that were known, both registered and unregistered.

To illustrate the registration problem, Table 3 provides the detail by age at death. The situation was particularly serious for infant mortality (Figure 17). In six projects 10 per cent or more of infant deaths were not registered. Within the neonatal period (Figure 18), deaths in the first day of life were the most seriously affected, with those unregistered reaching 10 per cent or more in 10 projects. Of the deaths within 1-27 days, registration was lacking for 10 per cent or more in five projects.

* In La Paz and San Salvador, death certificates were prepared in the hospitals and for some there was no evidence regarding registration. Whenever there was doubt, it was assumed that the death had been registered.

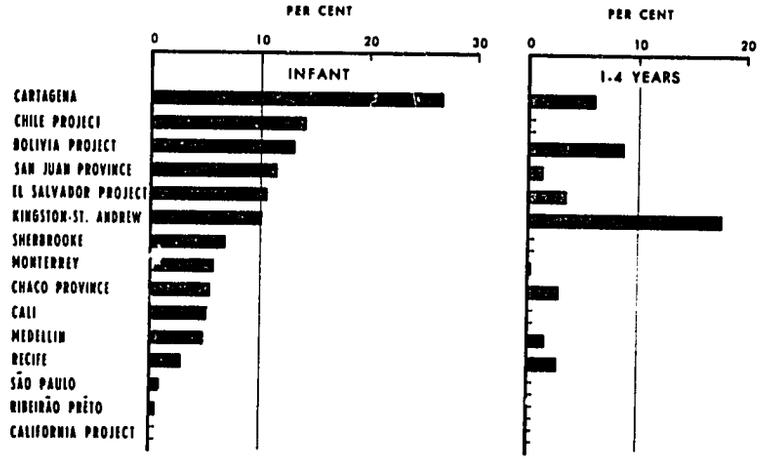
TABLE 3. Number and Percentage of Deaths of Children Under 5 Years Without Registration, by Age Group, in 15 Projects.

Age group	Total deaths	Without registration		Total deaths	Without registration		Total deaths	Without registration		Total deaths	Without registration	
		No.	%		No.	%		No.	%		No.	%
	ARGENTINA Chaco Province			ARGENTINA San Juan Province			BOLIVIA project			BRAZIL Recife		
Under 5 years	1,701	85	5.0	2,156	222	10.3	4,276	498	11.6	3,035	101	2.8
Infant	1,410	77	5.5	1,900	219	11.5	2,790	367	13.2	2,773	78	2.8
Neonatal	568	50	8.8	906	169	18.7	1,091	230	21.1	1,073	32	3.0
Under 1 day	186	36	19.4	258	81	31.4	317	124	39.1	357	14	3.9
1-27 days	382	14	3.7	648	88	13.6	774	106	13.7	716	18	2.5
Postneonatal	842	27	3.2	994	50	5.0	1,699	137	8.1	1,700	46	2.7
1-4 years	291	8	2.7	256	3	1.2	1,486	131	8.8	862	23	2.7
	BRAZIL Ribeirão Preto			BRAZIL São Paulo			CANADA Sherbrooke			CHILE project		
Under 5 years	1,126	4	0.4	4,312	26	0.6	371	21	5.7	2,714	344	12.7
Infant	959	4	0.4	3,788	26	0.7	310	21	6.8	2,404	344	14.3
Neonatal	515	4	0.8	1,958	26	1.3	229	19	8.3	1,160	343	29.6
Under 1 day	209	4	1.9	625	26	4.2	146	13	8.9	425	194	45.6
1-27 days	306	—	—	1,333	—	—	83	6	7.2	735	149	20.3
Postneonatal	444	—	—	1,830	—	—	81	2	2.5	1,244	1	0.1
1-4 years	167	—	—	524	—	—	61	—	—	310	—	—
	COLOMBIA Cali			COLOMBIA Cartagena			COLOMBIA Medellín			EL SALVADOR project		
Under 5 years	1,627	60	3.7	1,255	253	20.2	1,348	51	3.8	3,820	326	8.5
Infant	1,153	60	5.2	856	229	26.8	924	45	4.9	2,742	290	10.6
Neonatal	536	60	11.2	401	200	49.9	383	37	9.7	917	237	25.8
Under 1 day	220	44	20.0	146	95	65.1	136	18	13.2	305	126	41.3
1-27 days	316	16	5.1	255	105	41.2	247	19	7.7	612	111	18.1
Postneonatal	617	—	—	455	29	6.4	541	8	1.5	1,825	53	2.9
1-4 years	474	—	—	399	24	6.0	424	6	1.4	1,078	36	3.3
	JAMAICA Kingston-St. Andrew[a]			MEXICO Monterrey			UNITED STATES California project					
Under 5 years	1,903	216	11.4	3,953	188	4.8	898	—	—			
Infant	1,589	160	10.1	3,220	187	5.8	784	—	—			
Neonatal	990	79	8.0	1,377	181	13.1	570	—	—			
Under 1 day	323	36	11.1	563	166	29.5	327	—	—			
1-27 days	667	43	6.4	814	15	1.8	243	—	—			
Postneonatal	599	81	13.5	1,843	6	0.3	214	—	—			
1-4 years	314	56	17.8	733	1	0.1	114	—	—			

[a] Deaths considered registered in Kingston-St. Andrew were those for which a death certificate was available within 18 months after death.

Death registration for children 1-4 years was deficient by over 10 per cent in only one project, namely Kingston-St. Andrew (Figure 17). One or more unregistered deaths in that age group were found in nine projects. In Latin American projects

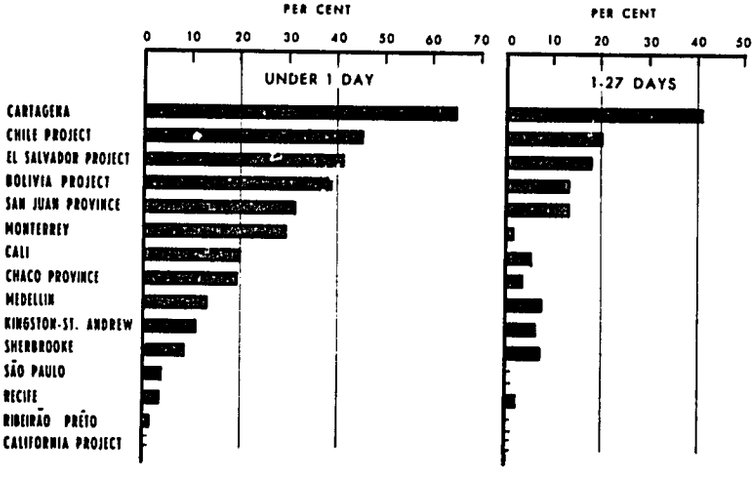
FIG. 17. Percentage of Infant Deaths and of Deaths of Children 1–4 Years of Age Without Registration in 15 Projects.



searches were conducted principally for unregistered neonatal deaths and for "fetal deaths" with evidence of life.

The problem affects principally neonatal mortality and was given close attention because of the importance of improving registration in that age period. International comparisons are often made without

FIG. 18. Percentage of Neonatal Deaths Without Registration in Two Age Groups in 15 Projects.



sufficient consideration of the quality of the basic data. The leveling off of the infant death rate in the United States at a higher level than in several European countries has been a matter of great concern to health authorities. Basic to comparability is the acceptance of the WHO definition of a live birth and a fetal death. As long as products born alive are termed "abortions" or still-births there will not be comparability. Until thorough investigations are made of procedures in hospitals as well as of deliveries at home, and until standard definitions are followed, comparability will remain in doubt. This leads to another point on which operational research is urgently needed, that is, the distribution of live births by birth weight (see Chapter III).

BIRTH RATES

The original proposal called for the current collection of data on all births among residents of the project areas. This proved difficult. In one project where birth registration was known to be incomplete, the nurses made daily visits to maternity services in order to complete individual cards on live births, and they also obtained information on home deliveries from midwives. Early counts for that project showed that only 5 per cent of the births were known to have occurred at home, while counts from the sample of households indicated a higher frequency of home deliveries. As a result, new approaches and intensive efforts were instituted which increased the percentage, though it remained lower than that found in the sample. In several projects the birth files were the source of the number of births used for calculation of birth rates and for the denominators for calculation of infant mortality in this report. In several projects a combination of files of hospital births and estimates of births occurring at home was used. In Colombia baptisms have traditionally been used as the source of data on births, but records of baptism are often filed late and some infants are not baptized; thus estimates of live births had to be made by other means.

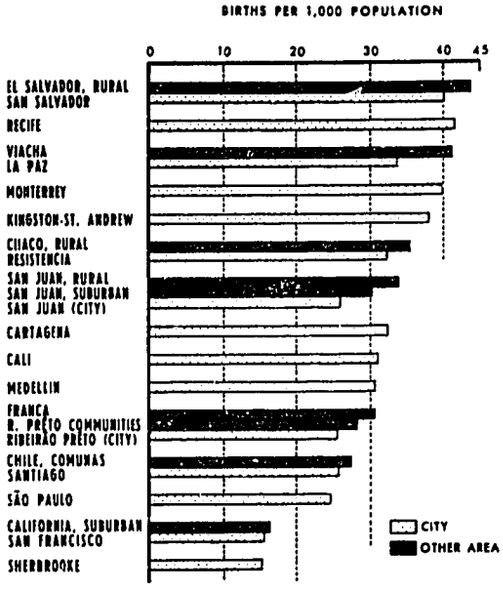
TABLE 4. Estimated Annual Birth Rates for Two Years[a] of the Investigation in 24 Areas of 15 Projects.

Area	Births per 1,000 population
ARGENTINA	
Chaco Province	33.7
Resistencia	32.3
Rural departments	35.7
San Juan Province	30.4
San Juan (city)	26.0
Suburban departments	30.3
Rural departments	34.0
BOLIVIA	
La Paz	34.1
Viacha	41.2
BRAZIL	
Recife	41.6
Ribeirão Prêto	
Ribeirão Prêto (city)	25.6
Franca	30.9
Communities	28.5
São Paulo	24.8
CANADA	
Sherbrooke	15.2
CHILE	
Santiago	26.0
Comunas	27.4
COLOMBIA	
Cali	31.1
Cartagena	32.5
Medellín	31.0
EL SALVADOR	
San Salvador	39.7
Rural *municipios*	43.8
JAMAICA	
Kingston-St. Andrew	38.0
MEXICO	
Monterrey	39.8
UNITED STATES	
San Francisco	15.8
California, suburban	16.5

[a] Except for California project (one year).

All sources of information regarding births were utilized for this report. The resulting estimated annual birth rates are given in Table 4 and Figure 19 for the two years of the Investigation. These rates ranged from the low of 15.2 per 1,000 population in the Sherbrooke project to 41.6 in Recife and 43.8 in the rural *municipios* of El Salvador. In all projects including rural populations, the rates were higher in the rural than in urban areas. In San Juan Province, for example, the estimated rate in the city of San Juan was 26.0, that in the suburban departments 30.3, and in the rural departments 34.0. Likewise in the El Salvador project the rate of 43.8 in the rural *municipios* was 10 per cent higher than that in the city of San Salvador (39.7). For the interpretation of the analyses that follow, especially in Chapter XII on patterns of reproduction, the level of the birth rate is an important factor to be considered.

Fig. 19. Estimated Annual Birth Rates for Two Years[a] of the Investigation in 24 Areas of 15 Projects.



[a] Except for California for one year.

SOURCES OF MEDICAL DATA

Efforts were made to obtain a complete record of the past history and fatal illnesses of the child, results of laboratory and other examinations, and autopsy findings in order to determine the underlying and associated causes of death, that is, the multiple causes. This approach has made it possible to establish important interrelationships as well as a precise measurement of high-risk conditions such as immaturity and nutritional deficiency.

The medical interviewers obtained information from hospitals, clinics, private physicians, and autopsy records; if no medical attention had been provided or if no satisfactory record was available, a visit was made to the family to obtain pertinent data.

Table 5 gives the numbers and percentages of deaths for which clinical information (with or without autopsy) was available in hospitals, clinics, or private physicians' offices; those for which autopsy records alone were available; those which could be investigated only through medical interviews of the families; and those for which the only source available was the death certificate or an incomplete record of death (without official certificate).

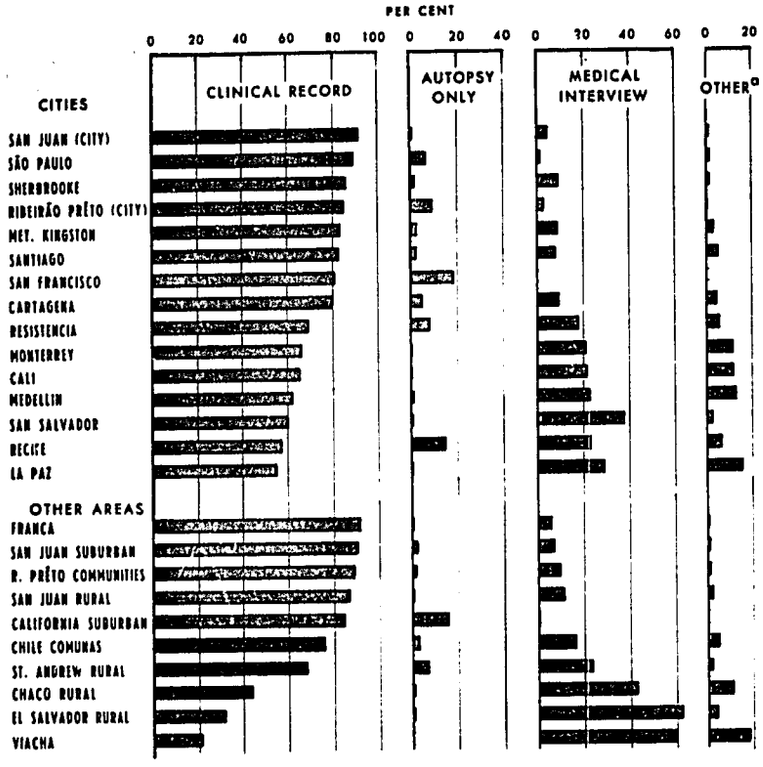
Figure 20 shows (in the left portion) the percentages of deaths for which clinical data, with or without autopsy, served as the basis for assignment of diagnoses. In 13 areas such information was available for more than 80 per cent of all deaths. The

TABLE 5. Sources of Medical Information for Assignment of Causes of Death of Children Under 5 Years of Age in 25 Areas of 15 Projects.

Area	Total deaths	Clinical information						Autopsy without clinical information		Medical interview only		Death certificate or other record	
		Total		Clinical information and autopsy		Clinical information without autopsy							
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Total	35,095	24,649	70.2	4,592	13.1	20,057	57.2	1,340	3.8	6,711	19.1	2,395	6.8
ARGENTINA													
Chaco Province													
Resistencia	864	609	70.5	122	14.1	487	56.4	63	7.3	145	16.8	47	5.4
Rural departments	837	371	44.3	19	2.3	352	42.1	6	0.7	360	43.0	100	11.9
San Juan Province													
San Juan (city)	326	300	92.0	82	25.2	218	66.9	5	1.5	17	5.2	4	1.2
Suburban departments	780	703	90.1	211	27.1	492	63.1	17	2.2	49	6.3	11	1.4
Rural departments	1,050	913	87.0	178	17.0	735	70.0	4	0.4	108	10.3	25	2.4
BOLIVIA													
La Paz	4,115	2,254	54.8	69	1.7	2,185	53.1	16	0.4	1,176	28.6	669	16.3
Viacha	161	35	21.7	—	—	35	21.7	—	—	97	60.2	29	18.0
BRAZIL													
Recife	3,635	2,071	57.0	480	13.2	1,591	43.8	477	13.1	822	22.6	265	7.3
Ribeirão Prêto													
Ribeirão Prêto (city)	464	400	86.2	146	31.5	254	54.7	45	9.7	17	3.7	2	0.4
Franca	434	401	92.4	8	1.8	393	90.6	3	0.7	24	5.5	6	1.4
Communities	228	203	89.0	22	9.6	181	79.4	4	1.8	20	8.8	1	0.4
São Paulo	4,312	3,881	90.0	578	13.4	3,303	76.6	289	6.7	92	2.1	50	1.2
CANADA													
Sherbrooke	371	323	87.1	174	46.9	149	40.2	7	1.9	34	9.2	7	1.9
CHILE													
Santiago	2,489	2,091	84.0	395	15.9	1,696	68.1	72	2.9	210	8.4	116	4.7
Comunas	225	172	76.4	34	15.1	138	61.3	5	2.2	35	15.6	13	5.8
COLOMBIA													
Cali	1,627	1,078	66.3	153	9.4	925	56.9	9	0.6	345	21.2	195	12.0
Cartagena	1,255	1,011	80.6	289	23.0	722	57.5	63	5.0	123	9.8	58	4.6
Medellín	1,348	854	63.4	61	4.5	793	58.8	16	1.2	298	22.1	180	13.4
EL SALVADOR													
San Salvador	2,738	1,656	60.5	189	6.9	1,467	53.6	10	0.4	1,012	37.0	60	2.2
Rural *municipios*	1,082	351	32.4	20	1.8	331	30.6	2	0.2	684	63.2	45	4.2
JAMAICA													
Metropolitan Kingston	1,754	1,478	84.3	575	32.8	903	51.5	60	3.4	155	8.8	61	3.5
St. Andrew, rural	149	101	67.8	43	28.9	58	38.9	10	6.7	35	23.5	3	2.0
MEXICO													
Monterrey	3,953	2,635	66.7	148	3.7	2,487	62.9	18	0.5	852	21.6	448	11.3
UNITED STATES													
San Francisco	234	191	81.6	157	67.1	34	14.5	43	18.4	—	—	—	—
California, suburban	664	567	85.4	439	66.1	128	19.3	96	14.5	1	0.2	—	—

figure also shows (in the middle portion) those for which the assignment basis was the autopsy only (California had the highest percentages, with Recife coming second). Medical interviews in the home (right portion of the figure) were necessary for more than 20 per cent of the deaths in 10 areas. The rural areas of the projects in Chaco Province, El Salvador, and Bolivia had the lowest percentages of deaths with clinical information—44.3, 32.4, and 21.7, respectively. Also the percentages with clinical information were low in La Paz (54.8) and Recife (57.0). These same areas

FIG. 20. Sources of Medical Information for Assignment of Causes of Death of Children Under 5 Years in 25 Areas of 15 Projects.



[a]Death certificate or other record.

and San Salvador had the highest percentages in which the only source of information was the medical interview in the home.

In the California project when a death occurred outside a hospital an autopsy usually was performed by the medical examiner and thus autopsy protocols were available for all deaths without clinical records (with one exception).

The percentages of deaths with no information other than the death certificate or other record are also shown in Table 5 and Figure 20 (last columns). The percentage was high in La Paz—16.3 (in this project a staff member worked in the large central cemetery and obtained daily information regarding burials of deceased children and copied the facts from the burial certificate). Often the home address was missing or incomplete and further searches had to be made to locate the family. This problem proved especially difficult in the Colombian projects, in which extensive searches had to be made. In Ribeirão Prêto efforts to find clinical records and families were successful and information was available on all but nine of the deaths. In San Juan Province, even with difficult roads in rural areas, data were available for all but 40 deaths (1.9 per cent). In the El Salvador project the repeated efforts to locate homes were successful; all but 2.2 per cent of deaths in

the city and 4.2 per cent in the rural *municipios* had clinical information or reports from home visits.

Even if the death occurred in a hospital, in certain areas some of the records had been lost or were incomplete. In contrast the quality of medical records was excellent in several projects such as those in San Juan Province, Argentina, and Cartagena, Colombia. These differences in the success of obtaining additional information, and the variation in quality of medical records, have to be taken into account in interpreting the data.

PEDIATRIC PATHOLOGY

In the planning phase as well as during the course of the Investigation, emphasis was placed on the value of pediatric pathology. The quality and quantity of autopsies improved markedly during the development of the study in several projects. In San Juan Province, for example, the increase was from 25 autopsies (out of 620 deaths) in the first six months (4.0 per cent) to 325 (out of 1,063) in the second year (30.6 per cent); for the two years autopsies were performed on 23.1 per cent of deaths in that project.

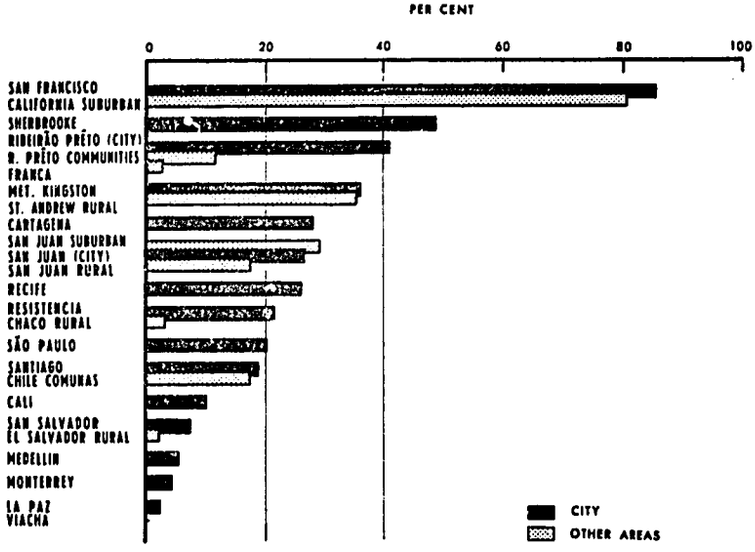
Data on percentage of deaths with autopsies are provided in Table 6 and Figure 21 for the areas of the 15 projects. Of 35,095 deaths in all projects, autopsies were performed on 5,932 or 16.9 per cent. As can be seen, the variation was great, from 2.0 per cent in rural El Salvador to 41.2 per cent in Ribeirão Prêto city, 48.8 per cent in the Sherbrooke project, and 85.5 in San Francisco. As expected, the percentages were usually higher for the cities than for rural areas.

Early in the data collection phase, a workshop on pediatric pathology was organized with the participation of pathologists from most of the projects. The impact was striking in a few projects where an immediate improvement in autopsies was achieved.

TABLE 6. Deaths of Children Under 5 Years of Age With Autopsies in 25 Areas of 15 Projects.

Area	Deaths	Autopsies	
		No.	%
Total	35,095	5,932	16.9
ARGENTINA			
Chaco Province			
Resistencia	864	185	21.4
Rural departments	837	25	3.0
San Juan Province			
San Juan (city)	326	87	26.7
Suburban departments	780	228	29.2
Rural departments	1,050	182	17.3
BOLIVIA			
La Paz	4,115	85	2.1
Viacha	161	—	—
BRAZIL			
Recife	3,635	957	26.3
Ribeirão Prêto			
Ribeirão Prêto (city)	464	191	41.2
Franca	434	11	2.5
Communities	228	26	11.4
São Paulo	4,312	867	20.1
CANADA			
Sherbrooke	371	181	48.8
CHILE			
Santiago	2,489	467	18.8
Comunas	225	39	17.3
COLOMBIA			
Cali	1,627	162	10.0
Cartagena	1,255	352	28.0
Medellín	1,348	77	5.7
EL SALVADOR			
San Salvador	2,738	199	7.3
Rural *municipios*	1,082	22	2.0
JAMAICA			
Metropolitan Kingston	1,754	635	36.2
St. Andrew, rural	149	53	35.6
MEXICO			
Monterrey	3,953	166	4.2
UNITED STATES			
San Francisco	234	200	85.5
California, suburban	664	535	80.6

FIG. 21. Percentage of Deaths of Children Under 5 Years of Age With Autopsies in 25 Areas of 15 Projects.



In several projects, such as that in San Juan Province, autopsies were performed more frequently on deceased infants than on deceased children 1-4 years of age (24.9 and 10.2 per cent, respectively). The reverse was true for Monterrey, Mexico, where the percentages were 8.7 for those aged 1-4 years and 3.2 for infants, and likewise for São Paulo, Brazil, and Medellín, Colombia.

There is no doubt that the availability of complete autopsies is a decisive factor in determining quality of data on the presence, specificity, and site of certain diseases and conditions, and hence in measuring death rates from those causes. Therefore, the lack of this important diagnostic tool indicates the need for caution in interpreting results, especially when comparisons are involved.

The Investigation, on the other hand, has demonstrated not only the urgent need for improving the teaching and practice of pediatric pathology in Latin America but also the feasibility of rapid progress when concerted efforts are made to improve the quality of diagnostic data and procedures.

In addition to the several factors affecting quality which are discussed above, others such as place of birth and death and evaluation of nutritional status will be considered in other chapters. In Chapter III, data on birth weight (an essential parameter for evaluating the condition of an infant at birth) are presented as a basis for understanding underlying health problems and the quality of the basic information.

Chapter III

Birth Weight

One of the intriguing findings of the Investigation in regard to neonatal mortality was the unusually high proportion of deaths of infants of low birth weight. The percentages of those dying in the neonatal period with birth weights of 2,500 grams or less were surprisingly high, and the percentages in the higher weight groups of 2,501 grams or more were much lower than those found in the United States in 1950 (Shapiro and Unger, 1965) and in the 1958 British Perinatal Mortality Survey (Butler and Bonham, 1963).

Clearly, completeness of registration of deaths of low-birth-weight infants is the first and most important factor to be considered in evaluating the findings. The report of Chase (1969) showed a change in the United States from 1950 to 1960, with the percentage of infants dying in the neonatal period with birth weights of 2,500 grams or less increasing from 64.0 to 72.7 in that interval. No doubt registration of the low-birth-weight babies had improved and mortality declined, especially in those of higher birth weights.

To evaluate mortality by birth weight, it is essential to establish the denominators, that is, live births by weight at birth. Unfortunately, the distributions of live births by birth weight are rarely collected and published for a city or country. Yet for understanding and interpreting differences in mortality in infants, such data have the greatest significance.

Weight at birth is dependent on the length of gestation. Also there is some evidence that birth weights vary in different ethnic groups. There is a distinct possibility that nutritional status of the mother affects the growth and development of the fetus and thus the birth weight. In a research program underway in the Institute of Nutrition of Central America and Panama (INCAP) the provision of additional food (20,000 calories or more during pregnancy) to pregnant women in two villages in Guatemala resulted in an increase of mean birth weight from 2,960 to 3,220 grams (Lechtig *et al.*, 1972). Such an increase was not observed in infants in two neighboring villages in which no additions were made to the pregnant women's diets.

Birch (1972)—in his recent review of progress in the field of malnutrition, learning, and intelligence—comments on the relation of the mother's nutritional status to the growth and development of her child and states in a concluding paragraph: "We have also pointed to intergenerational effects of nutrition upon mental development. The association between the mother's growth achievements and the risk to her infant is very strong. Poor nutrition and poor health in the mother when she was a

girl result in a woman at maturity who has a significantly elevated level of reproductive risk. Her pregnancy is more frequently disturbed and her child more often of low birth weight. Such a child is at increased risk of neurointegrative abnormality and of deficient IQ and school achievement."

The data on birth weight collected in this Investigation deserve careful study and point to the need for additional research to clarify the role of nutritional status of mothers (and possibly other factors such as ethnic group, altitude, and maternal infection) on the weight of products of pregnancy. The evaluation of nutritional status of infants and children must begin with their status at birth, and the most satisfactory and essential measurement is birth weight.

BACKGROUND

The Sixth Revision of the *International Classification of Diseases* of WHO (1948-a), in Section XV on Certain Diseases of Early Infancy, gave the following definition: "For the purpose of this Classification an immature infant is a liveborn infant with a birth weight of 5½ pounds (2,500 grams) or less, or specified as immature." In July 1948 the first World Health Assembly adopted Regulations (WHO, 1948-b) governing application of the *International Classification* by WHO Member Countries. Thus a definition of immaturity in terms of birth weight was established which should automatically be applied in countries using the *Classification*. In this Investigation efforts were made to obtain data on length of gestation for each birth, but the data were not as complete and reliable as those on birth weight and thus the definition utilizing weight only has been maintained, although the limitations of defining immaturity on the basis of birth weight alone are recognized.

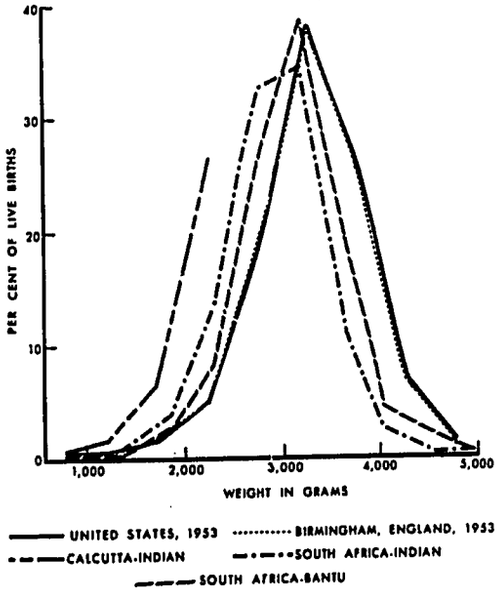
In the United States, when the standard birth certificate was revised in 1949, new certificates that included an item for birth weight were placed in use in many states. One of the authors (Puffer) assisted in introducing the new certificate in the State of Tennessee, and she placed emphasis on the completion of the birth-weight item. It was necessary not only to obtain the cooperation of hospital staffs but also to furnish scales to midwives for weighing the newborn. In 1949 birth weights of 2,500 grams or less were recorded for 7.6 per cent of live births in Tennessee and for 62 per cent of neonatal deaths. Neonatal death rates were calculated according to birth-weight group. In a paper on uses of statistics on prematurity in Tennessee (Hutcheson and Puffer, 1951), the statement was made: "In the field of prematurity rapid strides are being made in the development of comparable and useful data." Material that served to show the nature and size of the prematurity problem on the basis of birth weight was used at a series of workshops attended by health personnel in that state.

Data for the United States for three months in 1950 were analyzed in depth by Shapiro and Unger (1965) and Loeb (1965). The National Center for Health Statistics in its annual reports on natality gives the distributions of births by birth weight. Also, reports and analyses are available for

Baltimore (Taback, 1951), New York City (Department of Health, 1963), and New York State (Chase, 1961–1963).

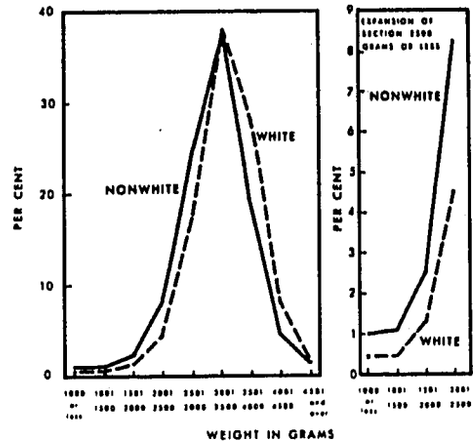
As staff members of the Pan American Health Organization, Verhoestraete and Puffer (1958-a) were concerned about the distribution of live births by birth weight for countries of the world. Available data were limited, but information was collected from several sources to illustrate the variations in several ethnic groups (Figure 22). Although the distributions of live births in the United States and in Birmingham, England, showed the same general weight distributions, the births in other ethnic groups appeared to have a shift to the left, that is, to lower weights. However, even in the birth-weight distributions in the white and nonwhite populations of the United States

FIG. 22. Percentage Distribution of Live Births by Birth Weight for Five Selected Areas or Groups.



Source: Adapted from Verhoestraete and Puffer (1958-a).

FIG. 23. Percentage Distribution of Live Births by Birth Weight, by Ethnic Group, United States, 1960.



Source: Vital Statistics of the United States (1960).

there were differences, with smaller percentages of nonwhites in the higher weight groups (Figure 23). Also, while in the United States 0.47 per cent of white births were in the birth-weight group of 1,000 grams or less in 1950, only 0.29 per cent were in that group in Birmingham, England, in 1953.

In *International Comparisons of Perinatal and Infant Mortality*, Chase (1967) referred to "low-rate" countries in which infants weighing 2,500 grams or less constituted 5 per cent of the live births, such countries including the Netherlands, Sweden, and New Zealand. According to the notifications of premature infants made to the British Ministry of Health in 1963, 7.4 per cent weighed 2,500 grams or less. Butler and Alberman (1969) gave a frequency of 7.9 per cent for live births and stillbirths in the week of 3-9 March 1958, in the British Perinatal Mortality Survey; only 0.36 per cent had birth weights under 1,001 grams, in contrast to 0.57 in the United States in 1960.

Health authorities (Department of Health) in New York City have regularly published data by birth weight. Also, for many years they have collected data on fetal deaths, taking that term to signify early as well as late fetal deaths (Erhardt, 1952). Thus live births and fetal deaths are usually registered in that city in accordance with the WHO definitions.

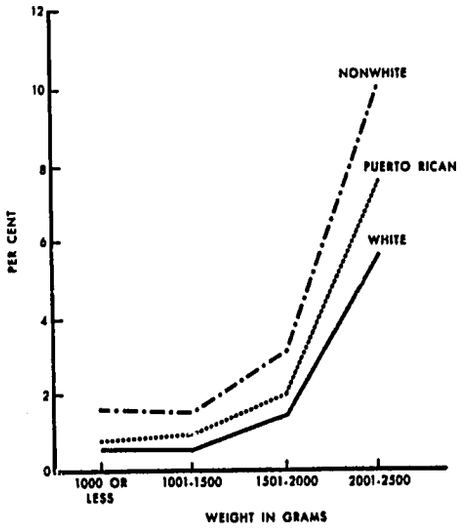
An investigation conducted in five hospitals in New York City in 1967 (Chase *et al.*, 1972) revealed that of 2,565 live births classed by vital signs in accordance with the WHO definition, all except four (or 0.16 per cent) were registered officially as live births. Of the 2,565 live births, 299 (11.7 per cent) were of 2,500 grams or less. This percentage was higher than the 8.2 per cent recorded for the United States in 1967.

The research program carried out in New York City on vital signs present at birth has important implications for this Investigation and for all future studies of perinatal, neonatal, and infant mortality. One of the objectives was "to determine the quantitative effect of using different combinations of vital signs to define live births." The study documented the vital signs observed at birth and found that heartbeat was present in every instance but one, and that mortality rates based on data using this sign alone yielded virtually the same result as the WHO definition which includes any of the four vital signs (breathing, beating of the heart, pulsation of the umbilical cord, or definite movement of voluntary muscles). Also the authors state: "If applied properly, the WHO definitions of live birth and fetal death tend to promote more uniform statistics than any of the other definitions which were considered here. . . . The study emphasizes the importance of basic information in vital registration and vital statistics. Its relevance extends beyond internal hospital procedures to problems of registration practices and the comparability of vital statistics. Not only are local, state, and national statistics affected by these basic definitional considerations, but international statistical comparisons are also influenced."

In the present Investigation the efforts of the field staff were centered on searches for all deaths in accordance with the WHO definition of a live birth. However, introduction of a recording form (Appendix I of the report by Chase *et al.*, 1972) for routine use in delivery rooms would have facilitated provision of the basic information for determination of the live births. Its use is recommended for future studies.

Distinct differences in the frequencies of low-weight births have been noted in three ethnic groups in New York City. Figure 24 shows the percentages of births in four weight groups for white, Puerto Rican, and

FIG. 24. Percentage of Live Births in Four Weight Groups, by Ethnic Group, New York City, 1966.



Source: Data from Jones (1971).

nonwhite populations in New York City in 1966. In the weight group of 1,000 grams or less the percentages were 0.43 for white, 0.69 for Puerto Rican, and 1.54 for nonwhite. Weights of 2,500 grams or less were recorded for 7.9 per cent of live births in the white group, 10.9 per cent in the Puerto Rican, and 15.9 per cent in the nonwhite. Thus there may be ethnic differences in the weight distributions of live births, which in turn may be due to differences in the health condition of mothers. Ethnic differences as well as their causative factors may be responsible for some of the variations in the distributions of neonatal and postneonatal deaths by birth weight found in the Latin American projects. No attempt was made in this Investigation to obtain information on ethnic groups, and this material for New York City and for the United States is presented principally to illustrate the many factors that must be considered in the interpretation of findings and also to stress the value of collection of data on birth weight in each country.

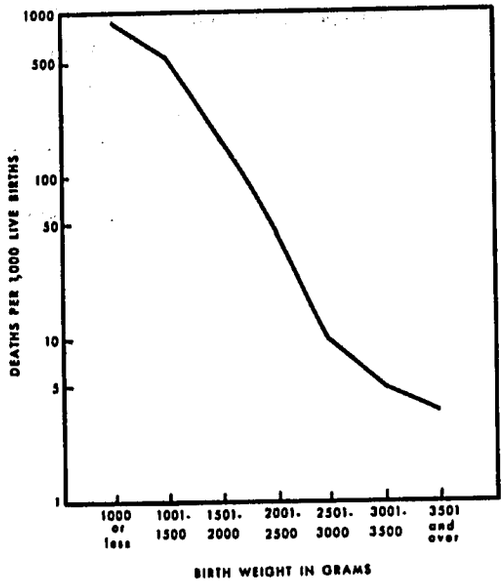
One of the reasons for including the project in Bolivia was to study the relation of altitude to birth weight. A longitudinal study in the small community of Masma in the Peruvian highlands (altitude 3,552 meters) revealed a higher frequency of low-weight births and a lower mean birth weight than in the coastal community of Lurín, Peru (Deck, 1971). In the same country McClung (1969) found that the infant in Cuzco, at 11,000 feet, was more than 200 grams lighter than the infant born at sea level (3,093 grams in Cuzco and 3,312 in Lima). Lichty *et al.* (1957) reported on the higher frequency of prematurity in Lake County, Colorado, at an altitude of 10,000-11,000 feet (30.8 per cent with birth weights of 2,500 grams or less), than in the State of Colorado as a whole (10.4 per cent) for the five years 1949-1953. Such studies as these suggested the probability of variations in birth weight due to altitude.

At the Conference on Research Methodology and Needs in Perinatal Studies, Terris (1966) reviewed the literature in his report on the epidemiology of prematurity. He summarized the studies on specific factors related to prematurity such as illegitimacy, prenatal care, and social class, reviewed those concerning maternal nutrition, and concluded that the relation between maternal nutrition and prematurity remained unsettled.

The data on birth weights in the projects, as presented in this chapter (as well as in others), are puzzling and yet indicate the great potential value of such information. Birth weight, as an important component of the health condition of the child at birth, should be obtained routinely as it determines the chances of survival as well as the management required in terms of medical care. In the collection of data of this type the first requirement, if international comparisons are desired, is to adhere to the same definitions of a live birth and a fetal death. If true and significant differences are established, the next step is exploration in depth of the causes of such differences.

The size of the neonatal death rate depends in large part on the frequency of low-weight births. In 1960 when 24,323 births with weights of 1,000 grams or less were registered in the United States (Chase, 1969), 22,202 became neonatal deaths (or 91.3 per cent). In the next 500-gram group (1,001–1,500) out of 27,756 births 14,475 (or 52.1 per cent) became neonatal deaths. In all, 56,859 (72.7 per cent) of the neonatal deaths were of infants weighing 2,500 grams or less, that is, immature by the WHO definition. Figure 25 shows the neonatal death rate according to seven weight groups in

FIG. 25. Neonatal Mortality by Weight at Birth, United States, 1960.



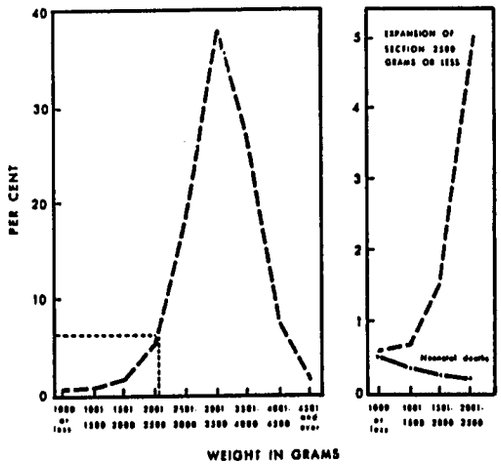
Source: Data from Chase (1969)

the United States in 1960, and Figure 26 shows the distribution of live births in the same year. The portion of the distribution of live births that is critical for neonatal mortality (i.e., those with weights of 2,500 grams or less) has been expanded in the right-hand section of Figure 26.* Crosses in the figure indicate the percentages of live births in various weight groups that became neonatal deaths. As birth weight decreases the percentages of births resulting in neonatal deaths increase and would become 100 per cent at some point in the group 1,000 grams or less. Comparability of mortality depends principally on the completeness of information on live births and neonatal deaths in these low-weight groups.

In England and Wales the death rate for the first day of life (Hirst *et al.*, 1968) remained relatively constant from 1950 to 1963, varying from 7.2 to 7.6 per 1,000 live births. In this same period in the United States the rate varied from 9.7 to 10.2, and in the white population from 9.0 to 9.7. Thus the death rate in the first day of life was at least 27.6 per cent higher in the United States. The explanation for this difference needs to be obtained.

Comparisons with European countries are difficult because of lack of data by birth weight. Using percentages from the report by Hirst *et al.* (1968), it was found that in 1960 in England and Wales only 0.7 per cent of the live births were in the weight group 1,500 grams or less, compared with 1.3 per cent in the United States. Also only 32.0 per cent of neonatal deaths were in this weight group, compared with 46.9 per cent in the United States. What are the reasons for the differences? Are low-weight babies born less frequently in England and Wales than in the United States? Is the WHO definition applied strictly in both countries? Research into the frequency of live births

FIG. 26. Percentage Distribution of Live Births by Birth Weight, United States, 1960.



Source: Data from Chase (1969).

* The basic data for the United States used in preparing these figures are given in Appendix 3.

of low birth weight is a major need, not only to draw comparisons but also to find explanations of the causes as a basis for preventive action.

AVAILABILITY OF BIRTH WEIGHTS FOR DECEASED INFANTS

Since weight at birth constitutes a key element in evaluating the state of health of the newborn, efforts were made to obtain birth weights in all projects. In certain areas many births occurred at home, and in several hospitals newborns were not weighed routinely. Table 7 provides information on infants dying in the neonatal and postneo-

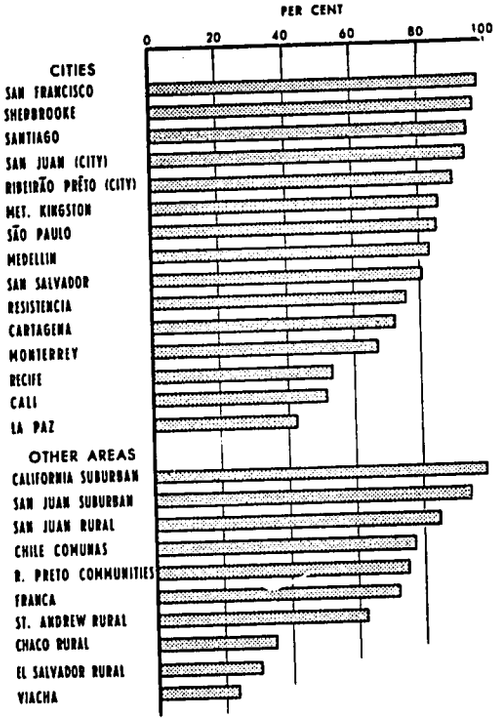
TABLE 7. Number and Percentage of Infants Dying in Neonatal and Postneonatal Periods with Birth Weight Stated, in 25 Areas of 15 Projects.

Area	Infant deaths			Neonatal deaths			Postneonatal deaths		
	Total	Weight stated		Total	Weight stated		Total	Weight stated	
		No.	%		No.	%		No.	%
ARGENTINA									
Chaco Province									
Resistencia	747	486	65.1	327	248	75.8	420	238	56.7
Rural departments	663	173	26.1	241	85	35.3	422	88	20.9
San Juan Province									
San Juan (city)	295	273	92.5	172	162	94.2	123	111	90.2
Suburban departments	696	620	89.1	353	333	94.3	343	287	83.7
Rural departments	909	713	78.4	381	324	85.0	528	389	73.7
BOLIVIA									
La Paz	2,685	725	27.0	1,049	445	42.4	1,636	280	17.1
Viacha	105	12	11.4	42	10	23.8	63	2	3.2
BRAZIL									
Recife	2,773	1,278	46.1	1,073	574	53.5	1,700	704	41.4
Ribeirão Prêto									
Ribeirão Prêto (city)	400	324	81.0	223	201	90.1	177	123	69.5
Franca	364	223	61.3	188	135	71.8	176	88	50.0
Communities	195	136	69.7	104	78	75.0	91	58	63.7
São Paulo	3,788	2,788	73.6	1,958	1,678	85.7	1,830	1,110	60.7
CANADA									
Sherbrooke	310	291	93.9	229	222	96.9	81	69	85.2
CHILE									
Santiago	2,207	1,958	88.7	1,094	1,038	94.9	1,113	920	82.7
Comunas	197	158	80.2	66	51	77.3	131	107	81.7
COLOMBIA									
Cali	1,153	372	32.3	536	278	51.9	617	94	15.2
Cartagena	856	486	56.8	401	290	72.3	455	196	43.1
Medellín	924	614	66.5	383	319	83.3	541	295	54.5
EL SALVADOR									
San Salvador	2,094	1,530	73.1	722	582	80.6	1,372	948	69.1
Rural *municipios*	648	199	30.7	195	61	31.3	453	138	30.5
JAMAICA									
Metropolitan Kingston	1,478	1,176	79.6	937	809	86.3	541	367	67.8
St. Andrew, rural	111	59	53.2	53	33	62.3	58	26	44.8
MEXICO									
Monterrey	3,220	2,081	64.6	1,377	925	67.2	1,843	1,156	62.7
UNITED STATES									
San Francisco	209	203	97.1	147	145	98.6	62	58	93.5
California, suburban	575	566	98.4	423	420	99.3	152	146	96.1

natal periods for whom birth weights were obtained. In 12 of the 15 cities and seven other areas birth weights were obtained for more than half of the infants who died in the first year of life. In La Paz many births occurred at home. In all projects some of the infant deaths were of babies born before the period of the Investigation and thus before weighing was stressed. The recording of birth weights for infants dying in the neonatal period was more satisfactory than for those dying in the postneonatal period. In nine cities and three other areas 80 per cent or more of those deceased in the neonatal period had recorded birth weights (the three other areas are suburban San Francisco and the suburban and rural departments of San Juan Province). Figure 27 illustrates the completeness of data on birth weight for infants dying in the neonatal period in 25 areas of the 15 projects. In a few areas only limited data were obtained—as in Bolivia, rural *municipios* of El Salvador, and rural departments of Chaco Province.

Weights were used only when recorded on the day of birth in hospitals and clinics. In a few areas (as in San Juan Province) babies born at home were taken immediately to the hospital for medical attention and thus were weighed. In several cities (as in La Paz and Cali) about half the deceased infants had been born at home (56 per cent of infant deaths with place of birth known in La Paz and 48 per cent in Cali) and thus the birth weights were not known.

FIG. 27. Percentage of Infants Dying in Neonatal Period, with Birth Weight Stated, in 25 Areas of 15 Projects.



In this chapter analysis of birth weights is limited to neonatal deaths.

Similar tabulations according to length of gestation indicated that the data were not complete enough to use in this report. Although ideally gestation and birth weight should be combined in the evaluation of the condition of the infant, in the near future probably birth weight will continue to be the most suitable measure of immaturity for studies in many countries of the world.

DISTRIBUTION OF NEONATAL DEATHS BY WEIGHT AT BIRTH

This analysis of birth weights is made for infants deceased in the neonatal period whose birth occurred in hospitals, and it is limited to the cities (including Sherbrooke project as a city), with two exceptions: for the California project the data are com-

bined for San Francisco and suburban counties, and the data for the suburban and rural departments of San Juan Province were sufficiently complete for use.

The distribution of neonatal deaths for seven birth-weight groups for 15 areas (Table 8) reveals important differences. For the low-weight group of 2,500 grams or less, the variation is from 53.9 per cent in Monterrey to 78.4 per cent in Metropolitan Kingston. Figure 28 shows the percentage distributions in the 15 areas, in descending

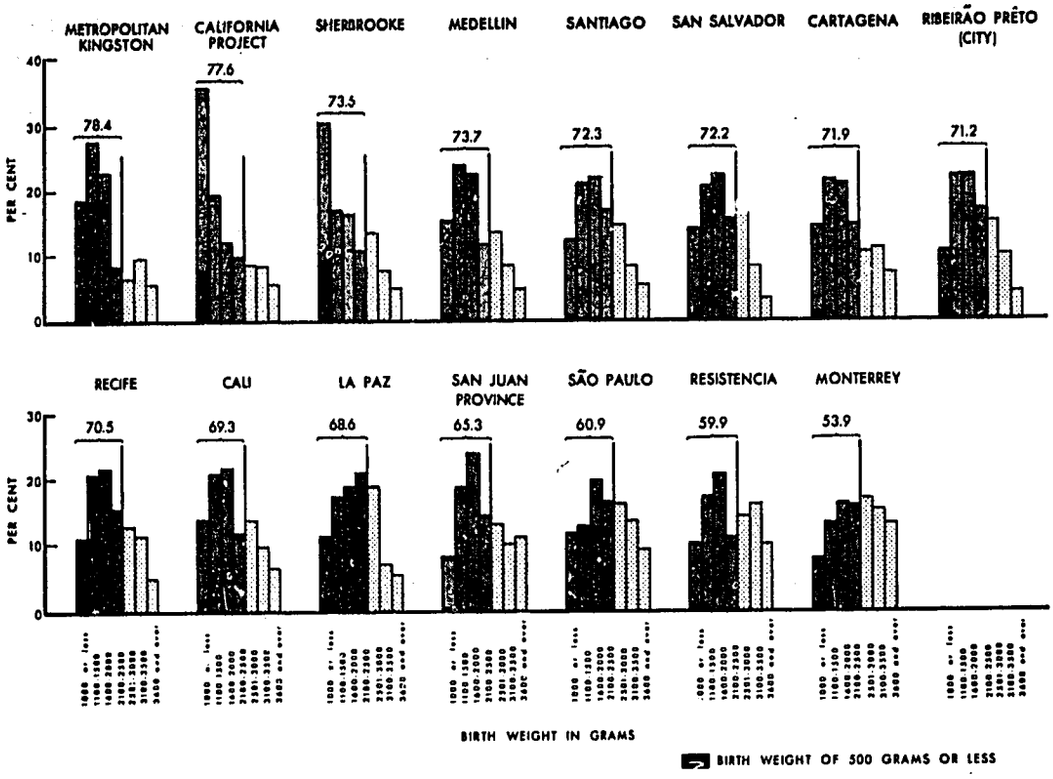
TABLE 8. Distribution of Infants Dying in Neonatal Period Born in Hospitals, by Birth-Weight Group,[a] in 13 Cities and Two Projects.

Birth weight in grams[a]	ARGENTINA				BOLIVIA		BRAZIL						CANADA		CHILE	
	Resistencia		San Juan Province		La Paz		Recife		Ribeirão Prêto (city)		São Paulo		Sherbrooke		Santiago	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Total	242	100.0	773	100.0	433	100.0	566	100.0	198	100.0	1,632	100.0	220	100.0	1,012	100.0
1000 or less	25	10.3	60	7.8	50	11.5	62	11.0	21	10.6	193	11.8	66	30.0	127	12.5
1100-1500	42	17.4	149	19.3	75	17.3	122	21.6	43	21.7	208	12.7	36	16.4	215	21.2
1600-2000	51	21.1	185	23.9	80	18.5	125	22.1	43	21.7	324	19.9	35	15.9	221	21.8
2100-2500	27	11.2	111	14.4	92	21.2	90	15.9	34	17.2	269	16.5	25	11.4	169	16.7
2500 or less	145	59.9	505	65.3	297	68.6	399	70.5	141	71.2	994	60.9	162	73.6	732	72.3
2501-3000	34	14.0	100	12.9	80	18.5	74	13.1	30	15.2	262	16.1	30	13.6	145	14.3
3100-3500	39	16.1	80	10.3	31	7.2	64	11.3	19	9.6	224	13.7	17	7.7	80	7.9
3600 and over	24	9.9	88	11.4	25	5.8	29	5.1	8	4.0	152	9.3	11	5.0	55	5.4
2501 and over	97	40.1	268	34.7	136	31.4	167	29.5	57	28.8	638	39.1	58	26.4	280	27.7

Birth weight in grams[a]	COLOMBIA						EL SALVADOR		JAMAICA		MEXICO		UNITED STATES	
	Cali		Cartagena		Medellín		San Salvador		Metropolitan Kingston		Monterrey		California project	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Total	264	100.0	278	100.0	315	100.0	571	100.0	756	100.0	909	100.0	563	100.0
1000 or less	38	14.4	40	14.4	49	15.6	81	14.2	142	18.8	73	8.0	202	35.9
1100-1500	55	20.8	60	21.6	76	24.1	117	20.5	212	28.0	123	13.5	110	19.5
1600-2000	59	22.3	59	21.2	71	22.5	126	22.1	174	23.0	151	16.6	68	12.1
2100-2500	31	11.7	41	14.7	36	11.4	88	15.4	65	8.6	143	15.7	57	10.1
2500 or less	183	69.3	200	71.9	232	73.7	412	72.2	593	78.4	490	53.9	437	77.6
2501-3000	37	14.0	28	10.1	42	13.3	94	16.5	48	6.3	156	17.2	47	8.3
3100-3500	26	9.8	30	10.8	27	8.6	45	7.9	74	9.8	142	15.6	47	8.3
3600 and over	18	6.8	20	7.2	14	4.4	20	3.5	41	5.4	121	13.3	32	5.7
2501 and over	81	30.7	78	28.1	83	26.3	159	27.8	163	21.6	419	46.1	126	22.4

[a] With weight stated; weights rounded to hundreds of grams except 2501-2549 which are in the weight group 2501-3000 grams.

FIG. 28. Distribution of Infants Dying in Neonatal Period Born in Hospitals, by Birth-Weight Group, in 13 Cities and Two Projects.[a]



[a] The percentages for birth weights of 2,500 grams or less are indicated above the bracketed four low-birth-weight groups.

order according to the proportions falling in the low-weight group of 2,500 grams or less.

With the exception of Metropolitan Kingston, the Latin American projects had relatively low proportions of neonatal deaths in the lowest weight group, 1,000 grams or less. The percentage for Kingston was 18.8 and the others varied from 7.8 in San Juan Province and 8.0 in Monterrey to 15.6 in Medellín. In the projects in California and Sherbrooke, respectively, 35.9 and 30.0 per cent of neonatal deaths were in this low-weight group. To illustrate the differences between these two projects and the other 13, Figure 28 subdivides this weight group into 500 grams or less (lower portion of the bar) and 600-1,000 grams. In the Sherbrooke and California projects (Table 9) the percentages in the subgroup 500 grams or less were 8.6 and 7.5, respectively, while in the other areas only from 0.4 to 2.5 per cent were in that subgroup. Thus, in addition to possible deficiencies in recording signs of life, it is likely that immature babies are more frequently delivered as live births and not as fetal deaths in the Canadian and California projects than in the others. Shapiro *et al.* (1968), in exploring differences in international comparisons of neonatal

TABLE 9. Infants Dying in Neonatal Period Born in Hospitals With Birth Weights of 1,000 Grams or Less in 13 Cities and Two Projects.

Project or city	Neonatal deaths (weight stated)	1,000 grams or less[a]					
		Total		600–1,000 grams		500 grams or less	
		No.	%	No.	%	No.	%
ARGENTINA							
Resistencia	242	25	10.3	24	9.9	1	0.4
San Juan Province	773	60	7.8	56	7.2	4	0.5
BOLIVIA							
La Paz	433	50	11.5	42	9.7	8	1.8
BRAZIL							
Recife	566	62	11.0	57	10.1	5	0.9
Ribeirão Prêto (city)	198	21	10.6	16	8.1	5	2.5
São Paulo	1,632	193	11.8	171	10.5	22	1.3
CANADA							
Sherbrooke	220	66	30.0	47	21.4	19	8.6
CHILE							
Santiago	1,012	127	12.5	121	12.0	6	0.6
COLOMBIA							
Cali	264	38	14.4	34	12.9	4	1.5
Cartagena	278	40	14.4	37	13.3	3	1.1
Medellín	315	49	15.6	47	14.9	2	0.6
EL SALVADOR							
San Salvador	571	81	14.2	75	13.1	6	1.1
JAMAICA							
Metropolitan Kingston	756	142	18.8	129	17.1	13	1.7
MEXICO							
Monterrey	909	73	8.0	67	7.4	6	0.7
UNITED STATES							
California project	563	202	35.9	160	28.4	42	7.5

[a] Weights rounded to hundreds of grams.

mortality, suggested that "some pregnancies that are destined to end in a neonatal or first-week death in the United States terminate in a fetal death in other countries."

The percentages of neonatal deaths in the birth-weight groups 1,100-1,500 grams and 1,600-2,000 grams were relatively high in many Latin American projects. These distributions differed markedly from those in California and Sherbrooke. Also the relatively small numbers of neonatal deaths of infants weighing 2,501 grams or more at birth are puzzling.

The numbers of neonatal deaths in the three subdivisions of San Juan Province were sufficient to allow for consideration of differences (Table 10 and Figure 29). In the rural departments, 67.1 per cent of these deaths had birth weights of 2,500 grams or less, while the figure for the city of San Juan was 59.5 per cent. In the lowest weight group (1,000 grams or less) there may be a slight deficiency in the number recorded in these rural departments, as the percentage of 6.4 was lower than in the other areas; some deaths may have been missed if the infants were born at home and death certificates were not filed. If complete data were available, the percentage of low-birth-weight infants might be even higher in the rural area.

These findings suggest that low-weight births which in turn become neonatal deaths may be more frequent in the rural

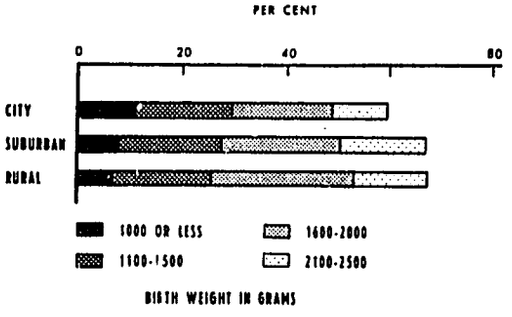
TABLE 10. Distribution of Infants Dying in Neonatal Period Born in Hospitals, by Birth-Weight Group, in Three Areas of San Juan Province, Argentina.

Birth weight in grams[b]	San Juan (city)		Suburban departments		Rural departments	
	No.	%	No.	%	No.	%
Total	161		321		307	
Birth weight stated	158	100.0	317	100.0	298	100.0
1000 or less	17	10.8	24	7.6	19	6.4
1100-1500	29	18.4	63	19.9	57	19.1
1600-2000	31	19.6	72	22.7	82	27.5
2100-2500	17	10.8	52	16.4	42	14.1
2500 or less	94	59.5	211	66.6	200	67.1
2501-3000	20	12.7	37	11.7	43	14.4
3100-3500	24	15.2	31	9.8	25	8.4
3600 and over	20	12.7	38	12.0	30	10.1
2501 and over	64	40.5	106	33.4	98	32.9

[b] Weights rounded to hundreds of grams except 2501-2549 which are in the weight group 2501-3000 grams.

area than in the city. As the facilities for saving prematures would be greater in the urban centers, these lower percentages in rural areas indicate that probably other factors could be responsible for low-weight births. As pointed out by Birch (1972) and also as has been found in the rural villages of the study in Guatemala (Lechtig *et al.*, 1972), nutritional status of the mother is one

FIG. 29. Percentage of Neonatal Deaths with Low Birth Weight[a] in Three Areas of San Juan Province, Argentina.



[a] Births in hospitals with weight stated.

of the factors. Chapter IX on nutritional deficiency shows that such deficiency was found more frequently in the rural than in the urban area of San Juan Province. Other factors affect birth weights and thus there is not a strict relationship between these two variables. In Monterrey, for example, the proportion of deceased neonates with birth weights of 3,600 grams and over was the highest (13.3 per cent); in this project there were 121 such deaths. In Monterrey some of the unusually large babies were born to mothers with diabetes and other babies may have been large at birth due to unsuspected diabetes in the mothers. As revealed in the Inter-American Investigation of Mortality in adults (Puffer and Griffith, 1967) diabetes was an important cause of death in Mexico City. It has been known for some time that diabetes in pregnant women increases the birth weight of the product (Miller and Wilson, 1943). Thus, while the death rate from nutritional deficiency is relatively high in Monterrey the distribution of births by weight may be influenced by diabetes as well as by the nutritional status of the mother.

Three main groups of factors could be invoked to explain the differences in distribution of neonatal deaths by birth weight, namely:

1) Quality of data on birth weights, depending on
   - degree to which international definitions of live birth and fetal death are observed;
   - proportion of births in hospitals; and
   - proportion of weights recorded and accuracy of weighing.

2) Biological and environmental factors such as
   - maternal nutrition before and during pregnancy;
   - maternal morbidity before and during pregnancy;

- ethnic group and environmental factors such as altitude; and
- age of mother and birth order of the child.

3) Quality, promptness, and continuity of medical attention during pregnancy and during the neonatal period.

The data presented on birth weights of infants dying in the neonatal period are puzzling and indicate the need for collection and analyses of birth weights for all live births in urban and rural areas in the Hemisphere. Study of mortality could then be made taking into account factors responsible for true differences. The data indicate gaps in our knowledge and important fields for further research in Latin America.

NEONATAL MORTALITY BY WEIGHT AT BIRTH, CALIFORNIA PROJECT

Fortunately, neonatal mortality can be analyzed by birth weight in the California project. The distribution of live births was obtained from the California State Health Department for San Francisco and for Alameda, Contra Costa, and San Mateo Counties for 1969. This distribution (total of 47,655 births) was applied to the number of births included in the California project (44,740).* The neonatal deaths per 1,000 live births for seven weight groups are given in Table 11.

As expected, the death rate of those with birth weights of 1,000 grams or less was high, 940.0 per 1,000 live births. In the next weight group (1,001-1,500 grams) the rate was much lower, 434.8 per 1,000 live births, which compares favorably with the rate of 521.5 in the United States† in 1960. In the weight groups 1,501-2,000 and 2,001-2,500 grams, the neonatal death rates were much lower (106.9 and 28.2 per 1,000 live births) and were far below those in the United States for the same weight groups in 1960 (180.6 and 41.4).

For infants weighing 2,501 grams and over, the death rate of 3.1 per 1,000 live births in the California project was low, indicating that when weight at birth is satisfactory the risk of death in the neonatal period is low. In the United States

TABLE 11. Neonatal Mortality by Weight at Birth in California Project.

Weight in grams	Estimated live births	Neonatal deaths[a]	
		No.	Rate[b]
Total	44,740	570	12.7
1000 or less	200	188	940.0
1001-1500	276	120	434.8
1501-2000	664	71	106.9
2001-2500	2,271	64	28.2
2500 or less	3,411	443	129.9
2501-3000	8,550	46	5.4
3001-3500	17,661	45	2.5
3501 and over	15,118	36	2.4
2501 and over	41,329	127	3.1

[a] Neonatal deaths are given in the same weight groups as live births, without rounding and with estimation of weights for those with weights not stated.
[b] Deaths per 1,000 live births.

* The project in California included San Francisco and the urban and suburban portions of the three counties (92 per cent of the total population), and the distribution of live births was believed to be satisfactory for use in estimating the distribution of births by birth weight in the project.

† Data for the United States are given in Appendix 3.

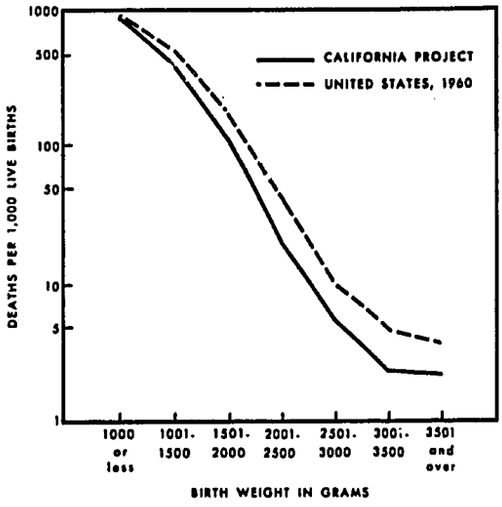
the comparable rate in 1960 was 5.4 per 1,000 live births. In Figure 30 these neonatal death rates in the California project are shown by the solid line, and those for the United States in 1960 by the broken line.

Although weights were available for the Sherbrooke project, the number of live births in the lowest weight group was much larger than the number of neonatal deaths, and this fact indicated a probable deficiency in the registration of neonatal deaths of babies born with low weights. On the basis of statistics for the United States, it can be expected that no more than 10 per cent of those weighing 1,000 grams or less will survive. In the United States in 1960 only 8.7 per cent survived, and in the California project only 6.0 per cent survived the neonatal period.

For evaluation of mortality of babies born with low weights, the outcome of each birth needs to be ascertained. Without a systematic check on the condition, several deaths may be missed. The efforts of the local staffs of the Investigation to find such deaths were described in Chapter II.

In the Sherbrooke project, among the 15,472 live births with weights of 2,501 grams or more, there were 58 neonatal deaths, giving a death rate of 3.7 per 1,000 live births. This rate is slightly higher than that for the same weight group in the California project (3.1 per 1,000 live births). This indicates that probably the total neonatal death rate would be even higher in the Sherbrooke project if all neonatal deaths were known.

FIG. 30. Neonatal Mortality by Weight at Birth, California Project and United States, 1960.



This experience in California illustrates once more the major role of low birth weight in neonatal mortality and the importance of knowing the distribution of live births and all neonatal deaths by birth weight in Latin America—or at least in several of the countries and selected areas of others.

MULTIPLE BIRTHS

During the field work special emphasis was placed on securing records of all deaths of products of multiple pregnancies. This was important as at times one casket is used for burial of twins and only one death certificate filed. Table 12 provides information on multiple births among infants dying in the neonatal period in 25 areas. In the 15 cities the percentages varied from 7.9 in San Salvador to 15.7 in Ribeirão Prêto. In the 10

other areas the variation was from 6.1 in the *comunas* in Chile to 16.0 in rural departments of San Juan Province.

Many factors affect these findings, the basic one being the completeness of the data, and another the frequency of multiple births among all live births in the area as determined by genetic differences in populations. Also the quality of medical treatment of products of multiple pregnancies, which are usually of low birth weight, influences neonatal mortality.

TABLE 12. Number and Percentage of Multiple Births among Infants Dying in Neonatal Period in 25 Areas of 15 Projects.

Area	Total neonatal deaths	Multiple births	
		No.	%
ARGENTINA			
Chaco Province			
Resistencia	327	40	12.2
Rural departments	241	31	12.9
San Juan Province			
San Juan (city)	172	20	11.6
Suburban departments	353	53	15.0
Rural departments	381	61	16.0
BOLIVIA			
La Paz	1,049	84	8.0
Viacha	42	5	11.9
BRAZIL			
Recife	1,073	142	13.2
Ribeirão Prêto			
Ribeirão Prêto (city)	223	35	15.7
Franca	188	14	7.4
Communities	104	13	12.5
São Paulo	1,958	218	11.1
CANADA			
Sherbrooke	229	25	10.9
CHILE			
Santiago	1,094	102	9.3
Comunas	66	4	6.1
COLOMBIA			
Cali	536	44	8.2
Cartagena	401	39	9.7
Medellín	383	49	12.8
EL SALVADOR			
San Salvador	722	57	7.9
Rural *municipios*	195	16	8.2
JAMAICA			
Metropolitan Kingston	937	128	13.7
St. Andrew, rural	53	5	9.4
MEXICO			
Monterrey	1,377	137	9.9
UNITED STATES			
San Francisco	147	17	11.6
California, suburban	423	59	13.9

For the study of neonatal mortality among products of multiple pregnancies, the data by birth weight in Table 13 are restricted to infants born in the hospital. Also the information is given only for the cities (including Sherbrooke project as a city), with the exception of San Juan Province and the California project in which data are presented for the entire projects.

For these neonatal deaths with weights stated, the percentages of multiple births varied from 8.6 in San Salvador to 15.7 in Resistencia, 16.3 in San Juan Province, and 17.3 in Recife (Figure 31). It is likely that all known multiple births resulting in neonatal deaths were included in San Salvador and San Juan Province, the areas representing the very high and low percentages. Thorough searches were conducted in both areas when the reproductive history of the mother indicated a multiple birth. Thus there may be real differences in the frequency of low-weight multiple births resulting in neonatal deaths.

Of the low-birth-weight babies (2,500 grams or less) dying in the neonatal period, from 10.7 per cent in San Salvador to 24.8 per cent in Resistencia were products of multiple pregnancies. Table 13 allows study of the weight distributions of neonatal deaths with the exclusion of multiple births, which is the method used by some authors. For example, Butler and Alberman (1969) presented the data by birth weight for single births in the British Perinatal Mortality Survey. For purposes of national health planning, in contrast to research, study of the distributions of all live births and neonatal deaths by birth weight is advisable.

In the California project, on the basis of the distributions of live births in the three counties and San Francisco, 885 of the estimated total would be multiple births. There were 76 neonatal deaths of products of mul-

TABLE 13. Number of Infants Dying in Neonatal Period Born in Hospitals, and of Multiple Birth, by Birth Weight, in 13 Cities and Two Projects.

Weight in grams[a]	Neonatal deaths	Multiple births		Neonatal deaths	Multiple births		Neonatal deaths	Multiple births		Neonatal deaths	Multiple births		Neonatal deaths	Multiple births	
		No.	%		No.	%		No.	%		No.	%		No.	%
	ARGENTINA						BOLIVIA			BRAZIL					
	Resistencia			San Juan Province			La Paz			Recife			Ribeirão Prêto (city)		
Total deaths	269	39	14.5	789	127	16.1	473	65	13.7	868	130	15.0	213	34	16.0
Weight stated	242	38	15.7	773	126	16.3	433	58	13.4	566	98	17.3	198	30	15.2
1000 grams or less	25	9	36.0	60	14	23.3	50	10	20.0	62	19	30.6	21	5	23.8
1100-1500	42	18	42.9	149	34	22.8	75	15	20.0	122	33	27.0	43	11	25.6
1600-2000	51	7	13.7	185	45	24.3	80	20	25.0	125	23	18.4	43	10	23.3
2100-2500	27	2	7.4	111	26	23.4	92	9	9.8	90	15	16.7	34	4	11.8
2500 or less	145	36	24.8	505	119	23.6	297	54	18.2	399	90	22.6	141	30	21.3
2501-3000	34	2	5.9	100	7	7.0	80	3	3.8	74	7	9.5	30	—	—
3100-3500	39	—	—	80	—	—	31	1	3.2	64	1	1.6	19	—	—
3600 and over	24	—	—	88	—	—	25	—	—	29	—	—	8	—	—
	BRAZIL São Paulo			CANADA Sherbrooke			CHILE Santiago			COLOMBIA					
										Cali			Cartagena		
Total deaths	1,762	210	11.9	226	25	11.1	1,037	102	9.8	310	34	11.0	291	36	12.4
Weight stated	1,632	203	12.4	220	25	11.4	1,012	98	9.7	264	30	11.4	278	35	12.6
1000 grams or less	193	47	24.4	66	12	18.2	127	22	17.3	38	8	21.1	40	10	25.0
1100-1500	208	53	25.5	36	4	11.1	215	40	18.6	55	10	18.2	60	9	15.0
1600-2000	324	62	19.1	35	5	14.3	221	29	13.1	59	8	13.6	59	11	18.6
2100-2500	269	31	11.5	25	4	16.0	169	5	3.0	31	4	12.9	41	2	4.9
2500 or less	994	193	19.4	162	25	15.4	732	96	13.1	183	30	16.4	200	32	16.0
2501-3000	262	8	3.1	30	—	—	145	2	1.4	37	—	—	28	2	7.1
3100-3500	224	2	0.9	17	—	—	80	—	—	26	—	—	30	1	3.3
3600 and over	152	—	—	11	—	—	55	—	—	18	—	—	20	—	—
	COLOMBIA Medellín			EL SALVADOR San Salvador			JAMAICA Met. Kingston			MEXICO Monterrey			UNITED STATES California project		
Total deaths	333	49	14.7	597	52	8.7	836	123	14.7	1,171	129	11.0	566	74	13.1
Weight stated	315	48	15.2	571	49	8.6	756	114	15.1	909	93	10.2	563	74	13.1
1000 grams or less	49	13	26.5	81	13	16.0	142	36	25.4	73	20	27.4	202	41	20.3
1100-1500	76	19	25.0	117	12	10.3	212	38	17.9	123	30	24.4	110	21	19.1
1600-2000	71	12	16.9	126	12	9.5	174	28	16.1	151	25	16.6	68	5	7.4
2100-2500	36	3	8.3	88	7	8.0	65	8	12.3	143	10	7.0	57	5	8.8
2500 or less	232	47	20.3	412	44	10.7	593	110	18.5	490	85	17.3	437	72	16.5
2501-3000	42	1	2.4	94	5	5.3	48	4	8.3	156	7	4.5	47	1	2.1
3100-3500	27	—	—	45	—	—	74	—	—	142	1	0.7	47	1	2.1
3600 and over	14	—	—	20	—	—	41	—	—	121	—	—	32	—	—

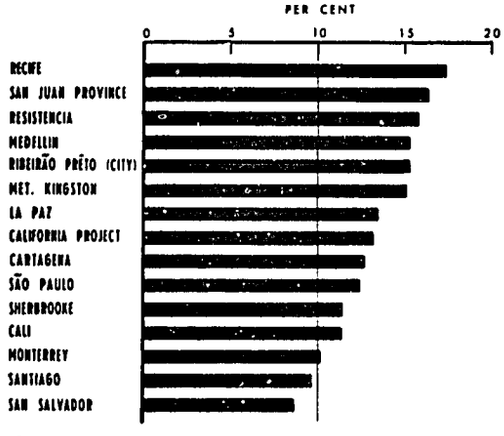
[a] Weights rounded to hundreds of grams except 2501-2549 which are in the weight group 2501-3000 grams.

tiple pregnancies (Table 12) and thus the neonatal death rate of 85.9 per 1,000 live births is much higher than that for single births (11.3) (Table 14). Actually 72 of the multiple births in hospitals and two occurring at home were of low birth weight (2,500 grams or less). The neonatal death rate in plural births of low weight—156.1

TABLE 14. Neonatal Mortality in Single and Plural Births, by Birth Weight, in California Project.

Type of birth	Estimated live births	Neonatal deaths		Birth weight in grams					
				2,500 or less			2,501 and over		
				Live births	Neonatal deaths		Live births	Neonatal deaths	
		No.	Rate		No.	Rate		No.	Rate
Total	44,740	570	12.7	3,411	443	129.9	41,329	127	3.1
Single	43,855	494	11.3	2,939	369	125.6	40,916	125	3.1
Plural	885	76	85.9	472	74	156.8	413	2	4.8

FIG. 31. Percentage of Multiple Births* among Infants Dying in Neonatal Period in 13 Cities and Two Projects.



* Of births in hospitals with weight stated.

per 1,000 live births—was higher than for single live births owing to the greater frequency of plural births in the lower weight groups. Since there were only two neonatal deaths among plural births with weights of 2,501 grams or more, the number is not large enough for evaluation of differences of mortality in that weight group. This California experience shows that products of multiple pregnancies have high neonatal mortality due to their low birth weights, among other factors.

* * *

The frequency of low-weight births has been presented as background information because of the important implications of this factor in terms of the child's future growth and development, susceptibility to infection, and chances of survival. Some of these implications are considered in later chapters. Knowledge of true differences in distribution of birth weights for all births and infant deaths in cities and countries is limited at present. Also the relationship of low birth weight to other factors cannot be established because of the lack of good-quality data. Therefore continued efforts are needed so that all the important information will be recorded for each birth and death. In addition, research in this field involving rural as well as urban populations is essential in order to establish bases for sound preventive action.

Chapter IV

Mortality in Childhood

The overall view of death rates in childhood in the 15 projects, as presented in this chapter, reveals wide variations in mortality that need to be studied in depth. The analysis of the rates by age group in infancy indicates also the problems that must be overcome to obtain complete and comparable data not only in the Americas but throughout the world. Official data of higher quality than those now available are indispensable for health planning. Moreover, in order to relate the findings on infants and young children to the health status of the mother, research on low birth weight, nutritional status, intelligence and mental condition, and congenital anomalies is necessary, and this requires full and comparable data on the outcome of all pregnancies.

For building healthy and intelligent populations, infancy is a decisive period of life, and one for which basic data of the highest quality should be made available. The present deficiencies cannot be tolerated in an era in which spectacular progress is possible in such other fields as travel in space. The well-being of each child can be attained through the application of medical technology. The first step is to define the problems.

DEATH RATES IN CHILDREN UNDER 5 YEARS OF AGE

Mortality in the period from birth to 5 years of age is discussed first in general terms to illustrate the variations found in urban, suburban, and rural areas of the 15 projects (Table 15). There are 25 distinct areas and these are shown in Figure 32 according to size of the death rates, which descend from the extreme high of 50.5 per 1,000 population to the low of 4.1.

The two areas with exceedingly high rates were the rural *municipios* of El Salvador (50.5) and the rural community of Viacha, Bolivia (48.1). The three with the next highest rates were cities: Recife, Brazil (29.3), La Paz, Bolivia (26.6), and San Salvador, El Salvador (26.4). Other areas with death rates exceeding 20 per 1,000 population were the rural and suburban departments of San Juan Province, Argentina (24.0 and 21.9) and the rural departments and the city of Resistencia in Chaco Province, Argentina (23.9 and 20.7). At the other end of the scale were three areas with very low rates: two in California in the

TABLE 15. Death Rates[a] Under 5 Years in Two Age Groups in 25 Areas of 15 Projects.

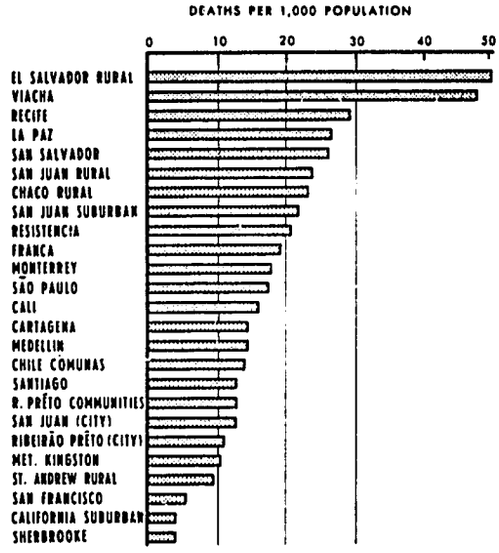
Area	Under 5 years	Under 1 year	1–4 years
ARGENTINA			
Chaco Province			
Resistencia	20.7	76.2	3.6
Rural departments	23.9	85.0	6.3
San Juan Province			
San Juan (city)	12.9	50.7	1.5
Suburban departments	21.9	87.9	2.9
Rural departments	24.0	94.5	4.0
BOLIVIA			
La Paz	26.6	73.0	11.9
Viacha	48.1	123.5	21.7
BRAZIL			
Recife	29.3	91.2	9.0
Ribeirão Prêto			
Ribeirão Prêto (city)	10.9	43.0	1.9
Franca	19.4	71.5	4.0
Communities	13.0	50.8	2.4
São Paulo	17.7	65.1	2.8
CANADA			
Sherbrooke	4.1	18.3	0.8
CHILE			
Santiago	13.0	54.9	1.8
Comunas	14.0	57.9	2.2
COLOMBIA			
Cali	16.1	54.6	5.9
Cartagena	14.6	47.8	5.8
Medellín	14.4	47.6	5.7
EL SALVADOR			
San Salvador	26.4	81.7	8.0
Rural *municipios*	50.5	120.0	26.2
JAMAICA			
Metropolitan Kingston	10.5	39.5	2.1
St. Andrew, rural	9.5	31.6	3.1
MEXICO			
Monterrey	18.1	60.7	4.3
UNITED STATES			
San Francisco	5.4	18.5	0.8
California, suburban	4.1	17.2	0.7

[a] Rates under 1 year per 1,000 live births; others per 1,000 population.

United States (5.4 and 4.1) and the project of Sherbrooke in Canada (4.1).

The rural *municipios* in El Salvador and Viacha in Bolivia had death rates of the order of two times those in the nearby cities. Also in San Juan Province, mortality in the rural and suburban departments was nearly double that in the city of San Juan. It is probable that in many areas of Latin America death rates in rural sectors are at least twice as high as those in cities.

FIG. 32. Mortality Under 5 Years of Age in 25 Areas of 15 Projects.



The differences in mortality between urban and rural areas were small in Chaco Province and in Jamaica. In Chaco, the rates were high in the city of Resistencia as well as in the rural departments, and (as will be noted later) there was little difference between the two in regard to health facilities and environmental conditions. Rural St. Andrew had the smallest number of deaths (only 149 under 5 years of age) and the number of those occurring in early life appears to be deficient, as judged by the low rate of 3.4 per 1,000 live births in the first day of life and the neonatal rate of 15.1. This deficiency may be due in part to lack of registration or perhaps to the fact that several deaths of rural St. Andrew residents were included with those of Metropolitan Kingston. Thus for many tables, Kingston and St. Andrew are treated as a whole.

In California the death rate of 4.1 for the suburban counties was slightly lower than that of 5.4 for San Francisco—the reverse of

the relationship noted in several projects of the Investigation.

It can be seen also that several of the Latin American cities such as Recife, La Paz, and São Paulo had death rates as high or higher than some of the rural areas. At the same time, all of the Latin American cities had rates at least twice as high as those in the projects in California and Sherbrooke. Thus it becomes clear that mortality could be reduced by at least one half.

The three areas with the lowest death rates under 5 years of age were those with the lowest estimated birth rates and likewise the lowest infant death rates. On the other hand, those with the highest death rates under 5 years had the highest birth rates and highest infant death rates. One explanation for part of the excessive mortality is that high birth rates imply many infants of high birth order, among whom mortality is high. Other factors (such as limited breast feeding, very little prenatal care, and lack of water supplies) which will be evaluated in this report also contribute to these wide variations.

In order to show the age periods of excessive mortality, Table 16 gives the numbers of deaths and the rates in infancy in full detail, as well as those in childhood for two age groups (1 year and 2-4 years). For the projects in San Juan and Chaco Provinces and in Kingston-St. Andrew, data are given for the projects as a whole as well as for their subdivisions, since such data are useful to the health officials for the direction of programs. A brief, general description of mortality by age group in children under 5 years of age is presented in the following sections.

This overall view of mortality under 5 years reveals that differences are marked not only among cities but also between cities and the corresponding rural areas. These differences between urban and rural populations tend to disappear as mortality reaches low levels.

INFANT MORTALITY

Of the 35,095 deaths under 5 years of age studied in the Investigation, 78.6 per cent (27,602) occurred in infancy, that is, in children under one year of age; 12.4 per cent occurred in children one year of age; and the remaining 8.9 per cent in those aged 2-4 years (Table 17). Major attention, therefore, must be given to mortality in infancy.

The infant death rates for 24 areas are ranked according to size in Table 18. In Figure 33 the neonatal period (under 28 days) is divided into the first day of life and the remainder, 1-27 days. The variation in these infant death rates is great—from 17.2 per 1,000 live births in the suburban counties of California to rates in excess of 100 per 1,000 in two rural areas (Viacha in Bolivia, and rural *municipios* in El Salvador). Nearly all of this variation occurs in the postneonatal rates (28 days-11 months), which ranged from 4.5 in suburban counties of California to 83.9 in the rural *municipios* of El Salvador. This high postneonatal mortality is due principally to infectious diseases and nutritional deficiency, and it indicates the impact of those serious health problems. In Chapter V the

TABLE 16. Mortality[a] Under 5 Years, by Age Group and Area, in 15 Projects.

Age group	ARGENTINA, Chaco Province						ARGENTINA, San Juan Province							
	Total		Resistencia		Rural departments		Total		San Juan (city)		Suburban departments		Rural departments	
	Deaths	Rate	Deaths	Rate	Deaths	Rate	Deaths	Rate	Deaths	Rate	Deaths	Rate	Deaths	Rate
Under 5 years	1,701	22.1	864	20.7	837	23.9	2,156	20.6	326	12.9	780	21.9	1,050	24.0
Under 1 year	1,410	80.1	747	76.2	663	85.0	1,900	81.3	295	50.7	696	87.9	909	94.5
Neonatal	568	32.3	327	33.4	241	30.9	906	38.8	172	29.6	353	44.6	381	39.6
Under 7 days	399	22.7	236	24.1	163	[illegible]	577	24.7	119	20.4	231	29.2	227	23.6
Under 1 day	186	10.6	117	11.9	69	[illegible]	258	11.0	52	8.9	109	13.8	97	10.1
1-6 days	213	12.1	119	12.1	94	12.1	319	13.7	67	11.5	122	15.4	130	13.5
7-27 days	169	9.6	91	9.3	78	10.0	329	14.1	53	9.1	122	15.4	154	16.0
Postneonatal	842	47.8	420	42.9	422	54.1	994	42.6	123	21.1	343	43.3	528	54.9
1-4 years	291	4.8	117	3.6	174	6.3	256	3.0	31	1.5	84	2.9	141	4.0
1 year	197	12.4	33	9.3	114	16.3	153	7.3	20	4.0	50	7.0	83	9.4
2-4 years	94	2.1	34	1.4	60	2.9	103	1.6	11	0.7	34	1.6	58	2.2

Age group	BOLIVIA				BRAZIL Recife		BRAZIL, Ribeirão Prêto						BRAZIL, São Paulo	
	La Paz		Viacha				Ribeirão Prêto (city)		Franca		Communities			
Under 5 years	4,115	26.6	161	48.1	3,635	29.3	464	10.9	434	19.4	228	13.0	4,312	17.7
Under 1 year	2,685	73.0	105	123.5	2,773	91.2	400	43.0	364	71.5	195	50.8	3,788	65.1
Neonatal	1,049	28.5	42	49.4	1,073	35.3	223	24.0	188	36.9	104	27.1	1,958	33.7
Under 7 days	608	16.5	32	37.6	769	25.3	175	18.8	131	25.7	86	22.4	1,183	20.3
Under 1 day	305	8.3	12	14.1	357	11.7	95	10.2	68	13.4	46	12.0	625	10.7
1-6 days	303	8.2	20	23.5	412	13.6	80	8.6	63	12.4	40	10.4	558	9.6
7-27 days	441	12.0	10	11.8	304	10.0	48	5.2	57	11.2	18	4.7	775	13.3
Postneonatal	1,636	44.5	63	74.1	1,700	55.9	177	19.0	176	34.6	91	23.7	1,830	31.5
1-4 years	1,430	11.9	56	21.7	862	9.0	64	1.9	70	4.0	33	2.4	524	2.8
1 year	899	27.2	36	50.7	515	19.2	34	3.9	32	6.9	13	3.6	282	5.2
2-4 years	531	6.1	20	10.7	347	5.0	30	1.2	38	2.9	20	2.0	242	1.8

Age group	CANADA Sherbrooke		CHILE				COLOMBIA						EL SALVADOR San Salvador	
			Santiago		Comunas		Cali		Cartagena		Medellín			
Under 5 years	371	4.1	2,489	13.0	225	14.0	1,627	16.1	1,255	14.6	1,348	14.4	2,738	26.4
Under 1 year	310	18.3	2,207	54.9	197	57.9	1,153	54.6	856	47.8	924	47.6	2,094	81.7
Neonatal	229	13.5	1,094	27.2	66	19.4	536	25.4	401	22.4	383	19.7	722	28.2
Under 7 days	208	12.3	801	19.9	44	12.9	429	20.3	308	17.2	315	16.2	491	19.2
Under 1 day	146	8.6	403	10.0	22	6.5	220	10.4	146	8.2	136	7.0	237	9.3
1-6 days	62	3.7	398	9.9	22	6.5	209	9.9	162	9.1	179	9.2	254	9.9
7-27 days	21	1.2	293	7.3	22	6.5	107	5.1	93	5.2	68	3.5	231	9.0
Postneonatal	81	4.8	1,113	27.7	131	38.5	617	29.2	455	25.4	541	27.9	1,372	53.6
1-4 years	61	0.8	282	1.8	28	2.2	474	5.9	399	5.8	424	5.7	644	8.0
1 year	20	1.2	149	4.0	17	5.4	271	13.4	266	15.5	233	12.5	398	17.4
2-4 years	41	0.7	133	1.1	11	1.1	203	3.3	133	2.6	191	3.4	246	4.3

Age group	EL SALVADOR Rural municipios		JAMAICA						MEXICO Monterrey		UNITED STATES			
			Kingston-St. Andrew		Metropolitan Kingston		St. Andrew, rural				San Francisco		California, suburban	
Under 5 years	1,082	50.5	1,903	10.4	1,754	10.5	149	9.5	3,953	18.1	234	5.4	664	4.1
Under 1 year	648	120.0	1,589	38.8	1,478	39.5	111	31.6	3,220	60.7	209	18.5	575	17.2
Neonatal	195	36.1	990	24.2	937	25.0	53	15.1	1,377	26.0	147	13.0	423	12.7
Under 7 days	114	21.1	729	17.8	692	18.5	37	10.5	982	18.5	128	11.3	368	11.0
Under 1 day	68	12.6	323	7.9	311	8.3	12	3.4	563	10.6	81	7.2	246	7.4
1-6 days	46	8.5	406	9.9	381	10.2	25	7.1	419	7.9	47	4.2	122	3.6
7-27 days	81	15.0	261	6.4	245	6.5	16	4.6	395	7.5	19	1.7	55	1.6
Postneonatal	453	83.9	599	14.6	541	14.4	58	16.5	1,843	34.8	62	5.5	152	4.5
1-4 years	434	26.2	314	2.2	276	2.1	38	3.1	733	4.3	25	0.8	89	0.7
1 year	217	48.1	175	4.5	154	4.3	21	6.3	421	9.4	8	0.9	25	0.8
2-4 years	217	18.0	139	1.3	122	1.3	17	1.9	312	2.5	17	0.7	64	0.7

[a] Rates under 1 year per 1,000 live births; others per 1,000 population.

TABLE 17. Distribution of Deaths by Age Group for 15 Projects Combined.

Age group	Deaths	%
Under 5 years	35,095	100.0
Under 1 year	27,602	78.6
Neonatal	12,674	36.1
Postneonatal	14,928	42.5
1–4 years	7,493	21.4
1 year	4,361	12.4
2–4 years	3,132	8.9

multiple causes involved in these excessive death rates will be clarified.

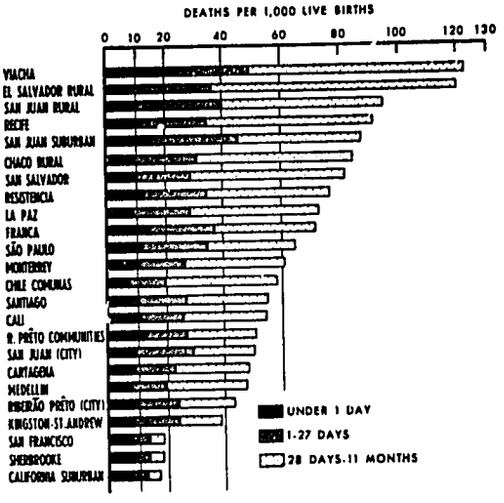
Mortality in the neonatal period showed much less variation, ranging from 12.7 per 1,000 live births in suburban counties of California to rates three and four times higher—44.6 in suburban departments of San Juan Province and 49.4 in Viacha. The first four weeks of life constitute a crucial

TABLE 18. Infant Mortality* by Age Group in 24 Areas of 15 Projects.

Area	Infant	Neonatal	Under 1 day
Viacha	123.5	49.4	14.1
El Salvador, rural	120.0	36.1	12.6
San Juan, rural	94.5	39.6	10.1
Recife	91.2	35.3	11.7
San Juan, suburban	87.9	44.6	13.8
Chaco, rural	85.0	30.9	8.8
San Salvador	81.7	28.2	9.3
Resistencia	76.2	33.4	11.9
La Paz	73.0	28.5	8.3
Franca	71.5	36.9	13.4
São Paulo	65.1	33.7	10.7
Monterrey	60.7	26.0	10.6
Chile, *comunas*	57.9	19.4	6.5
Santiago	54.9	27.2	10.0
Cali	54.6	25.4	10.4
Ribeirão Prêto, communities	50.8	27.1	12.0
San Juan (city)	50.7	29.6	8.9
Cartagena	47.8	22.4	8.2
Medellín	47.6	19.7	7.0
Ribeirão Prêto (city)	43.0	24.0	10.2
Kingston-St. Andrew	38.8	24.2	7.9
San Francisco	18.5	13.0	7.2
Sherbrooke	18.3	13.5	8.6
California, suburban	17.2	12.7	7.4

* Deaths per 1,000 live births.

FIG. 33. Infant Mortality by Age Group in 24 Areas of 15 Projects.



period for the child's growth and development; health programs for infants in this age group can be effective not only in reducing neonatal mortality but also in preventing serious morbidity and reducing death rates in later periods of infancy and childhood.

The first day of life is the most hazardous period, and more than half the neonatal deaths in the California and Canadian projects occurred in the first 24 hours after birth. For obtaining comparable information on deaths of all those born alive in accordance with the WHO definition, this is the critical period. As was pointed out in Chapter II, the standard of 10 deaths in the first 24 hours of life per 1,000 live births was used to estimate the completeness of data in each project. The efforts exerted by the principal collaborators to find information on these deaths in order to distinguish those born alive from those born dead (the fetal deaths) and obtain full data on the outcome of pregnancies (including abortions) resulted in the discovery of many deaths occurring shortly after birth and

hopefully of nearly all the unregistered deaths in this age period. Actually, of the 4,543 deaths in the first day of life in all 15 projects, 977 or 21.5 per cent were added through these searches.

The death rates in the first day of life in the 24 areas varied from 6.5 per 1,000 live births in the *comunas* of Chile and 7.0 in Medellín, to 14.1 in Viacha. This is a relatively narrow range when compared with that observed for mortality after the first day.

In recent years comparisons of infant mortality in countries of the world have been the subject of critical review in publications of the World Health Organization (WHO, 1972-a), the Pan American Health Organization (1971-b), and the National Center for Health Statistics of the United States (Chase, 1967). Chase (1972-a) discussed international comparisons on the basis of completeness and accuracy of vital statistics using the *Demographic Yearbook* as the source of rates (United Nations, 1968). She points to the difficulties in ranking infant mortality because of the differences in registration practices, and at the same time stresses the value of comparisons of infant mortality. On the basis of relatively complete data she limited comparisons to 15 countries: Canada and the United States in the Americas, Japan in Asia, Australia and New Zealand, and 10 European countries. Concerted efforts are needed so that such international comparisons may include many more countries, especially those in the Western Hemisphere.

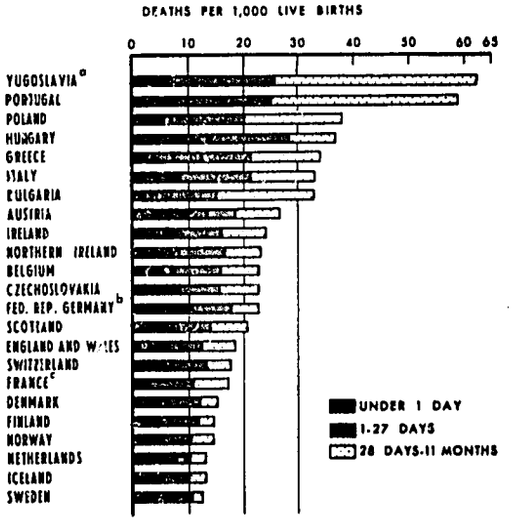
To illustrate the problems and to emphasize the need for comparability, Table 19 and Figure 34 present information for 23 European countries, drawn in part from data in the recent WHO publication *The Prevention of Perinatal Morbidity and Mortality* (WHO, 1972-a) and from the

TABLE 19. Infant Mortality[a] by Age Group in 23 European Countries, 1967.

Country	Infant	Neo-natal	Under 1 day
Yugoslavia[b]	62.1	26.3	6.2
Portugal	59.2	25.2	7.8
Poland	38.1	20.4	6.6
Hungary	37.0	28.6	14.2
Greece	34.3	21.4	4.6
Italy	33.2	21.3	8.3
Bulgaria	33.1	15.0	1.9
Austria	26.4	18.7	10.9
Ireland	24.4	16.0	7.3
Northern Ireland	23.5	16.3	8.0
Belgium	22.9	16.0	7.3
Czechoslovakia	22.9	15.5	8.2
Fed. Rep. Germany	22.9	17.8	10.8
Scotland	21.0	13.8	6.9
England and Wales	18.3	12.5	6.3
Switzerland	17.5	13.5	7.3
France[c]	17.1	10.9	2.0
Denmark	15.8	12.1	5.7
Finland	14.8	11.8	4.8
Norway	14.8	11.1	5.6
Netherlands	13.4	10.4	4.0
Iceland	13.3	9.9	4.3
Sweden	12.9	10.5	4.4

[a] Deaths per 1,000 live births.
[b] By year of registration.
[c] Excluding live born babies dead before registration.
Source: World Health Statistics Annual (WHO, 1970-a).

FIG. 34. Infant Mortality by Age Group in 23 European Countries, 1967.



a Provisional.
b Deaths under 29 days for neonatal period.
c Excluding live-born babies dead before registration.

Annual Vital Statistics of WHO. In Figure 34 the infant death rates for these countries are shaded in the same way as those for the 24 areas of this Investigation shown in Figure 33. Mortality in the first day of life was less than 10 per 1,000 live births in all but three of these countries, and actually was less than 5 in seven of them. Even countries such as Norway and Sweden, with a long history of vital statistics, had rates of only 5.6 and 4.4 per 1,000, and likewise England and Wales had a rate of 6.3. As these figures suggest, it is likely that the WHO definition of a live birth has not been applied consistently throughout these countries. Actually, variations in registration practices are known for several of them (Chase, 1967). Probably the infant death rates in many of these countries would be higher if the WHO definition was followed consistently.

On the other hand, the possibility that some of the deaths in the first day of life are being prevented in highly developed areas deserves consideration also. The frequency of low-birth-weight babies may be less in some of these countries. Explanations of the reasons for the differences should aid in the formulation of preventive programs and the reduction of unnecessary biological wastage.

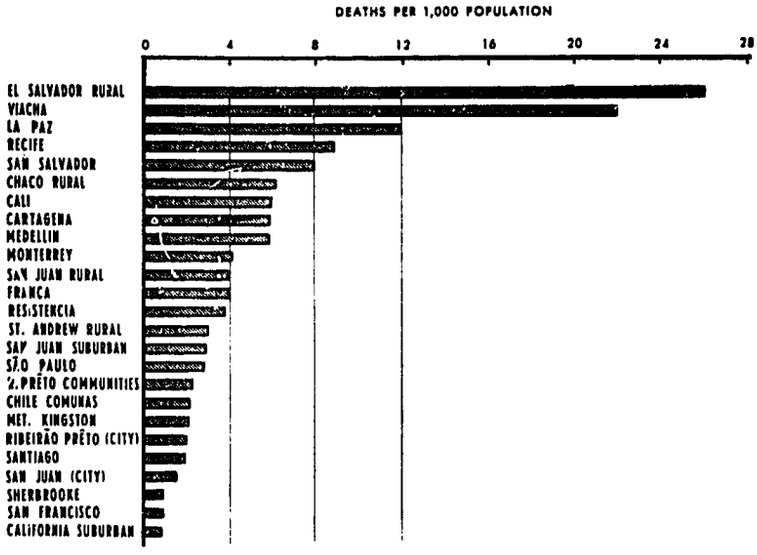
Obviously efforts must be directed to recording the outcome of pregnancies following the accepted definition of WHO. The English (Butler and Bonham, 1963) have studied perinatal mortality by combining late fetal deaths (over 28 weeks of gestation) and deaths in the first week of life, and WHO (1972-b) is planning a study of factors determining perinatal mortality in seven countries, based on official statistics. Although in these studies length of gestation is one of the measures, in most countries of the world this factor is not sufficiently well known and recorded. The distinction between live births and fetal deaths is useful for many purposes, in health as well as social fields. Calculation of life expectancy at birth—a measure of evaluation of progress often used—necessitates knowledge of live births and of deaths of those born alive. Until standard definitions are followed consistently, there will not be comparability in the data on mortality or on life expectancy at birth.

In addition to these advantages of adhering to standard definitions, there are immediate needs in terms of evaluation of the outcome of products of conception. As technology advances, measures to prevent premature deliveries become more effective and the probability of survival and the prognosis for infants born with low weights are improved. While such improvements are being achieved in specialized centers, large areas (states and countries) are undergoing important changes in policies in programs such as those of family planning and legalized abortion. It is evident that accurate and comparable data are essential for measuring the contributions of programs of maternal and child health in reducing morbidity and mortality among infants and young children.

MORTALITY IN EARLY CHILDHOOD

The variations in death rates in early childhood (1-4 years of age) were great in the 25 areas in the Investigation. They ranged from over 20 per 1,000 population in rural El Salvador and Viacha in Bolivia, to as low as 0.8 and 0.7 in Sherbrooke and

FIG. 35. Mortality in Children 1–4 Years of Age in 25 Areas of 15 Projects.



California (Table 15 and Figure 35). The highest rate was 38 times the lowest. The rural areas in El Salvador and Bolivia had rates two to three times larger than those in three cities with the next highest figures (La Paz, Recife, and San Salvador). These rural areas are close to medical centers and thus mortality in the remote rural populations is probably even higher.

In descending order, the rural departments of Chaco Province had the sixth highest death rate (6.3 per 1,000 population), followed by only slightly lower ones in the three cities of Colombia. Ten of the 25 areas had rates within the range of 4.3 (Monterrey) to 2.1 (Metropolitan Kingston). The rates were low in three Latin American cities: 1.9 in Ribeirão Prêto, 1.8 in Santiago, and 1.5 in San Juan.

This great variability in death rates indicates the wide differences in health conditions in urban, suburban, and rural areas and shows also that the rates can be reduced to very low levels.

COMPARISONS WITH OFFICIAL DATA

Several factors affect comparisons of the death rates obtained in the Investigation with those published in official reports of the countries, provinces or departments, or cities. First, the data of the Investigation are based on place of residence of the deceased, both for deaths (the numerator) and for live births (the denominator of infant death rates). Moreover, these data refer to the specific areas described in Chapter I. For cities such as Cali, Cartagena, and Medellín, they include only urban areas of the city. In São Paulo and Santiago as well, they are for specifically defined areas. The

population bases may differ from those used in official reports owing to the availability of census data at the time of publication of the Investigation findings and to the methods employed for estimation of population under 5 years of age. In all projects except that in California, non-registered deaths were included in the data of the Investigation. Thus differences may be observed between the official rates for the areas of projects and those obtained in the Investigation. These differences are determined in part by factors affecting official data, such as deficiencies in registration of births and/or deaths and inclusion of those of non-residents of the areas. Presentation and discussion of the results of the Investigation in relation to official rates seems desirable in order to stimulate action based on these results.

Death rates in infancy and early childhood for 1969 or a recent year for eight countries* in which the projects were carried out are given in the tables of this section, along with the data obtained in the Investigation (the coverages of vital statistics systems in Bolivia and Brazil are not sufficient for presentation of death rates for the entire countries). These eight countries vary widely in the composition of their urban and rural populations, which affects the size of the death rates. Also the coverage and adequacy of the registration systems need to be considered in relation to the Investigation findings. When possible, additional official data for provinces, departments, or states are provided.

Argentina

The death rates for the urban, suburban, and rural departments of the two provinces included in the Investigation are given in Table 20 along with those for the country as a whole The wide variations in San Juan Province are clear, the rates for the rural departments being around twice those in the city of San Juan. In the Chaco project, the rates were high in both urban and rural areas.

For the country as a whole, mortality in children under 5 years and in infants (under 1 year) was lower than for these provinces but higher than that in the city of San Juan. For the age group 1-4 years, the death rate of 3.5 per 1,000 population for Argentina was higher than that for San Juan Province but lower than the rate for Chaco Province. Argentina has a large urban population in Metropolitan Buenos Aires and thus it is expected that the death rates for the country will be lower than those for provinces that have large rural areas.

Improvements in registration of deaths in San Juan Province were made during the period of the Investigation, and these are in part reflected in the increases in the infant

TABLE 20. Death Rates[a] Under 5 Years by Age Group for Areas of Two Provinces of Argentina Included in the Investigation, and for the Country.

Area	Under 5 years	Under 1 year	1–4 years
Investigation			
Chaco Province,			
7 departments	22.1	80.1	4.8
Resistencia	20.7	76.2	3.6
Six rural departments	23.9	85.0	6.3
San Juan Province	20.6	81.3	3.0
San Juan (city)	12.9	50.7	1.5
Suburban departments	21.9	87.9	2.9
Rural departments	24.0	94.5	4.0
Official data, 1968			
Argentina	14.7	57.8	3.5

[a] Deaths under 1 year per 1,000 live births; others per 1,000 population.

* Data provided by the Ministries of Health to the Pan American Health Organization.

death rate per 1,000 live births in the province, as shown below:

1966	63.8
1967	65.4
1968	68.3
1969	69.0
1970	77.9

During the Investigation a manual outlining standards and procedures for the registration system in hospitals in San Juan was issued (1969) by the Director of the Provincial Health Service. Such improvements in registration should be made as soon as possible in areas where the present systems are deficient, in order to provide data that will correctly describe the situation as a basis for planning and serve to measure the real progress made in reducing mortality.

Bolivia

Mortality in the small rural community of Viacha was much higher than in the city of La Paz for children under 5 years of age (Table 21). Since this community is close to La Paz, it is likely that rates in the remote rural areas are much higher. Thus the infant death rate for the country is probably very high. In this project 11.6 per cent of the deaths had not been registered and they were found by reviewing hospital charts and making daily visits to the cemetery. Establishment of a satisfactory registration system in which all certificates are transmitted routinely to a central office is necessary in order to provide the basic data needed for health planning.

There is evidence that birth weights are relatively low, and thus the inclusion in the birth certificates of items covering birth weight as well as mother's age and the infant's birth order would provide data necessary for an analysis of reproduction among populations living in high-altitude areas in this country.

Brazil

Death rates in the five areas of the projects in Brazil varied greatly, from the relatively low figure for the city of Ribeirão Prêto to the high rate in Recife (Table 22). There was marked variation in the four distinctly different areas in São Paulo State, the small interior city of Franca having much higher rates than the city of Ribeirão Prêto.

The infant death rates in the period 1966-1970 for the State of São Paulo as given below showed a decided increase in 1969 and 1970:

1966	75.9
1967	77.5
1968	73.7
1969	84.2
1970	83.6

TABLE 21. Death Rates[a] Under 5 Years by Age Group in the Investigation in Bolivia.

Area	Under 5 years	Under 1 year	1–4 years
La Paz	26.6	73.0	11.9
Viacha	48.1	123.5	21.7

[a] Deaths under 1 year per 1,000 live births; others per 1,000 population.

TABLE 22. Death Rates[a] Under 5 Years by Age Group in Areas of Three Projects of the Investigation in Brazil.

Area	Under 5 years	Under 1 year	1–4 years
Recife	29.3	91.2	9.0
Ribeirão Prêto			
Ribeirão Prêto (city)	10.9	43.0	1.9
Franca	19.4	71.5	4.0
Communities	13.0	50.8	2.4
São Paulo	17.7	65.1	2.8

[a] Deaths under 1 year per 1,000 live births; others per 1,000 population.

These official rates for the state are much higher than those for the project areas, and the difference is probably due in part to high rates in rural areas that were not included in the Investigation. Also deaths of residents of other states may have been included in the official figures. Birth certificates were not found for 9.5 per cent of the deceased infants included in the Investigation in the District of São Paulo (Laurenti *et al.*, 1971) and therefore the denominator of the infant death rates may be too low. The development of birth and death statistics by residence would be very beneficial for purposes of health planning. Steps to ensure registration of all births routinely are also important.

The official birth rate in São Paulo State declined from 33.5 per 1,000 population in 1961 to 26.3 in 1970, a 21-per-cent reduction in 10 years.

Canada

The death rates in the Sherbrooke project (Table 23) were slightly lower than those for Canada as a whole. Since registration of neonatal deaths was found to be incomplete in this project, there may be some deficits in other areas of the country as well. In any event, the death rates in infancy and early childhood are low in Canada.

TABLE 23. Death Rates[a] Under 5 Years by Age Group in the Sherbrooke Project of the Investigation and in Canada.

Area	Under 5 years	Under 1 year	1–4 years
Investigation			
Sherbrooke	4.1	18.3	0.8
Official data, 1969			
Canada	4.4	19.3	0.9

[a] Deaths under 1 year per 1,000 live births; others per 1,000 population.

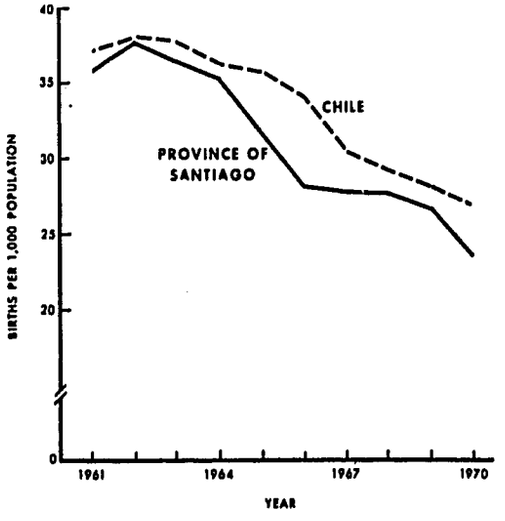
Chile

At the present time when the birth rate in Chile is declining rapidly, analyses of infant mortality are of unusual value. The birth rate for the Province of Santiago (Chile, National Health Service, Zone V, 1970) as well as for the country (Chile, National Health Service, 1971) declined in the 10 years 1961–1970 (Figure 36). The birth rates per 1,000 population were as follows:

	Country	*Province*
1961	37.0	35.6
1962	38.0	37.6
1963	37.7	36.4
1964	36.2	35.2
1965	35.6	31.5
1966	34.0	28.2
1967	30.4	27.8
1968	29.2	27.7
1969	28.1	26.6
1970	26.9	23.5

In this 10-year period the reduction in the birth rate was around 30 per cent both in the country and in Santiago Province (27

FIG. 36. Birth Rates in Province of Santiago and in Chile, 1961–1970.



and 34 per cent, respectively) but the decline started somewhat earlier in the province. Such reductions in natality are due to changes in the fertility rates of women at different ages and in parity, with shifts to younger mothers and to lower birth orders. Such shifts result in lower infant death rates. Infant mortality per 1,000 live births for the country (Chile, National Health Service, 1971) and for the province (Chile, National Health Service, Zone V, 1966-1970) declined from 1966 to 1970 as shown below:

	Country	*Province*
1966	97.7	76.4
1967	94.3	69.8
1968	83.5	56.5
1969	78.7	55.0
1970	79.3	54.1

The death rates under 5 years of age obtained in the Investigation in the city of Santiago and the suburban-rural *comunas* (Table 24) were lower than for the country as a whole. Infant mortality for the city was similar to that given in the official report for the Province of Santiago. However, the rate for the province would be higher if the WHO definition of a live birth was adhered to, as is shown by the fact that 14.3 per cent of the infant deaths included in the Investigation had not been registered.

An intensive search was made for non-registered neonatal deaths in Santiago, and it resulted in the discovery of 344 that were included in the sample of deaths in the Investigation. The excellent work done to ensure completeness of infant mortality data in this project will be the subject of a separate report, which will be published as a guide to procedures for improving registration of deaths in hospitals.

The availability of official information on distribution of live births by age of mother and infants' birth order for Santiago Province made it possible in this project to analyze neonatal and infant mortality in relation to these two factors. The collection and publication of such basic data on births are essential for evaluation of changes in infant mortality in relation to patterns of reproduction, as well as for the study of mortality by causes.

Colombia

The death rates found in the three cities in the Investigation (Table 25) were lower than those for the country as a whole in 1968. Thus it is probable that mortality in infancy and early childhood is much higher in rural areas and contributes

TABLE 24. Death Rates[a] Under 5 Years by Age Group in Two Areas of the Investigation in Chile, and Official Rates for the Province of Santiago and for Chile.

Area	Under 5 years	Under 1 year	1-4 years
Investigation			
Santiago	13.0	54.9	1.8
Comunas	14.0	57.9	2.2
Official data, 1969			
Chile	18.0	78.7	3.3
Province of Santiago	...	55.0	2.3

[a] Deaths under 1 year per 1,000 live births; others per 1,000 population.

TABLE 25. Death Rates[a] Under 5 Years by Age Group in Three Projects of the Investigation in Colombia, and Official Rate for Colombia.

Area	Under 5 years	Under 1 year	1-4 years
Investigation			
Cali	16.1	54.6	5.9
Cartagena	14.6	47.8	5.8
Medellín	14.4	47.6	5.7
Official data, 1968			
Colombia	21.1	75.0	9.7

[a] Deaths under 1 year per 1,000 live births; others per 1,000 population.

heavily to the high death rates for the country.

Problems in relation to registration of deaths were uncovered in the Investigation. In fact, 20.2 per cent of the deaths found in Cartagena had not been registered.

In spite of the recovery of non-registered deaths in the Investigation, the official infant death rates for all three cities in 1967 were higher than those found in the Investigation, as shown below:

	Official 1967	*Investigation*
Cali	71.6	54.6
Cartagena	55.4	47.8
Medellín	63.2	47.6

These differences may be due to a decline in infant mortality, or else the official data may include deaths of non-residents from rural and other areas, and there may be subregistration of births. The three projects in Colombia were restricted to the urban areas of the three cities. Estimates of births (the bases for infant death rates) were necessary since such data were not available by residence.

The underregistration uncovered in these cities indicates the need for improvement of procedures in hospitals as well as in civil registration offices in Colombia.

El Salvador

The infant death rates found in the Investigation in the city of San Salvador and in the rural *municipios* (Table 26) were much higher than the rate for the country. The rate of 120.0 per 1,000 live births for the rural *municipios* was 47 per cent higher than that for San Salvador (81.7), which in turn was 29 per cent higher than the rate for the country in 1969 (63.4). The rural *municipios* (Apopa, Nejapa, and Quezaltepeque) are close to the city of San Salvador and do not represent the rural populations of the country since they have access to the facilities available in the capital city. Therefore, mortality in rural El Salvador may be much higher.

TABLE 26. Death Rates[a] Under 5 Years by Age Group in Two Areas of the Investigation in El Salvador, and Official Rate for El Salvador.

Area	Under 5 years	Under 1 year	1–4 years
Investigation			
San Salvador	26.4	81.7	8.0
Rural *municipios*	50.5	120.0	26.2
Official data, 1969			
El Salvador	24.4	63.4	13.2

[a] Deaths under 1 year per 1,000 live births; others per 1,000 population.

The problem of registration of deaths (especially those in early life) as uncovered in the Investigation probably occurs throughout the country. In the last three years an increase was noted in official infant death rates for El Salvador, as given below, which may be due to improvements in registration:

1968	59.2
1969	63.4
1970	66.6

Nevertheless, infant mortality in the country as a whole must be much higher since San Salvador, the largest city, was found to have a rate of 81.7 per 1,000 live births.

Jamaica

The infant death rate of 38.8 per 1,000 live births in Kingston-St. Andrew obtained in the Investigation was higher than the rate of 34.7 for the country as a whole (Table 27). Since 10.1 per cent of the infant deaths found in the Investigation had not been registered currently, there

TABLE 27. Death Rates[a] Under 5 Years by Age Group in Two Areas of the Investigation in Jamaica, and Official Rate for Jamaica.

Area	Under 5 years	Under 1 year	1-4 years
Investigation			
Kingston-St. Andrew	10.4	38.8	2.2
Metropolitan Kingston	10.5	39.5	2.1
St. Andrew, rural	9.5	31.6	3.1
Official data, 1968			
Jamaica	11.5	34.7	5.4

[a] Deaths under 1 year per 1,000 live births; others per 1,000 population.

TABLE 28. Death Rates[a] Under 5 Years by Age Group in Monterrey in the Investigation, and Official Rates for Monterrey, State of Nuevo León, and Mexico.

Area	Under 5 years	Under 1 year	1-4 years
Investigation			
Monterrey	18.1	60.7	4.3
Official data, 1969			
Monterrey	...	51.7	5.4
Nuevo León	...	50.0	5.1
Mexico	22.0	66.7	9.7

[a] Deaths under 1 year per 1,000 live births; others per 1,000 population.

may be a similar deficit in registration in other parishes. A deficiency in regard to neonatal deaths was noted in rural St. Andrew even though procedures were established whereby deaths were reported currently for investigation by the local staff.

For children 1-4 years of age the rate of 2.2 per 1,000 population in Kingston-St. Andrew was less than half the rate of 5.4 for the country as a whole. This higher rate in early childhood for Jamaica suggests that mortality is greater in the rural areas than in the capital city, and that higher infant mortality would also be found if registration was complete.

Improved procedures such as those made possible in the Investigation in Kingston with the introduction of the WHO definition of a live birth need to be extended to the rest of Jamaica. Also, measures should be established for registration of all deaths on a current basis.

Mexico

The infant death rate of 60.7 per 1,000 live births obtained for Monterrey in the Investigation was higher than the official rate of 51.7 for the same area (Table 28). Among the factors responsible for the higher rate in the Investigation were the inclusion of non-registered deaths in the numerator and the exclusion of non-resident births in the denominator of the infant death rate. It is significant to note that Monterrey's hospitals are used for deliveries by non-residents coming from a large outlying area.

The official rate for Monterrey was lower than the rate for the country as a whole (66.7). No doubt the rural rate is much higher than that for this city, as has been shown for rural areas of El Salvador, Bolivia, and San Juan Province in Argentina.

For children 1-4 years of age, the rate of 4.3 per 1,000 population obtained for Monterrey in the Investigation was less than half the official rate of 9.7 for the whole of Mexico. This difference likewise could be attributed to high death rates in rural areas.

United States, California

The data from the California project were unusually favorable, the infant death rate being slightly lower than that for the United States (Table 29). The suburban counties had an even lower rate (17.2 per 1,000 live births) than that of San Francisco (18.5), which was similar to that for the State of California (18.3).

TABLE 29. Death Rates[a] Under 5 Years by Age Group in Two Areas of the Investigation in California, and Official Rates for California and for the United States.

Area	Under 5 years	Under 1 year	1–4 years
Investigation			
San Francisco	5.4	18.5	0.8
Suburban California	4.1	17.2	0.7
Official data, 1969			
California	...	18.3	0.8
United States	4.9	20.7[b]	0.8

[a] Deaths under 1 year per 1,000 live births; others per 1,000 population.
[b] Provisional.

The final report of the California study (University of California, 1972) provided data by ethnic group that revealed higher death rates in the Negro population than in the white population and the group termed *other*, which includes those of Chinese and Japanese origin (Table 30).

TABLE 30. Infant Death Rates[a] by Ethnic Group in the California Project.

Age group	Total	White	Negro	Other
Total	17.5	15.7	28.8	11.2
Neonatal	12.7	11.6	20.5	3.2
Postneonatal	4.8	4.1	8.2	3.5

[a] Deaths per 1,000 live births.
Source: Final Report of California Study, University of California, 1972.

The California State Health Department provided the distribution of live births by age of mother, birth order, and birth weight, and thus the California project has been especially valuable for the analysis of mortality taking these variables into account.

* * *

These comparisons of the Investigation findings with official data indicate several fields for action:

1. Procedures should be established in local areas for ensuring registration of each birth and each death.

2. For an accurate knowledge of mortality in cities, it is necessary to have data by place of residence, both for deaths and for births, since hospital facilities of cities are used by residents of other urban communities and rural areas.

3. The excessive death rates found in rural areas in the Investigation indicate the need to extend registration systems to cover such areas, or to obtain data by alternative methods such as sampling, in order to make available basic information required for the solution of serious health problems.

Chapter V

Infant Mortality

The dynamic and complex process of growth and development is the outstanding characteristic of the early life of the infant (as it is of the rest of childhood). This process—a continuous one under normal conditions—begins with a state of complete dependency on the mother during intrauterine life and progresses in a complex and sometimes unfavorable environment during and after birth. Countless factors can interfere with the normal evolution of this process and hence with the health of the child.

The interrelationships of factors affecting the mother, the fetus, delivery, and postnatal development constitute an extremely important field for analysis in the study of multiple causes and conditions responsible for morbidity and mortality. For an understanding of these interrelationships and associations, it is necessary to take into account also the chain of events leading to death.

Closely related to these considerations is the evidence that diseases and their effects are not static. The impact that a morbid condition may produce on health depends to a great extent on the state of the host—that is, stage of development, previous illnesses, and existence of concomitant pathological processes. In an age group in which growth and development are biological necessities, recurrent episodes of one or more diseases have *additive* or compounded effects; repetition of an apparently mild process can lead to a critical state of health and even to death. Typical examples are the very common problems of diarrheal diseases and respiratory infections which, through repeated episodes, build susceptibility to a point where one episode that would be trivial for a healthy child becomes fatal. Finally, it is known that morbid conditions may have reciprocal and even synergistic effects, and therefore effective measures directed toward reducing mortality, besides saving lives, undoubtedly have vital roles in improving the future of survivors.

In this chapter, the multiple-cause approach is described first, and data are then presented on mortality for the entire infant period by causes, underlying as well as associated, and on mortality for the neonatal and postneonatal periods. Neonatal mortality is analyzed in further depth in Chapter VI.

MULTIPLE CAUSES OF DEATH

In the Investigation the term "cause" is used to designate whatever disease, syndrome, morbid state, or pathologic condition is involved either directly or indirectly in the process of death.

Taking into account the serious difficul-

ties that could be encountered in making the assignments, it was considered important to establish the interrelationships among the causes found in each death. In this way, knowledge could be obtained of the true associations and of their direct or indirect causal roles. With such knowledge, it is possible to recommend effective action in the health field with emphasis on prevention.

The assignment of causes was based on all the information available for each death. The starting point was selection of the *underlying cause* of death in accordance with the definition* and the rules for selection and modification set forth in the *International Classification of Diseases* (WHO, 1967).

After the underlying cause and the intermediary and terminal diseases or morbid conditions were established, the *contributory causes*† were determined.

In all the analyses in this Investigation the multiple causes of death have been classified in two main groups: underlying and associated. From the definition of the former, it is clear that there are as many underlying causes as there are deaths. The group of associated causes comprises both the contributory and the *consequential* causes, or consequences, the term consequential signifying those morbid conditions that are usually included in the chain triggered by the underlying cause (i.e., the intermediate and terminal conditions).

The rationale of this classification is similar to that of the international form of medical certificate of cause of death, in which the underlying cause and its chain of events are stated in Part I (items a, b, and c) and the contributory conditions in Part II. However, from the study of interrelations of causes in the Investigation, it appears that in reality the intermediate and terminal causes (complications or consequences) are not the result of the underlying cause alone. Instead, it is the *complex of underlying cause-contributory cause* which together give origin to the fatal complications (Serrano, 1969). The implications of this concept are exceedingly important from the preventive viewpoint because measures aimed at preventing the underlying cause are not sufficient if the contributory conditions remain. One example is the common association of nutritional deficiency and infection, which necessitates prevention of both components of the complex, without which the phenomenon of "substitution" may come into play—that is, a death prevented by suppressing one underlying cause (usually an infection) may later occur as the result of another underlying cause (another infection) if the contributory condition (nutritional deficiency) remains. In this and other chapters that follow more evidence is brought forth to elucidate the synergistic effects between nutritional deficiency and infection (Scrimshaw *et al.*, 1968), and certain other important associations are discussed.

The neonatal age group is one in which associations and interrelationships of causes of death are of great importance. Deaths during this period may be the result of prenatal factors (maternal or fetal), conditions present during birth, postnatal conditions, or combinations of any of these. Among the prenatal maternal factors, some are related to pregnancy itself and some to other conditions. These other conditions in the mother, however, may be intimately

* *Underlying cause* is "the disease or injury which initiated the train of morbid events leading directly to death."

† *Contributory cause* is "any other significant condition which unfavorably influenced the course of the morbid process and thus contributed to the fatal outcome, but which was not related to the disease or condition directly causing death."

connected with an obstetric or prenatal condition. The diabetic mother, for example, could after difficult labor give birth to an abnormally large baby susceptible to hypoglycemia and respiratory distress.

The following example taken from the Investigation illustrates the complexity of multiple causes of death in this age group. A child who died at 3 days of age was a product of a seven-month pregnancy and born to a preeclamptic mother who had a partial separation of placenta prior to delivery. At birth, the infant's weight was 1,030 grams and its condition fair. The clinical course was characterized by progresssive respiratory distress and death occurred on the third day after an episode of bleeding from the respiratory and digestive systems.

The multiple causes assigned were:

Preeclampsia of pregnancy	762.1	Underlying cause
Premature separation of placenta	770.1	Consequences
Immaturity	777	Consequences
Respiratory distress syndrome	776.2	Consequences
Hemorrhagic disease of the newborn (terminal)	778.2	Consequences

At the time of death neither the maternal nor the placental conditions were acting upon this child. The immaturity or prematurity was a consequence of the preeclampsia and its complication (premature separation of placenta) and at the same time was an important factor in the development of the respiratory distress and hemorrhagic condition. The only cause mentioned in the medical certificate of cause of death was prematurity, yet all the necessary information related to the underlying cause and its consequences was available in the hospital record. The sequence element is very important to an understanding of the cause-effect relationship within the multiple-cause constellation in this age period, and it is essential that the maternal, fetal, obstetric, and postnatal factors be taken into account in order to provide adequate medical care.

Undoubtedly, official mortality statistics would improve greatly if all the diagnoses stated in the death certificate were used in the analyses of causes of death. A consultant group convened by the World Health Organization in October 1969 formulated similar recommendations in regard to analyses and basic tabulations of multiple causes of mortality using death certificates as source of data (WHO, 1969).

An even greater benefit would be obtained if selected centers, at least, could routinely collect information complementary to the medical certificate of death, using data from clinical histories and autopsies (Puffer, 1970). All actions aimed at improving the quality of clinical histories, autopsies, and death certificates will contribute toward improvement of the information needed for a successful study of multiple causes of mortality.

Only through the multiple-cause approach is it possible to measure the real magnitude of serious health problems that have remained occult because studies were based only on single causes. The method used in this Investigation involves a sequential or chronological interrelationship, which is at times difficult to establish. Nevertheless, the effort made is recommended for other community-centered investigations since it provides an excellent epidemiologic experience with aspects that

escape single-cause analysis. The knowledge so derived, complemented by the study of other various factors involved in mortality, should serve as a basis for health planning and teaching with an integrated multidisciplinary focus.

MORTALITY BY AGE GROUP

The infant is at greatest risk of death in the first few hours and days of life, and mortality declines rapidly from high rates in the first day to the lowest ones later in childhood. Of the 35,095 deaths under 5 years of age subjected to thorough study of multiple causes and related factors, 27,602 or nearly four-fifths (78.6 per cent) were of infants. The infant period is divided into neonatal (0–27 days of age) and postneonatal (28 days through 11 months). More than a third of the deaths of children under 5 years were neonatal deaths (12,674, or 36.1 per cent).

In several areas deaths under 5 years were heavily concentrated in the neonatal period, accounting for more than 60 per cent in three areas in Canada and California:

	Per cent
California, suburban counties	63.7
San Francisco	62.8
Sherbrooke	61.7

At the other extreme, the following four areas had very low percentages in the neonatal period:

	Per cent
San Salvador	26.4
Viacha	26.1
La Paz	25.5
El Salvador, rural	18.0

This great variation in distributions of deaths by age, as well as by causes, indicates the complexity of the process of analyzing and interpreting data on infant mortality from areas with such widely divergent health problems.

The infant death rates for 24 areas (Table 31) varied widely, from less than 20 per 1,000 live births in three areas to 120 or more in two rural areas (the highest being 7.2 times the lowest). The variation

TABLE 31. Death Rates[a] in Infancy, Neonatal, and Postneonatal Periods in 24 Areas of 15 Projects.

Project and area	Under 1 year	Neonatal	Postneonatal
ARGENTINA			
Chaco Province			
Resistencia	76.2	33.4	42.9
Rural departments	85.0	30.9	54.1
San Juan Province			
San Juan (city)	50.7	20.6	21.1
Suburban departments	87.9	44.6	43.3
Rural departments	94.5	39.6	54.9
BOLIVIA			
La Paz	73.0	28.5	44.5
Viacha	123.5	49.4	74.1
BRAZIL			
Recife	91.2	35.3	55.9
Ribeirão Prêto			
Ribeirão Prêto (city)	43.0	24.0	19.0
Franca	71.5	36.9	34.6
Communities	50.8	27.1	23.7
São Paulo	65.1	33.7	31.5
CANADA			
Sherbrooke	18.3	13.5	4.8
CHILE			
Santiago	54.9	27.2	27.7
Comunas	57.9	19.4	38.5
COLOMBIA			
Cali	54.6	25.4	29.2
Cartagena	47.8	22.4	25.4
Medellín	47.6	19.7	27.9
EL SALVADOR			
San Salvador	81.7	28.2	53.6
Rural *municipios*	120.0	36.1	83.9
JAMAICA			
Kingston-St. Andrew	38.8	24.2	14.6
MEXICO			
Monterrey	60.7	26.0	34.8
UNITED STATES			
San Francisco	18.5	13.0	5.5
California, suburban	17.2	12.7	4.5

[a] Per 1,000 live births.

was less for neonatal mortality, with ranges from 12.7 to 49.4 per 1,000 live births, but much greater for postneonatal mortality, from 4.5 to 83.9 per 1,000.

Study of the infant deaths by age and by causes reveals a wide diversity in patterns. Each of the 24 areas appears to have distinct differences from the others, though there are similarities as well. The various patterns can be viewed critically in terms of the possibilities of reducing mortality by means of preventive programs.

UNDERLYING AND ASSOCIATED CAUSES

Underlying and associated causes of infant mortality for important groups of causes are given for 24 areas* in Table 32. Five groups of causes for these same areas are shown in Figure 37, in descending order of the infant death rates from all causes.

The broad group of certain causes of perinatal mortality (categories 760-778 of the *International Classification of Diseases*) is of particular importance during the neonatal period and includes conditions originating prior to or during pregnancy in the mother or during delivery or soon after. This group was responsible for from 9.0 to 34.1 deaths per 1,000 live births as underlying causes in Sherbrooke, Canada, and in Viacha, Bolivia, respectively. The rates for the same group as associated causes varied from 16.4 in rural Chaco to 60.6 in the suburban departments of San Juan Province. The role of immaturity (category 777) as an underlying cause is relatively insignificant because the rules for classification specify that it is not to be used if any other cause of perinatal mortality is reported. However, the contribution of this condition to mortality as an associated cause is apparent, as can be seen in Figure 37 and in Table 32, the range being from 9.3 per 1,000 live births (Sherbrooke) to 29.4 (San Juan suburban). Fourteen of the 24 areas had death rates of 15.0 or higher from immaturity as an associated cause. Only in the projects in Canada and California were the rates less than 10 per 1,000 live births. The role of immaturity as an important contributor to mortality is thus being clarified in this report.

Mortality is given also for six other groups of perinatal causes. Since nearly all deaths from these causes occur in the neonatal period, mortality for each of these groups is analyzed in depth in Chapter VI (Neonatal Mortality).

The broad group of infective and parasitic diseases (000-136) is essentially constituted by infectious diseases. Their role as underlying causes varied widely; they produced more than half of all infant deaths in both areas of the El Salvador project and only 4 out of 310 in Sherbrooke, that is 0.2 deaths per 1,000 live births. In all the Latin American projects the death rates from infectious diseases were lower as associated than as underlying causes. However, many infectious diseases were found to be associated causes—some to other infectious diseases and others to noninfectious underlying causes. Utilization of the multiple-cause approach thus provides knowledge of the contribution of these diseases as associated as well as underlying causes of death.

* Rural St. Andrew is included with Metropolitan Kingston in the Kingston-St. Andrew project.

Table 32. Underlying and Associated Causes of Infant Deaths[a] in 24 Areas of 15 Projects.

Cause	UNDERLYING No.	UNDERLYING Rate	ASSOCIATED No.	ASSOCIATED Rate	UNDERLYING No.	UNDERLYING Rate	ASSOCIATED No.	ASSOCIATED Rate	UNDERLYING No.	UNDERLYING Rate	ASSOCIATED No.	ASSOCIATED Rate
	ARGENTINA, Chaco Province								ARGENTINA San Juan (city)			
	Resistencia				Rural departments							
All causes	747	76.2	968	98.8	663	85.0	650	83.3	295	50.7	587	100.9
Infectious diseases 000-136	296	30.2	97	9.9	302	38.7	59	7.6	81	13.9	80	13.7
Nutritional deficiency 260-269	20	2.0	250	25.5	10	1.3	205	26.3	4	0.7	51	8.8
Diseases of nervous system 310-389	13	1.3	21	2.1	23	2.9	25	3.2	11	1.9	8	1.4
Diseases of respiratory system 460-519	104	10.6	134	13.7	133	17.1	95	12.2	43	7.4	69	11.9
Congenital anomalies 740-759	35	3.6	14	1.4	11	1.4	5	0.6	18	3.1	8	1.4
Certain perinatal causes 760-778	236	24.1	257	26.2	135	17.3	128	16.4	123	21.1	230	39.5
Maternal conditions 760-763	16	1.6	1	0.1	9	1.2	1	0.1	13	2.2	4	0.7
Difficult labor, birth injury 764-768, 772	56	5.7	18	1.8	26	3.3	3	0.4	43	7.4	15	2.6
Conditions of placenta and cord 770, 771	17	1.7	3	0.3	7	0.9	2	0.3	12	2.1	12	2.1
Hemolytic disease 774, 775	8	0.8	—	—	4	0.5	—	—	5	0.9	1	0.2
Anoxic, hypoxic conditions 776	56	5.7	51	5.2	29	3.7	26	3.3	19	3.3	47	8.1
Immaturity 777	22	2.2	169	17.2	29	3.7	85	10.9	4	0.7	104	17.9
Other 769, 778	61	6.2	15	1.5	31	4.0	11	1.4	27	4.6	47	8.1
Other causes Remainder	43	4.4	195	19.9	49	6.3	133	17.1	15	2.6	141	24.2
	ARGENTINA, San Juan Province								BOLIVIA La Paz			
	Suburban departments				Rural departments							
All causes	696	87.9	1,468	185.4	909	94.5	1,730	179.8	2,685	73.0	2,841	77.3
Infectious diseases 000-136	220	27.8	207	26.1	334	34.7	241	25.1	835	22.7	239	6.5
Nutritional deficiency 260-269	22	2.8	165	20.8	29	3.0	240	24.9	36	1.0	710	19.3
Diseases of nervous system 310-389	15	1.9	36	4.5	25	2.6	43	4.5	22	0.6	28	0.8
Diseases of respiratory system 460-519	137	17.3	198	25.0	214	22.2	259	26.9	996	27.1	600	16.3
Congenital anomalies 740-759	37	4.7	37	4.7	31	3.2	14	1.5	47	1.3	26	0.7
Certain perinatal causes 760-778	229	28.9	480	60.6	239	24.8	462	48.0	548	14.9	710	19.3
Maternal conditions 760-763	12	1.5	11	1.4	15	1.6	13	1.4	53	1.4	11	0.3
Difficult labor, birth injury 764-768, 772	50	6.3	46	5.8	69	7.2	30	3.1	129	3.5	31	0.8
Conditions of placenta and cord 770, 771	16	2.0	13	1.6	22	2.3	11	1.1	42	1.1	26	0.7
Hemolytic disease 774, 775	10	1.3	—	—	8	0.8	2	0.2	6	0.2	1	0.0
Anoxic, hypoxic conditions 776	59	7.4	84	10.6	53	5.5	78	8.1	158	4.3	121	3.3
Immaturity 777	4	0.5	233	29.4	8	0.8	241	25.1	43	1.2	432	11.8
Other 769, 778	78	9.8	93	11.7	64	6.7	87	9.0	117	3.2	88	2.4
Other causes Remainder	36	4.5	345	43.6	37	3.8	471	49.0	201	5.5	528	14.4
	BOLIVIA Viacha				BRAZIL Recife				BRAZIL Ribeirão Prêto (city)			
All causes	105	123.5	82	96.5	2,773	91.2	5,084	167.2	400	43.0	773	83.0
Infectious diseases 000-136	32	37.6	10	11.8	1,411	46.4	711	23.4	138	14.8	49	5.3
Nutritional deficiency 260-269	—	—	25	29.4	47	1.5	1,033	34.0	2	0.2	114	12.2
Diseases of nervous system 310-389	2	2.4	—	—	44	1.4	107	3.5	13	1.4	23	2.5
Diseases of respiratory system 460-519	39	45.9	18	21.2	316	10.4	901	29.6	35	3.8	121	13.0
Congenital anomalies 740-759	—	—	—	—	111	3.7	81	2.7	38	4.1	24	2.6
Certain perinatal causes 760-778	29	34.1	24	28.2	725	23.8	1,095	36.0	159	17.1	274	29.4
Maternal conditions 760-763	3	3.5	—	—	28	0.9	13	0.4	9	1.0	2	0.2
Difficult labor, birth injury 764-768, 772	4	4.7	1	1.2	136	4.5	44	1.4	27	2.9	9	1.0
Conditions of placenta and cord 770, 771	—	—	—	—	58	1.9	20	0.7	14	1.5	6	0.6
Hemolytic disease 774, 775	1	1.2	—	—	10	0.3	—	—	1	0.1	—	—
Anoxic, hypoxic conditions 776	15	17.6	6	7.1	260	8.6	188	6.2	58	6.2	61	6.6
Immaturity 777	1	1.2	16	18.8	59	1.9	675	22.2	1	0.1	163	17.5
Other 769, 778	5	5.9	1	1.2	174	5.7	155	5.1	49	5.3	33	3.5
Other causes Remainder	3	3.5	5	5.9	119	3.9	1,156	38.0	15	1.6	168	18.0
	BRAZIL, Ribeirão Prêto								BRAZIL São Paulo			
	Franca				Communities							
All causes	364	71.5	625	122.8	195	50.8	328	85.4	3,788	65.1	7,651	131.6
Infectious diseases 000-136	144	28.3	36	7.1	68	17.7	21	5.5	1,411	24.3	1,067	18.3
Nutritional deficiency 260-269	9	1.8	110	21.6	—	—	64	16.7	61	1.0	1,001	17.2
Diseases of nervous system 310-389	9	1.8	6	1.2	5	1.3	9	2.3	177	3.0	195	3.4
Diseases of respiratory system 460-519	40	7.9	68	13.4	23	6.0	39	10.2	604	10.4	1,045	18.0
Congenital anomalies 740-759	20	3.9	15	2.9	10	2.6	6	1.6	213	3.7	144	2.5
Certain perinatal causes 760-778	122	24.0	205	40.3	85	22.1	108	28.1	1,148	19.7	2,205	37.9
Maternal conditions 760-763	6	1.2	2	0.4	5	1.3	3	0.8	107	1.8	61	1.0
Difficult labor, birth injury 764-768, 772	27	5.3	8	1.6	8	2.1	4	1.0	222	3.8	109	1.9
Conditions of placenta and cord 770, 771	9	1.8	1	0.2	2	0.5	—	—	98	1.7	27	0.5
Hemolytic disease 774, 775	2	0.4	—	—	1	0.3	—	—	26	0.4	15	0.3
Anoxic, hypoxic conditions 776	60	11.8	49	9.6	47	12.2	24	6.2	364	6.3	388	6.7
Immaturity 777	3	0.6	117	23.0	1	0.3	64	16.7	46	0.8	1,178	20.3
Other 769, 778	15	2.9	28	5.5	21	5.5	13	3.4	285	4.9	427	7.3
Other causes Remainder	20	3.9	185	36.3	4	1.0	81	21.1	174	3.0	1,994	34.3

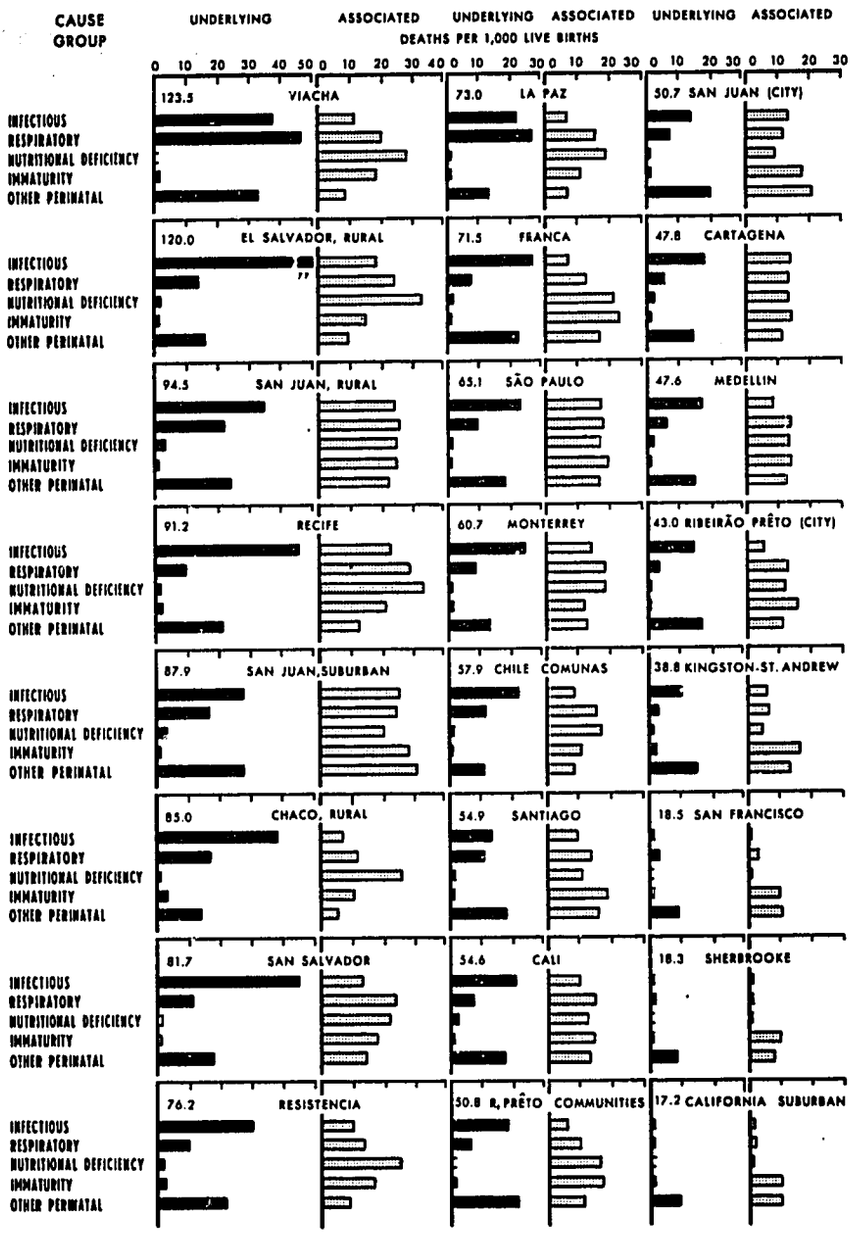
[a] With rates per 1,000 live births.

TABLE 32. Underlying and Associated Causes of Infant Deaths[a] in 24 Areas of 15 Projects (*cont.*).

Cause	UNDERLYING No.	UNDERLYING Rate	ASSOCIATED No.	ASSOCIATED Rate	UNDERLYING No.	UNDERLYING Rate	ASSOCIATED No.	ASSOCIATED Rate	UNDERLYING No.	UNDERLYING Rate	ASSOCIATED No.	ASSOCIATED Rate
	CANADA Sherbrooke				CHILE Santiago				CHILE Comunas			
All causes	310	18.3	446	26.3	2,207	54.9	3,635	90.5	197	57.9	303	89.1
Infectious diseases 000-136	4	0.2	8	0.5	577	14.4	405	10.1	77	22.6	32	9.4
Nutritional deficiency 260-269	—	—	6	0.4	36	0.9	458	11.4	4	1.2	62	18.2
Diseases of nervous system 310-389	1	0.1	10	0.6	73	1.8	92	2.3	11	3.2	11	3.2
Diseases of respiratory system 460-519	27	1.6	25	1.5	453	11.3	557	13.9	41	12.1	53	15.6
Congenital anomalies 740-759	98	5.8	81	4.8	155	3.9	111	2.8	13	3.8	11	3.2
Certain perinatal causes 760-778	152	9.0	283	16.7	781	19.4	1,408	35.0	39	11.5	69	20.3
Maternal conditions 760-763	20	1.2	8	0.5	85	2.1	85	2.1	3	0.9	5	1.5
Difficult labor, birth injury 764-768, 772	18	1.1	17	1.0	128	3.2	104	2.6	5	1.5	4	1.2
Conditions of placenta and cord 770, 771	20	1.2	8	0.5	80	2.0	20	0.5	4	1.2	2	0.6
Hemolytic disease 774, 775	13	0.8	1	0.1	40	1.0	12	0.3	4	1.2	2	0.6
Anoxic, hypoxic conditions 776	26	1.5	58	3.4	181	4.5	259	6.4	12	3.5	12	3.5
Immaturity 777	9	0.5	158	9.3	30	0.7	762	19.0	1	0.3	39	11.5
Other 769, 778	46	2.7	33	1.9	237	5.9	166	4.1	10	2.9	5	1.5
Other causes Remainder	28	1.6	33	1.9	132	3.3	604	15.0	12	3.5	65	19.1
	COLOMBIA Cali				COLOMBIA Cartagena				COLOMBIA Medellín			
All causes	1,153	54.6	1,723	81.7	856	47.8	1,587	88.7	924	47.6	1,621	83.6
Infectious diseases 000-136	440	20.9	206	9.8	326	18.2	244	13.6	344	17.7	171	8.8
Nutritional deficiency 260-269	44	2.1	262	12.4	40	2.2	238	13.3	23	1.2	285	14.7
Diseases of nervous system 310-389	26	1.2	28	1.3	18	1.0	36	2.0	25	1.3	29	1.5
Diseases of respiratory system 460-519	161	7.6	290	13.7	82	4.6	231	12.9	123	6.3	281	14.5
Congenital anomalies 740-759	56	2.7	52	2.5	57	3.2	54	3.0	69	3.6	49	2.5
Certain perinatal causes 760-778	377	17.9	578	27.4	281	15.7	435	24.3	294	15.2	516	26.6
Maternal conditions 760-763	51	2.4	12	0.6	33	1.8	11	0.6	38	2.0	28	1.4
Difficult labor, birth injury 764-768, 772	66	3.1	46	2.2	59	3.3	23	1.3	58	3.0	57	2.9
Conditions of placenta and cord 770, 771	33	1.6	9	0.4	40	2.2	6	0.3	38	2.0	4	0.2
Hemolytic disease 774, 775	11	0.5	1	0.0	7	0.4	—	—	9	0.5	—	—
Anoxic, hypoxic conditions 776	117	5.5	144	6.8	56	3.1	107	6.0	63	3.2	112	5.8
Immaturity 777	19	0.9	302	14.3	13	0.7	241	13.5	4	0.2	261	13.5
Other 769, 778	80	3.8	64	3.0	73	4.1	47	2.6	84	4.3	54	2.8
Other causes Remainder	49	2.3	307	14.5	52	2.9	349	19.5	46	2.4	290	14.9
	EL SALVADOR San Salvador				EL SALVADOR Rural municipios				JAMAICA Kingston-St. Andrew			
All causes	2,094	81.7	3,658	142.8	648	120.0	942	174.4	1,589	38.8	2,510	61.3
Infectious diseases 000-136	1,148	44.8	335	13.1	416	77.0	104	19.3	452	11.0	239	5.8
Nutritional deficiency 260-269	29	1.1	568	22.2	13	2.4	185	34.3	37	0.9	206	5.0
Diseases of nervous system 310-389	20	0.8	48	1.9	5	0.9	14	2.6	29	0.7	54	1.3
Diseases of respiratory system 460-519	283	11.0	603	23.5	78	14.4	135	25.0	118	2.9	269	6.6
Congenital anomalies 740-759	92	3.6	62	2.4	24	4.4	18	3.3	130	3.2	112	2.7
Certain perinatal causes 760-778	446	17.4	824	32.2	94	17.4	139	25.7	714	17.4	1,225	29.9
Maternal conditions 760-763	68	2.7	32	1.2	16	3.0	2	0.4	111	2.7	41	1.0
Difficult labor, birth injury 764-768, 772	116	4.5	71	2.8	19	3.5	3	0.6	87	2.1	68	1.7
Conditions of placenta and cord 770, 771	34	1.3	20	0.8	9	1.7	1	0.2	30	0.7	13	0.3
Hemolytic disease 774, 775	11	0.4	4	0.2	—	—	1	0.2	16	0.4	2	0.0
Anoxic, hypoxic conditions 776	94	3.7	130	5.1	24	4.4	31	5.7	184	4.5	235	5.7
Immaturity 777	6	0.2	463	18.1	5	0.9	81	15.0	63	1.5	692	16.9
Other 769, 778	117	4.6	104	4.1	21	3.9	20	3.7	223	5.4	174	4.2
Other causes Remainder	76	3.0	1,218	47.5	18	3.3	347	64.3	109	2.7	405	9.9
	MEXICO Monterrey				UNITED STATES San Francisco				UNITED STATES California, suburban			
All causes	3,220	60.7	5,859	110.5	209	18.5	356	31.5	575	17.2	997	29.8
Infectious diseases 000-136	1,364	25.7	770	14.5	16	1.4	13	1.1	27	0.8	36	1.1
Nutritional deficiency 260-269	44	0.8	959	18.1	—	—	7	0.6	—	—	14	0.4
Diseases of nervous system 310-389	74	1.4	165	3.1	7	0.6	6	0.5	8	0.2	16	0.5
Diseases of respiratory system 460-519	523	9.9	985	18.6	33	2.9	24	2.1	44	1.3	60	1.8
Congenital anomalies 740-759	227	4.3	126	2.4	32	2.8	57	5.0	115	3.4	158	4.7
Certain perinatal causes 760-778	812	15.3	1,390	26.2	106	9.4	231	20.4	321	9.6	653	19.5
Maternal conditions 760-763	81	1.5	59	1.1	13	1.1	9	0.8	39	1.2	19	0.6
Difficult labor, birth injury 764-768, 772	169	3.2	98	1.8	11	1.0	18	1.6	31	0.9	54	1.6
Conditions of placenta and cord 770, 771	116	2.2	41	0.8	24	2.1	4	0.4	79	2.4	16	0.5
Hemolytic disease 774, 775	21	0.4	4	0.1	2	0.2	—	—	3	0.1	4	0.1
Anoxic, hypoxic conditions 776	141	2.7	342	6.5	24	2.1	57	5.0	49	1.5	160	4.8
Immaturity 777	62	1.2	663	12.5	3	0.3	112	9.9	16	0.5	322	9.6
Other 769, 778	222	4.2	183	3.5	29	2.6	31	2.7	104	3.1	78	2.3
Other causes Remainder	176	3.3	1,464	27.6	15	1.3	18	1.6	60	1.8	60	1.8

[a] With rates per 1,000 live births.

FIG. 37. Broad Groups of Underlying and Associated Causes of Infant Mortality[a] in 24 Areas of 15 Projects.



[a]The infant death rate is given in the left corner for each area.

Diseases of the respiratory system (460-519)—which include those of the upper respiratory tract, influenza, bronchitis, bronchopneumonia, pneumonia, and other conditions—were underlying causes of 45.9 infant deaths per 1,000 live births in Viacha, 27.1 per 1,000 in La Paz, and 22.2 in the rural departments of San Juan Province. With the exception of the rural departments of Chaco Province and both areas in the Bolivia project, all the Latin American areas had higher death rates from respiratory diseases as associated causes than as underlying causes. In Sherbrooke and San Francisco the rates for these diseases as underlying and as associated causes differed only slightly; the rates were low (below 3 per 1,000 live births) for both types of causes in these two areas as well as in the suburban California counties.

Congenital anomalies (740-759) were underlying causes of a high proportion of infant deaths in Sherbrooke—98 deaths, or 31.6 per cent. The rate of 5.8 per 1,000 live births was higher than in the other projects. However, relatively high rates were noted in the suburban departments of San Juan (4.7), in the rural *municipios* of El Salvador (4.4), and in Monterrey (4.3). In three areas (Sherbrooke, rural *municipios* of El Salvador, and Monterrey) the death rates were high from congenital anomalies of the central nervous system. In the California project more anomalies were reported as associated causes than as underlying causes, several anomalies having been diagnosed in the same infant. In all other projects the reverse was usually noted, with higher rates as underlying causes. Mortality from specific types of congenital anomalies is discussed in Chapter X.

Nutritional deficiency (260-269), which includes the various forms of protein-calorie malnutrition, constitutes another important group of causes. The role of nutritional deficiency and immaturity in mortality has in the past been masked by adherence to the principle of underlying cause, both conditions usually being assigned as associated causes. As is illustrated in Figure 37, these two conditions have high death rates as associated causes in many of the Latin American projects, especially in those with high infant death rates.

ROLE OF IMMATURITY AND NUTRITIONAL DEFICIENCY

Immaturity and nutritional deficiency constitute deficits in growth and development during intrauterine and early life. The data on these causes have been processed so as to make only one assignment for each, immaturity (777) or nutritional deficiency (260-269). It is thus possible to obtain the number of infant deaths in which one of these causes is present (Table 33).

As was revealed by the data in Chapter III, the frequency of deaths of neonates with low birth weights (2,500 grams or less) was relatively high in many of the projects. Of the 24 areas, there were six in which immaturity was reported as underlying or associated cause for at least 20 deaths per 1,000 live births in infancy; in contrast, the two areas in California had rates of only 10.1 and 10.2.

Low-birth-weight infants surviving the first month of life often develop a superimposed nutritional deficiency state. Likewise, nutritional deficiency develops in many infants weighing 2,501 grams or more as a result of repeated attacks of diarrheal disease or other morbid conditions, usually associated with inadequate intake of proteins and calories. In the Latin American

TABLE 33. Immaturity and Nutritional Deficiency as Underlying or Associated Cause of Infant Deaths[a] in 24 Areas of 15 Projects.

Project and area	Total infant deaths		Underlying or associated cause					
			Immaturity or nutritional deficiency		Immaturity		Nutritional deficiency	
	No.	Rate	No.	Rate	No.	Rate	No.	Rate
ARGENTINA								
Chaco Province								
Resistencia	747	76.2	461	47.0	191	19.5	270	27.6
Rural departments	663	85.0	329	42.2	114	14.6	215	27.6
San Juan Province								
San Juan (city)	295	50.7	163	28.0	108	18.6	55	9.5
Suburban departments	696	87.9	424	53.5	237	29.9	187	23.6
Rural departments	909	94.5	518	53.8	249	25.9	269	28.0
BOLIVIA								
La Paz	2,685	73.0	1,221	33.2	475	12.9	746	20.3
Viacha	105	123.5	42	49.4	17	20.0	25	29.4
BRAZIL								
Recife	2,773	91.2	1,814	59.7	734	24.1	1,080	35.5
Ribeirão Prêto								
Ribeirão Prêto (city)	400	43.0	280	30.1	164	17.6	116	12.5
Franca	364	71.5	239	47.0	120	23.6	119	23.4
Communities	195	50.8	129	33.6	65	16.9	64	16.7
São Paulo	3,788	65.1	2,286	39.3	1,224	21.0	1,062	18.3
CANADA								
Sherbrooke	310	18.3	173	10.2	167	9.8	6	0.4
CHILE								
Santiago	2,207	54.9	1,286	32.0	792	19.7	494	12.3
Comunas	197	57.9	106	31.2	40	11.8	66	19.4
COLOMBIA								
Cali	1,153	54.6	627	29.7	321	15.2	306	14.5
Cartagena	856	47.8	532	29.7	254	14.2	278	15.5
Medellín	924	47.6	573	29.5	265	13.7	308	15.9
EL SALVADOR								
San Salvador	2,094	81.7	1,066	41.6	469	18.3	597	23.3
Rural *municipios*	648	120.0	284	52.6	86	15.9	198	36.7
JAMAICA								
Kingston-St. Andrew	1,589	38.8	998	24.4	755	18.4	243	5.9
MEXICO								
Monterrey	3,220	60.7	1,728	32.6	725	13.7	1,003	18.9
UNITED STATES								
San Francisco	209	18.5	122	10.8	115	10.2	7	0.6
California, suburban	575	17.2	352	10.5	338	10.1	14	0.4

[a] With rates per 1,000 live births.

areas the infant deaths with nutritional deficiency as an underlying or associated cause varied from 5.9 per 1,000 live births in Kingston-St. Andrew to high rates of 35.5 in Recife and 36.7 in the rural *municipios* of El Salvador.

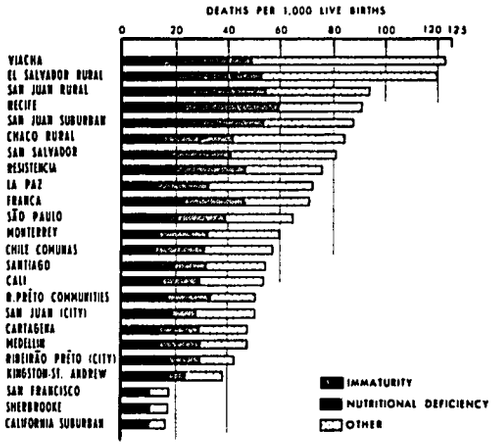
If the deaths from these two causes are combined (immaturity and nutritional deficiency) it can be seen that relatively high proportions of infant deaths have this important evidence of insufficient growth and development. In fact, in nine areas the number of infant deaths with these conditions as a cause was at least 40 per 1,000 live births. In Recife the rate was exceedingly high—59.7 per 1,000. These high rates point clearly to the need for preventive measures to combat these serious conditions.

In the three areas in Northern America, immaturity was stated for more than half the infant deaths: 53.9 per cent in Sherbrooke, 55.0 per cent in San Francisco, and 58.8 per cent in the California counties. Deaths in which nutritional deficiency was reported were rare in these three places.

Differences in the size of these problems in urban and rural areas were evident in two projects with relatively complete data, namely, San Juan Province and El Salvador. In San Juan the rates of 53.8 and 53.5 for the two causes combined in the rural and suburban departments were 1.9 times the rate in the city of San Juan (28.0). In El Salvador the rate for the rural *municipios* (52.6) was higher than that in the city of San Salvador, which was also high (41.6). These are clear indications that probably many rural areas have more serious problems in these fields than do the cities in the same countries.

Figure 38 shows the marked variation in infant death rates in which immaturity and nutritional deficiency were causes. Infants with such evidence of deficiency are highly susceptible to infectious diseases. It is thus evident that action to improve the nutritional status of infants must include prevention of low birth weight as well as measures to ensure satisfactory growth after birth. In other words, prevention at the primary level should be emphasized by concentrating efforts on adequate care of women at risk of giving birth to a low-weight product. Measures oriented only to intensive care of low-birth-weight babies, though important, should not receive the highest priority. Likewise, the infant at high risk of becoming malnourished is the one that should receive attention.

FIG. 38. Immaturity and Nutritional Deficiency as Underlying or Associated Cause in Infant Mortality in 24 Areas of 15 Projects.

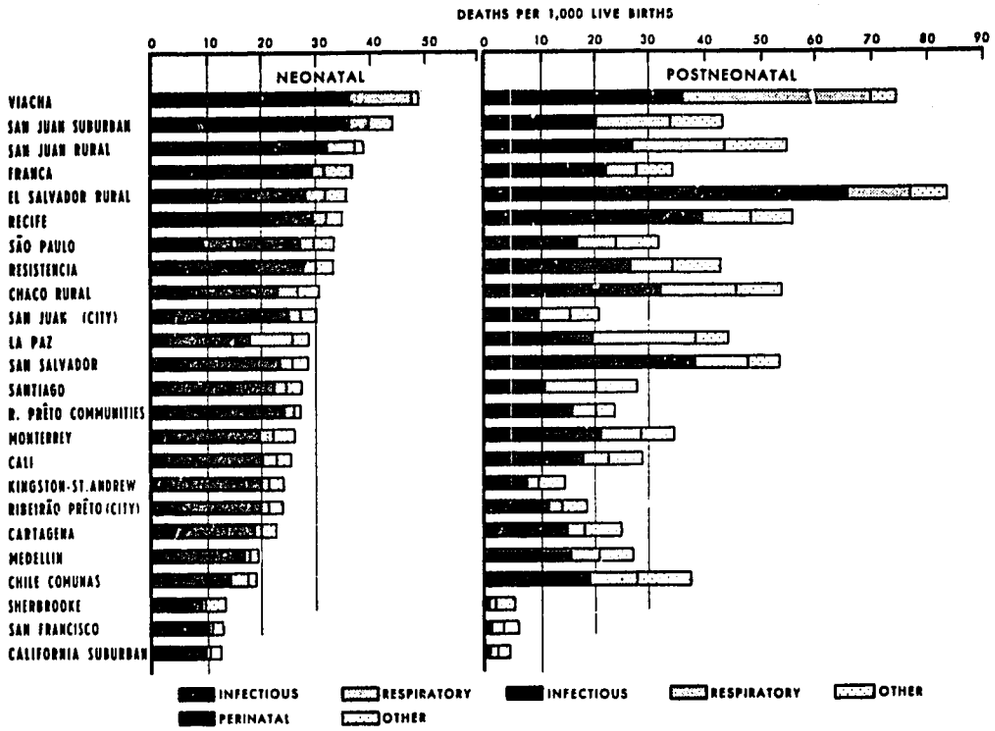


Several areas that had high death rates with immaturity as a cause also had high rates for nutritional deficiency, as can be seen in Figure 38. Birth weights were not available for infants born at home (as was pointed out in Chapter III), but in spite of the marked variations in the material available from such widely separated areas, there appears to be some correlation of these two indicators of deficits in growth and development. Therefore, concerted efforts should be made to ensure availability of data of good quality in order to expand the studies on these relationships and lay solid bases for planning preventive action.

UNDERLYING CAUSES OF NEONATAL AND POSTNEONATAL MORTALITY

The underlying causes of death in the neonatal period are distinctly different from those in the postneonatal period. Neonatal death rates are shown in the left section of Figure 39 for 24 areas, in descending order. The postneonatal rates (appearing in the right section) fail to demonstrate a consistent relationship with the neonatal rates,

FIG. 39. Certain Causes of Neonatal and Postneonatal Mortality in 24 Areas of 15 Projects.



although the three areas with the lowest neonatal mortality also have the lowest postneonatal death rates.

For these two age groups the underlying causes are given in Table 34, the leading groups of causes being shown in Figure 39.

In the neonatal period more than half the deaths were included in the group of certain perinatal causes. Infectious diseases were responsible for death rates of at least 5 per 1,000 live births in eight areas (rural Chaco 6.3, suburban San Juan 7.7, rural San Juan 7.9, Recife 6.5, Franca 6.5, São Paulo 7.5, San Salvador 6.3, and rural El Salvador 11.3). Diarrheal disease was the leading cause in this group in all areas except those in Canada, California, Kingston-St. Andrew in Jamaica, and rural El Salvador. In the Sherbrooke project no neonatal death was due to diarrheal disease but one was due to septicemia. In San Francisco two were due to diarrheal disease, two to septicemia, and two to poliomyelitis (in the group of others). In the suburban counties of California no death was caused by diarrheal disease but six were due to septicemia. In the rural *municipios* of El Salvador more deaths were caused by tetanus (28) than by diarrheal disease (27). In Kingston-St. Andrew the deaths from septicemia numbered more than those from diarrheal disease (57 and 45). Also in this project tetanus was responsible for 16 deaths.

Thus in addition to diarrheal disease, tetanus and septicemia caused many neonatal deaths in several projects. Tetanus was responsible for eight neonatal deaths in Resistencia, 15 in rural Chaco, 22 in Recife,

TABLE 34. Underlying Causes of Neonatal and Postneonatal Deaths[a] in 24 Areas of 15 Projects.

Cause	NEO-NATAL		POST-NEO-NATAL		NEO-NATAL		POST-NEO-NATAL		NEO-NATAL		POST-NEO-NATAL		NEO-NATAL		POST-NEO-NATAL	
	No.	Rate	No	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate
	ARGENTINA, Chaco Province								ARGENTINA, San Juan Province							
	Resistencia				Rural departments				San Juan (city)				Suburban departments			
All causes	327	33.4	420	42.9	241	30.9	422	54.1	172	29.6	123	21.1	353	44.6	343	43.3
Diarrheal disease	24	2.4	224	22.9	22	2.8	223	28.6	18	3.1	44	7.6	48	6.1	122	15.4
Measles	—	—	9	0.9	—	—	14	1.8	—	—	5	0.9	—	—	18	2.3
Other infectious diseases	12	1.2	27	2.8	27	3.5	16	2.1	6	1.0	8	1.4	13	1.6	19	2.4
Nutritional deficiency	—	—	20	2.0	—	—	10	1.3	1	0.2	3	0.5	—	—	22	2.8
Respiratory diseases	27	2.8	77	7.9	27	3.5	106	13.6	10	1.7	33	5.7	29	3.7	108	13.6
Congenital anomalies	15	1.5	20	2.0	8	1.0	3	0.4	10	1.7	8	1.4	22	2.8	15	1.9
Perinatal causes	236	24.1	—	—	134	17.2	1	0.1	122	21.0	1	0.2	229	28.9	—	—
Other	13	1.3	43	4.4	23	2.9	49	6.3	5	0.9	21	3.6	12	1.5	39	4.9
	ARGENTINA, San Juan Province Rural departments				BOLIVIA								BRAZIL Recife			
					La Paz				Viacha							
All causes	381	39.6	528	54.9	1,049	28.5	1,636	44.5	42	49.4	63	74.1	1,073	35.3	1,700	55.9
Diarrheal disease	62	6.4	216	22.5	81	2.2	510	13.9	2	2.4	17	20.0	146	4.8	995	32.7
Measles	—	—	20	2.1	1	0.0	150	4.1	—	—	11	12.9	1	0.0	129	4.2
Other infectious diseases	14	1.5	22	2.3	26	0.7	67	1.8	—	—	2	2.4	51	1.7	89	2.9
Nutritional deficiency	1	0.1	28	2.9	1	0.0	35	1.0	—	—	—	—	—	—	47	1.5
Respiratory diseases	49	5.1	165	17.2	298	8.1	698	19.0	10	11.8	29	34.1	62	2.0	254	8.4
Congenital anomalies	11	1.1	20	2.1	27	0.7	20	0.5	—	—	—	—	55	1.8	56	1.8
Perinatal causes	239	24.8	—	—	543	14.8	5	0.1	29	34.1	—	—	721	23.7	4	0.1
Other	5	0.5	57	5.9	72	2.0	151	4.1	1	1.2	4	4.7	37	1.2	126	4.1
	BRAZIL, Ribeirão Prêto												BRAZIL São Paulo			
	Ribeirão Prêto (city)				Franca				Communities							
All causes	223	24.0	177	19.0	188	36.9	176	34.6	101	27.1	91	23.7	1,958	33.7	1,830	31.5
Diarrheal disease	22	2.4	93	10.0	32	6.3	102	20.0	5	1.3	54	14.1	356	6.1	793	13.6
Measles	—	—	8	0.9	—	—	3	0.6	—	—	2	0.5	—	—	52	0.9
Other infectious diseases	5	0.5	10	1.1	1	0.2	6	1.2	2	0.5	5	1.3	82	1.4	128	2.2
Nutritional deficiency	—	—	2	0.2	—	—	9	1.8	—	—	—	—	2	0.0	59	1.0
Respiratory diseases	12	1.3	23	2.5	11	2.2	29	5.7	6	1.6	17	4.4	184	3.2	420	7.2
Congenital anomalies	19	2.0	19	2.0	12	2.4	8	1.6	4	1.0	6	1.6	117	2.0	96	1.7
Perinatal causes	159	17.1	—	—	122	24.0	—	—	85	22.1	—	—	1,133	19.5	15	0.3
Other	6	0.6	22	2.4	10	2.0	19	3.7	2	0.5	7	1.8	84	1.4	267	4.6
	CANADA Sherbrooke				CHILE								COLOMBIA Cali			
					Santiago				Comunas							
All causes	229	13.5	81	4.8	1,094	27.2	1,113	27.7	66	19.4	131	38.5	536	25.4	617	29.2
Diarrheal disease	—	—	2	0.1	65	1.6	385	9.6	6	1.8	42	12.4	25	1.2	337	16.0
Measles	—	—	—	—	—	—	9	0.2	—	—	1	0.3	—	—	14	0.7
Other infectious diseases	1	0.1	1	0.1	60	1.5	58	1.4	5	1.5	23	6.8	32	1.5	32	1.5
Nutritional deficiency	—	—	—	—	—	—	36	0.9	—	—	4	1.2	—	—	44	2.1
Respiratory diseases	5	0.3	22	1.3	79	2.0	374	9.3	10	2.9	31	9.1	54	2.6	107	5.1
Congenital anomalies	65	3.8	33	1.9	74	1.8	81	2.0	5	1.5	8	2.4	27	1.3	29	1.4
Perinatal causes	152	9.0	—	—	772	19.2	9	0.2	38	11.2	1	0.3	375	17.8	2	0.1
Other	6	0.4	23	1.4	44	1.1	161	4.0	2	0.6	21	6.2	23	1.1	52	2.5
	COLOMBIA								EL SALVADOR							
	Cartagena				Medellín				San Salvador				Rural municipios			
All causes	401	22.4	455	25.4	383	19.7	541	27.9	722	28.2	1,372	53.6	195	36.1	453	83.9
Diarrheal disease	23	1.3	199	11.1	23	1.2	266	13.7	105	4.1	856	33.4	27	5.0	310	57.4
Measles	—	—	24	1.3	—	—	17	0.9	1	0.0	45	1.8	—	—	16	3.0
Other infectious diseases	31	1.7	49	2.7	10	0.5	28	1.4	55	2.1	86	3.4	34	6.3	29	5.4
Nutritional deficiency	—	—	40	2.2	1	0.1	22	1.1	—	—	29	1.1	—	—	13	2.4
Respiratory diseases	25	1.4	57	3.2	21	1.1	102	5.3	51	2.0	232	9.1	18	3.3	60	11.1
Congenital anomalies	23	1.3	34	1.9	26	1.3	43	2.2	47	1.8	45	1.8	15	2.8	9	1.7
Perinatal causes	280	15.6	1	0.1	291	15.0	3	0.2	443	17.3	3	0.1	94	17.4	—	—
Other	19	1.1	51	2.8	11	0.6	60	3.1	20	0.8	76	3.0	7	1.3	16	3.0
	JAMAICA Kingston-St. Andrew				MEXICO Monterrey				UNITED STATES							
									San Francisco				California, suburban			
All causes	990	24.2	599	14.6	1,377	26.0	1,843	34.8	147	13.0	62	5.5	423	12.7	152	4.5
Diarrheal disease	45	1.1	289	7.1	130	2.5	820	15.5	2	0.2	7	0.6	—	—	3	0.1
Measles	—	—	4	0.1	—	—	120	2.3	—	—	—	—	—	—	—	—
Other infectious diseases	83	2.0	31	0.8	96	1.8	198	3.7	6	0.5	1	0.1	8	0.2	16	0.5
Nutritional deficiency	—	—	37	0.9	1	0.0	43	0.8	—	—	—	—	—	—	—	—
Respiratory diseases	36	0.9	82	2.0	139	2.6	384	7.2	6	0.5	27	2.4	7	0.2	37	1.1
Congenital anomalies	73	1.8	57	1.4	121	2.3	106	2.0	24	2.1	8	0.7	81	2.4	34	1.0
Perinatal causes	706	17.2	8	0.2	804	15.2	8	0.2	106	9.4	—	—	318	9.5	3	0.1
Other	47	1.1	91	2.2	86	1.6	164	3.1	3	0.3	10	1.7	9	0.3	59	1.8

[a] With rates per 1,000 live births.

9 in Cali, 15 in Cartagena, and 16 in San Salvador, in addition to those in rural El Salvador and Kingston-St. Andrew. A few deaths from tetanus occurred in other projects.

Septicemia caused deaths in the neonatal period in nearly all areas but the rates were in excess of 1 per 1,000 live births in 5 areas, namely, suburban San Juan, Santiago, *comunas* of Chile, Kingston-St. Andrew, and Monterrey.

In the postneonatal period the death rates from infectious diseases were high in many areas. Rates were in excess of 20 per 1,000 live births in four cities: Recife (39.9), Resistencia (26.5), San Salvador (38.5), and Monterrey (21.5), as well as in six other areas: Viacha (35.3), suburban San Juan (20.1), rural San Juan (26.8), Franca (21.8), rural El Salvador (65.7), and rural Chaco (32.4). These are exceedingly high rates. In all of these areas except Franca

TABLE 35. Nutritional Deficiency and Diarrheal Disease as Underlying and Associated Causes of Postneonatal Mortality[a] in 24 Areas of 15 Projects.

Project and area	Nutritional deficiency				Diarrheal disease			
	Underlying		Associated		Underlying		Associated	
	No.	Rate	No.	Rate	No.	Rate	No.	Rate
ARGENTINA								
Chaco Province								
Resistencia	20	2.0	242	24.7	224	22.9	41	4.2
Rural departments	10	1.3	201	25.8	223	28.6	37	4.7
San Juan Province								
San Juan (city)	3	0.5	47	8.1	44	7.6	16	2.7
Suburban departments	22	2.8	151	19.1	122	15.4	69	8.7
Rural departments	28	2.9	223	23.2	216	22.5	79	8.2
BOLIVIA								
La Paz	35	1.0	644	17.5	510	13.9	153	4.2
Viacha	—	—	24	28.2	17	20.0	10	11.8
BRAZIL								
Recife	47	1.5	991	32.6	995	32.7	279	9.2
Ribeirão Prêto								
Ribeirão Prêto (city)	2	0.2	114	12.2	93	10.0	24	2.6
Franca	9	1.8	105	20.6	102	20.0	18	3.5
Communities	—	—	63	16.4	54	14.1	7	1.8
São Paulo	59	1.0	895	15.4	793	13.6	349	6.0
CANADA								
Sherbrooke	—	—	6	0.4	2	0.1	2	0.1
CHILE								
Santiago	36	0.9	439	10.9	385	9.6	126	3.1
Comunas	4	1.2	59	17.4	42	12.4	10	2.9
COLOMBIA								
Cali	44	2.1	256	12.1	337	16.0	76	3.6
Cartagena	40	2.2	228	12.7	199	11.1	94	5.3
Medellín	22	1.1	281	14.5	266	13.7	49	2.5
EL SALVADOR								
San Salvador	29	1.1	546	21.3	856	33.4	143	5.6
Rural *municipios*	13	2.4	178	33.0	310	57.4	49	9.1
JAMAICA								
Kingston-St. Andrew	37	0.9	200	4.9	289	7.1	73	1.8
MEXICO								
Monterrey	43	0.8	910	17.2	820	15.5	192	3.6
UNITED STATES								
San Francisco	—	—	7	0.6	7	0.6	1	0.1
California, suburban	—	—	14	0.4	3	0.1	2	0.1

[a] With rates per 1,000 live births.

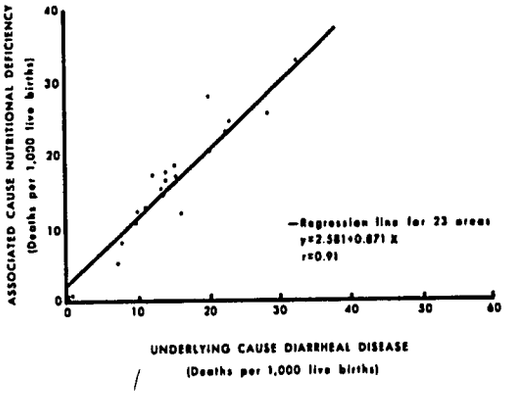
measles was an important contributor to mortality. Since measles was second to diarrheal disease in causing deaths due to infectious diseases, a section of the chapter on infectious diseases is devoted to an analysis of this problem.

Respiratory diseases caused high rates in the postneonatal period in La Paz and Viacha (19.0 and 34.1 per 1,000 live births, respectively). The rates were in excess of 10 in the suburban and rural areas of the projects in Argentina (rural Chaco 13.6, suburban San Juan 13.6, and rural San Juan 17.2) and in the rural *municipios* of El Salvador (11.1).

The postneonatal death rates for nutritional deficiency were high, principally as an associated cause (Table 35). Rates in Recife and rural El Salvador exceeded 30 per 1,000 live births as associated cause (32.6 and 33.0, respectively), while those in six other areas were over 20 per 1,000. Because of their great importance, these deaths with nutritional deficiency are studied in depth in Chapter IX.

The postneonatal rates for diarrheal disease are also given in Table 35. On studying the past histories of infants dying from this cause, it was observed that many had had previous repeated episodes of the disease that could have led to deterioration of their nutritional state. The relationship between these two morbid conditions was analyzed and a correlation was found between mortality from diarrheal disease as underlying cause and nutritional deficiency as an associated cause, this being shown by the regression line in Figure 40. The rural *municipios* of El Salvador had an excessive death rate from diarrheal disease (57.4 as an underlying cause), but though the rate for nutritional deficiency (as far as known) was very high (33.0 as an associated cause) it was not high enough to be close to a regression line through the other points. Therefore the regression line in Figure 40 excludes this area. The correlation coefficient of 0.91 for the death rates for these two variables (diarrheal disease and nutritional deficiency) is highly significant. The data thus demonstrate that there is a close relationship between diarrheal disease as an underlying cause and nutritional deficiency as an associated cause.

FIG. 40. Mortality from Diarrheal Disease as Underlying Cause and with Nutritional Deficiency as Associated Cause in the Postneonatal Period in 24 Areas of 15 Projects.



ROLE OF BIRTH WEIGHT IN POSTNEONATAL MORTALITY

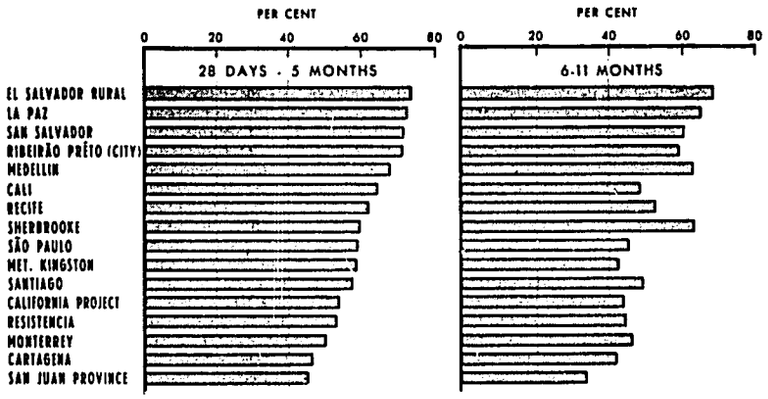
The findings in regard to distribution of deaths by birth weight in the postneonatal period are puzzling, as can be observed in Table 36 and Figure 41. Taking as an arbitrary division of birth weights the figure of 3,000 grams, the percentages of infants dying in the age period 28 days-5 months and born with a weight of 3,000 grams or less varied from 73.6 in rural El Salvador to 45.8 in San Juan Province. In the two areas

TABLE 36. Distribution of Postneonatal Deaths by Birth Weight[a] in Two Age Groups for 16 Areas of 15 Projects.

Birth weight in grams	28 days—5 mos.		6–11 mos.		28 days—5 mos.		6–11 mos.		28 days—5 mos.		6–11 mos.		28 days—5 mos.		6–11 mos.	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
	ARGENTINA								BOLIVIA La Paz				BRAZIL Recife			
	Resistencia				San Juan Province											
Total	175	100.0	63	99.9	598	100.0	189	100.0	184	100.0	96	100.0	461	100.0	243	100.0
2500 or less	34	19.4	8	12.7	118	19.7	16	8.5	53	28.8	16	16.7	159	34.5	36	14.8
2501–3000	59	33.7	20	31.7	156	26.1	48	25.4	81	44.0	47	49.0	127	27.5	91	37.4
3000 or less	93	53.1	28	44.4	274	45.8	64	33.9	134	72.8	63	65.6	286	62.0	127	52.3
3100–3500	50	28.6	22	34.9	198	33.1	77	40.7	39	21.2	26	27.1	122	26.5	80	32.9
3600 and over	32	18.3	13	20.6	126	21.1	48	25.4	11	6.0	7	7.3	53	11.5	36	14.8
	BRAZIL								CANADA Sherbrooke				CHILE Santiago			
	Ribeirão Prêto (city)				São Paulo											
Total	220	99.9	49	100.0	903	100.0	207	100.0	50	100.0	19	100.1	720	100.0	200	100.0
2500 or less	96	43.6	7	14.3	288	31.9	33	15.9	19	38.0	3	15.8	175	24.3	35	17.5
2501–3000	61	27.7	22	44.9	246	27.2	61	29.5	11	22.0	9	47.4	242	33.6	63	31.5
3000 or less	157	71.4	29	59.2	534	59.1	94	45.4	30	60.0	12	63.2	417	57.9	98	49.0
3100–3500	43	19.5	9	18.4	221	24.5	77	37.2	10	20.0	3	15.8	198	27.5	66	33.0
3600 and over	20	9.1	11	22.4	148	16.4	36	17.4	10	20.0	4	21.1	105	14.6	36	18.0
	COLOMBIA												EL SALVADOR San Salvador			
	Cali				Cartagena				Medellín							
Total	57	100.0	37	99.9	96	100.0	100	100.0	176	100.1	119	99.9	600	99.9	348	100.0
2500 or less	23	40.4	7	18.9	27	28.1	13	13.0	61	34.7	37	31.1	178	29.7	62	17.8
2501–3000	14	24.6	11	29.7	18	18.8	29	29.0	59	33.5	38	31.9	253	42.2	149	42.8
3000 or less	37	64.9	18	48.6	45	46.9	42	42.0	120	68.2	75	63.0	431	71.8	211	60.6
3100–3500	13	22.8	7	18.9	34	35.4	42	42.0	42	23.9	21	17.6	143	23.8	110	31.6
3600 and over	7	12.3	12	32.4	17	17.7	16	16.0	14	8.0	23	19.3	26	4.3	27	7.8
	EL SALVADOR Rural municipios				JAMAICA Metropolitan Kingston				MEXICO Monterrey				UNITED STATES California project			
Total	72	100.0	66	100.0	202	100.0	165	100.0	829	100.1	327	100.0	154	100.0	50	100.0
2500 or less	23	31.9	15	22.7	67	33.2	30	18.2	184	22.2	67	20.5	41	26.6	11	22.0
2501–3000	30	41.7	30	45.5	52	25.7	40	24.2	231	27.9	84	25.7	42	27.3	11	22.0
3000 or less	53	73.6	45	68.2	119	58.9	70	42.4	415	50.1	151	46.2	83	53.9	22	44.0
3100–3500	16	22.2	16	24.2	48	23.8	66	40.0	232	28.0	93	28.4	41	26.6	17	34.0
3600 and over	3	4.2	5	7.6	35	17.3	29	17.6	182	22.0	83	25.4	30	19.5	11	22.0

[a] With weight stated; weights rounded to hundreds of grams except 2501–2549 which are in the weight group 2501–3000 grams.

FIG. 41. Percentage of Infants Dying in Postneonatal Period with Birth Weights of 3,000 Grams or Less in 16 Areas of 15 Projects.



in El Salvador and also La Paz and the city of Ribeirão Prêto more than 70 per cent of the deceased infants in this age period had birth weights of 3,000 grams or less. For infants dying in the second half of the first year of life the percentages ranged from 68.2 in rural El Salvador and 65.6 in La Paz to 33.9 in San Juan Province. In La Paz and areas of El Salvador low proportions of these infants dying in the postneonatal period were in the birth weight group 3,600 grams and over (less than 10 per cent). In contrast, in seven projects from 20.6 to 32.4 per cent were infants with such birth weights. Although it is possible that there are ethnic differences and well-developed infants may weigh less in certain areas, the frequency of nutritional deficiency as an associated cause combined with lower birth weights indicates the need for thorough study the condition of the newborn.

These analyses have been made using the weights available and do not represent the totality of postneonatal deaths in each project. For several areas numbers were small, and it was necessary to restrict data to cities except for the San Juan Province, El Salvador, and California projects. In spite of these limitations, and admitting the possibility that in certain areas infants with very low weight have better chances of surviving the first 28 days of life, the differences indicate the urgent need for conducting studies on birth weight and survival. In such studies and in programs of health care, infants in the weight group 2501-3000 grams may need more attention than has been given in the past.

In areas in which nutritional deficiency is common, environmental conditions unfavorable, and birth rates high, mothers may be giving birth to small babies. These infants may continue to be at greater risk of dying in the postneonatal period (if they do not die earlier) because of their reduced vitality and unfavorable environment.

In summary, infant mortality is excessive in the Latin American projects. Infectious and respiratory diseases as well as certain perinatal causes are the principal groups of underlying causes of death. However, when multiple causes are analyzed the important role of nutritional deficiency and immaturity as associated causes becomes clear. The distribution of infant deaths by birth weight suggests that the health of the mother, in-

cluding her nutritional status, may be a factor influencing survival of her infant even beyond the neonatal period. The need is therefore evident for research into the interrelationship of the health of the mother, outcome of pregnancy, and survival of the infant during at least the first year of life.

Chapter VI

Neonatal Mortality

The neonatal age period encompasses the first 28 days of life and thus includes the postnatal component (first seven days of life) of the perinatal period (which extends from the 28th week of gestation through the first week after birth). The context of neonatal morbidity and mortality is therefore highly complex, involving the action of multiple factors that may go back into pregnancy and even earlier and have health implications extending beyond the neonatal period, often through a lifetime.

The health status of the mother before and during pregnancy, as well as the risks of labor and delivery, are important determinants of the condition of the product of conception. Though normality is the rule in the course of pregnancy and childbirth, the opportunities for hazards are numerous and varied. The intricacy of the interrelationships of the mother's health and that of the fetus or infant makes it necessary to adopt the multiple-cause approach to the study of mortality, so as to establish the links between morbid conditions in the mother and their effect on the newborn, and similarly, between complications of delivery and their effects.

The role of external environment becomes increasingly important and direct from the moment of birth. The effect of ecological factors on the newborn depends on the degree of vulnerability of the infant, which in turn is determined by the infant's state of health and maturity, measured by the degree of growth and development at birth. A state of increased vulnerability (i.e., low birth weight) may have been the result of an abnormal maternal condition during pregnancy or delivery, and therefore such relationships should be established. On the other hand, infections, which commonly occur under unfavorable environmental conditions, can develop during the prenatal period (or during delivery) by any of the well-known mechanisms of intrauterine infection.

The quality of information on causes of neonatal deaths, particularly in relation to the so-called "certain causes of perinatal mortality," depends in large part on the proportion of births occurring in hospitals and on the completeness of clinical records, which should include data on weight and condition of the infant at birth. Moreover, as was pointed out in Chapter II, failure to include all deaths in the first days of life may seriously interfere with measurement of neonatal mortality and the determination of its causes.

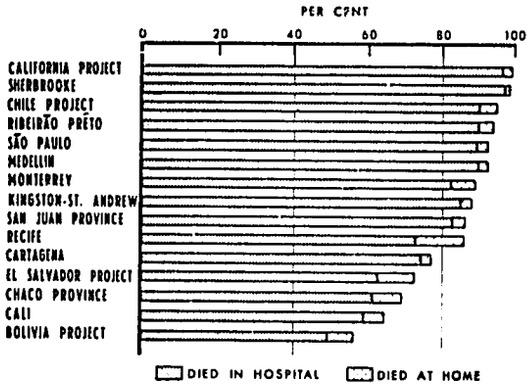
The proportions of infants dying in the neonatal period and known to have been born in hospitals are shown in Table 37 and Figure 42. In six of the 15 projects more than 90 per cent of deceased neonates had been born in hospitals, and in four

TABLE 37. Place[a] of Birth and Death of Infants Dying in Neonatal Period in 15 Projects.

Project	Total deaths	Born in hospital, died in hospital		Born in hospital, died at home		Born at home, died in hospital		Born at home, died at home		Place unspecified
		No.	%[b]	No.	%[b]	No.	%[b]	No.	%[b]	No.
ARGENTINA										
Chaco Province	568	345	61.1	45	8.0	83	14.7	92	16.3	3
San Juan Province	906	739	82.3	48	5.3	78	8.7	33	3.7	8
BOLIVIA project	1,091	421	48.4	62	7.1	50	5.8	336	38.7	222
BRAZIL										
Recife	1,073	729	72.5	135	13.4	39	3.9	102	10.1	68
Ribeirão Prêto	515	457	89.4	21	4.1	18	3.5	15	2.9	4
São Paulo	1,958	1,712	89.5	50	2.6	101	5.3	49	2.6	46
CANADA										
Sherbrooke	229	223	97.4	3	1.3	2	0.9	1	0.4	—
CHILE project	1,160	1,024	89.9	58	5.1	25	2.2	32	2.8	21
COLOMBIA										
Cali	536	281	58.5	28	5.8	54	11.2	117	24.4	56
Cartagena	401	280	74.1	11	2.9	52	13.8	35	9.3	23
Medellín	383	325	89.8	8	2.2	12	3.3	17	4.7	21
EL SALVADOR project	917	562	62.4	90	10.0	36	4.0	213	23.6	16
JAMAICA										
Kingston-St. Andrew	990	831	84.9	29	3.0	78	8.0	41	4.2	11
MEXICO										
Monterrey	1,377	1,076	82.3	88	6.7	58	4.4	85	6.5	70
UNITED STATES										
California project	570	551	96.7	15	2.6	3	0.5	1	0.2	—

[a] "At home" includes those stated to have occurred at home and those stated to have occurred in places other than hospitals.
[b] Based on deaths with place of occurrence of both birth and death stated.

FIG. 42. Percentage of Infants Dying in Neonatal Period Who Were Born in Hospital in 15 Projects.



other projects more than 80 per cent. In Bolivia and Cali the percentages were only 55.6 and 64.4.

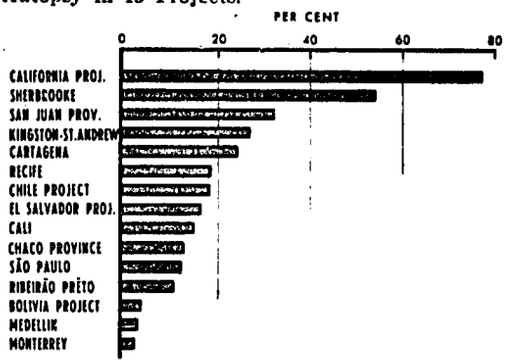
The large proportions of deceased neonates born outside hospitals in some projects limited the availability of basic data on birth weight and morbidity. This limitation was increased by the fact that a number of neonatal deaths of babies born in hospitals occurred outside these institutions (from 1.3 to 13.4 per cent), which meant a loss of valuable information on causes of death. On the other hand, such loss was partially compensated by the finding that a similar proportion (from 0.5 to 14.7 per cent) of neonatal deaths were of babies born at home but who died in the hospital.

The percentages of neonatal deaths in which autopsies were performed are presented in Table 38 and Figure 43. In only three projects was the percentage over 30 (California 77.5 per cent, Sherbrooke 54.1, and San Juan Province 32.5). In three other projects (Bolivia, Medellín, and

TABLE 38. Number of Neonatal Deaths with Autopsy in 15 Projects.

Project	Deaths	With autopsy	
		No.	%
Total	12,674	2,354	18.6
ARGENTINA			
Chaco Province	568	75	13.2
San Juan Province	906	294	32.5
BOLIVIA project	1,091	46	4.2
BRAZIL			
Recife	1,073	203	18.9
Ribeirão Prêto	515	56	10.9
São Paulo	1,958	251	12.8
CANADA			
Sherbrooke	229	124	54.1
CHILE project	1,160	213	18.4
COLOMBIA			
Cali	536	78	14.6
Cartagena	401	98	24.4
Medellín	383	13	3.4
EL SALVADOR project	917	156	17.0
JAMAICA			
Kingston-St. Andrew	990	265	26 8
MEXICO			
Monterrey	1,377	40	2.9
UNITED STATES			
California project	570	442	77.5

FIG. 43. Percentage of Neonatal Deaths with Autopsy in 15 Projects.



Monterrey) less than 5 per cent of neonatal deaths had autopsies. The implications of this deficit in number of autopsies (not taking into account their wide variety in quality) are obvious, particularly when mortality from certain causes such as trauma, infection, and congenital anomalies affecting internal organs is to be measured.

MAGNITUDE OF NEONATAL MORTALITY AND ROLE OF IMMATURITY

Mortality in the neonatal period varied greatly. The rates per 1,000 live births ranged from 12.7 and 13.5 in the California and Sherbrooke projects to 38.8 and 35.3 in San Juan Province and Recife (Table 39 and Figure 44). These figures make it clear that even in this age period great improvements can be attained. Even in the group under 7 days of age—the one most affected by underregistration and commonly considered the least susceptible to reduction of mortality—death rates could be lowered by about half in several projects. In the last three weeks of the neonatal period (7-27 days) the variations in rates were proportionally greater, the range being from 1.2 and 1.7 per 1,000 live births in the Sherbrooke and California projects to 14.1 and 13.3 in San Juan Province and São Paulo. In this age group, which is subject to increasing effects of the environment, the rates could be reduced to a small fraction of those currently found in certain projects in Latin America. Actions leading to reduction of mortality in these crucial age periods would have a great impact on the future health of infants surviving the first four weeks of life. In this chapter, which will deal with the causes of neonatal deaths, first attention will be given to the "certain causes of perinatal morbidity and mortality," because of their prominent role and chronological significance.

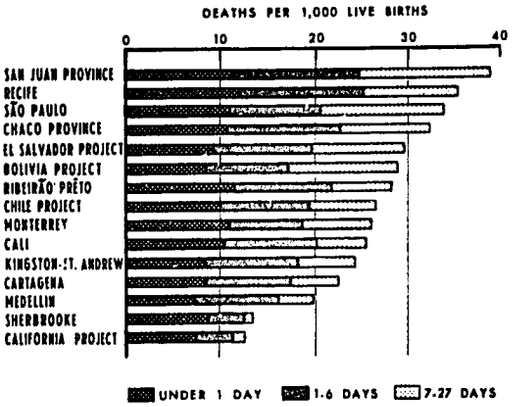
The study of underlying causes in the

TABLE 39. Neonatal Mortality* by Age Group in 15 Projects.

Project	Total	Under 1 day	1-6 days	7-27 days
ARGENTINA				
Chaco Province	32.3	10.6	12.1	9.6
San Juan Province	38.8	11.0	13.7	14.1
BOLIVIA project	29.0	8.4	8.6	12.0
BRAZIL				
Recife	35.3	11.7	13.6	10.0
Ribeirão Prêto	28.2	11.5	10.0	6.7
São Paulo	33.7	10.7	9.6	13.3
CANADA				
Sherbrooke	13.5	8.6	3.7	1.2
CHILE project	26.6	9.8	9.6	7.2
COLOMBIA				
Cali	25.4	10.4	9.9	5.1
Cartagena	22.4	8.2	9.1	5.2
Medellín	19.7	7.0	9.2	3.5
EL SALVADOR project	29.6	9.8	9.7	10.1
JAMAICA				
Kingston-St. Andrew	24.2	7.9	9.9	6.4
MEXICO				
Monterrey	26.0	10.6	7.9	7.5
UNITED STATES				
California project	12.7	7.3	3.8	1.7

* Rates per 1,000 live births.

FIG. 44. Neonatal Mortality by Age Group in 15 Projects.



two age groups of the neonatal period (under 7 days and 7-27 days) reveals important differences (Table 40 * and Figure 45). As expected, the perinatal causes were found to play a predominant role in mortality in the first week of life. The abnormal conditions included in the section of "certain causes of perinatal mortality" (categories 760-778 of the *International Classification of Diseases*) have been grouped as follows:

- Maternal conditions (760–763), including those related to pregnancy and others independent of gestation.
- Other complications of pregnancy and childbirth (769), such as premature rupture of membranes, hydramnios, multiple pregnancy, and antepartum hemorrhage.
- Difficult labor and injury at birth (764–768), in which the type of dystocia and the effect on the product of gestation are also specified, and birth injury without mention of cause (772).
- Conditions of placenta and cord (770, 771).
- Hemolytic diseases of newborn (774, 775).
- Anoxic and hypoxic conditions not elsewhere classified (776), which include hyaline membrane disease, respiratory distress syndrome, fetal distress, and others.
- Immaturity (777).
- Other conditions of newborn (778).

The basic Table 40 provides data for the main groups of certain perinatal causes as well as for five other causes or groups of causes of death in the early and late neonatal periods.

Death rates from the perinatal causes in the first week of life ranged from 848.6 and 891.8 per 100,000 live births in the Sherbrooke and California projects to 2,190.8 and 2,089.0 in Recife and San Juan Province. Taking the first two of these projects as standards, it can be seen that at least one half of all deaths occurring in the first week of life and due to perinatal causes could be avoided in several of the Latin American projects.

For the three last weeks of the neonatal period, mortality from the broad group of

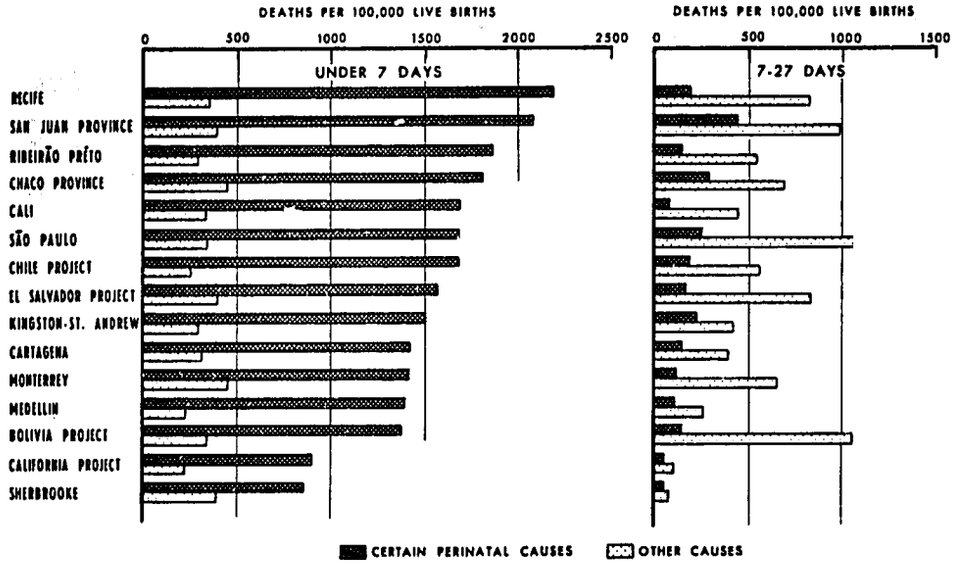
* Beginning with this table, death rates are given per 100,000 live births as is customary for rates from specific causes, and this unit will be used for nearly all the rest of the tables in this report, except for rates by age group.

TABLE 40. Underlying Causes of Neonatal Deaths[a] for Two Age Groups in 15 Projects.

Underlying cause	Under 7 days		7-27 days		Under 7 days		7-27 days		Under 7 days		7-27 days		Under 7 days		7-27 days	
	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate
	ARGENTINA															
	Chaco Province				San Juan Province				BOLIVIA project				BRAZIL Recife			
All causes	399	2,267.0	169	960.2	577	2,470.0	329	1,408.4	640	1,701.7	451	1,199.1	769	2,529.6	304	1,000.0
Diarrheal disease	5	28.4	41	233.0	13	55.7	115	492.3	10	26.6	73	194.1	7	23.0	139	457.2
Other infectious diseases	17	96.6	22	125.0	9	38.5	24	102.7	7	18.6	20	53.2	22	72.4	30	98.7
Diseases of respiratory system	16	90.9	38	215.9	26	111.3	62	265.4	61	162.2	247	656.7	21	69.1	41	134.9
Congenital anomalies	15	85.2	8	45.5	30	128.4	13	55.7	14	37.2	13	34.6	36	118.4	19	62.5
Certain perinatal causes	322	1,829.5	48	272.7	488	2,089.0	102	436.6	516	1,372.0	56	148.9	666	2,190.8	55	180.9
Maternal conditions	23	130.7	2	11.4	34	145.5	6	25.7	49	130.3	6	16.0	25	82.2	3	9.9
Complications of pregnancy[b]	65	369.3	12	68.2	110	470.9	30	128.4	81	215.4	11	29.2	117	384.9	11	36.2
Difficult labor, birth injury	74	420.5	8	45.5	133	569.3	29	124.1	126	335.0	7	18.6	122	401.3	13	42.8
Conditions of placenta, cord	22	125.0	2	11.4	43	184.1	7	30.0	38	101.0	4	10.6	57	187.5	1	3.3
Hemolytic disease	7	39.8	5	28.4	11	47.1	12	51.4	7	18.6	—	—	8	26.3	2	6.6
Anoxic, hypoxic conditions	79	448.9	6	34.1	119	509.4	12	51.4	166	441.4	7	18.6	247	812.5	13	42.8
Immaturity	40	227.3	10	56.8	15	64.2	—	—	31	82.4	12	31.9	58	190.8	1	3.3
Other	12	68.2	3	17.0	23	98.5	6	25.7	18	47.9	9	23.9	32	105.3	11	36.2
Other causes	24	136.4	12	68.2	11	47.1	13	55.7	32	85.1	42	111.7	17	55.9	20	65.8
	BRAZIL															
	Ribeirão Prêto				São Paulo				CANADA Sherbrooke				CHILE project			
All causes	392	2,149.1	123	674.3	1,183	2,034.0	775	1,332.5	208	1,225.7	21	123.7	845	1,939.0	315	722.8
Diarrheal disease	5	27.4	54	296.1	19	32.7	337	579.4	—	—	—	—	2	4.6	69	158.3
Other infectious diseases	4	21.9	4	21.9	20	34.4	62	106.6	—	—	1	5.9	17	39.0	48	110.1
Diseases of respiratory system	11	60.3	18	98.7	61	104.9	123	211.5	3	17.7	2	11.8	20	45.9	69	158.3
Congenital anomalies	25	137.1	10	54.8	70	120.4	47	80.8	56	330.0	9	53.0	51	117.0	28	64.2
Certain perinatal causes	341	1,869.5	25	137.1	991	1,703.9	142	244.2	144	848.6	8	47.1	735	1,686.6	75	172.1
Maternal conditions	18	98.7	2	11.0	93	159.9	13	22.4	19	112.0	1	5.9	73	167.5	15	34.4
Complications of pregnancy[b]	76	416.7	4	21.9	219	376.5	31	53.3	42	247.5	2	11.8	198	454.3	30	68.8
Difficult labor, birth injury	58	318.0	4	21.9	191	328.4	23	39.5	15	88.4	3	17.7	124	284.5	8	18.4
Conditions of placenta, cord	25	137.1	—	—	86	147.9	11	18.9	19	112.0	1	5.9	81	185.9	1	2.3
Hemolytic disease	2	11.0	2	11.0	8	13.8	17	29.2	12	70.7	1	5.9	30	68.8	10	22.9
Anoxic, hypoxic conditions	156	855.3	9	49.3	336	577.7	28	48.1	26	153.2	—	—	183	419.9	9	20.7
Immaturity	2	11.0	3	16.4	31	53.3	13	22.4	9	53.0	—	—	30	68.8	—	—
Other	4	21.9	1	5.5	27	46.4	6	10.3	2	11.8	—	—	16	36.7	2	4.6
Other causes	6	32.9	12	65.8	22	37.8	64	110.0	5	29.5	1	5.9	20	45.9	26	59.7
	COLOMBIA															
	Cali				Cartagena				Medellín				EL SALVADOR project			
All causes	429	2,033.2	107	507.1	308	1,720.7	93	519.6	315	1,623.7	68	350.5	605	1,950.4	312	1,005.8
Diarrheal disease	2	9.5	23	109.0	1	5.6	22	122.9	2	10.3	21	108.2	9	29.0	123	396.5
Other infectious diseases	11	52.1	21	99.5	9	50.3	22	122.9	6	30.9	4	20.6	28	90.3	62	199.9
Diseases of respiratory system	22	104.3	32	151.7	13	72.6	12	67.0	14	72.2	7	36.1	26	83.8	43	138.6
Congenital anomalies	19	90.0	8	37.9	16	89.4	7	39.1	17	87.6	9	46.4	39	125.7	23	74.1
Certain perinatal causes	360	1,706.2	15	71.1	255	1,424.6	25	139.7	271	1,396.9	20	103.1	486	1,566.7	51	164.4
Maternal conditions	50	237.0	—	—	30	167.6	2	11.2	36	185.6	1	5.2	75	241.8	9	29.0
Complications of pregnancy[b]	69	327.0	7	33.2	55	307.3	6	33.5	67	345.4	8	41.2	100	322.4	17	54.8
Difficult labor, birth injury	65	308.1	1	4.7	56	312.8	3	16.8	54	278.4	4	20.6	124	399.7	10	32.2
Conditions of placenta, cord	32	151.7	1	4.7	37	206.7	3	16.8	34	175.3	4	20.6	40	128.9	3	9.7
Hemolytic disease	8	37.9	2	9.5	5	27.9	2	11.2	8	41.2	1	5.2	4	12.9	7	22.6
Anoxic, hypoxic conditions	116	549.8	1	4.7	50	279.3	6	33.5	61	314.4	2	10.3	115	370.7	3	9.7
Immaturity	17	80.6	2	9.5	12	67.0	1	5.6	4	20.6	—	—	11	35.5	—	—
Other	3	14.2	1	4.7	10	55.9	2	11.2	7	36.1	—	—	17	54.8	2	6.4
Other causes	15	71.1	8	37.9	14	78.2	5	27.9	5	25.8	7	36.1	17	54.8	10	32.2
	JAMAICA Kingston-St. Andrew				MEXICO Monterrey				UNITED STATES California project							
All causes	729	1,779.8	261	637.2	982	1,852.5	395	745.1	496	1,108.6	74	165.4				
Diarrheal disease	4	9.8	41	100.1	10	18.9	120	226.4	—	—	2	4.5				
Other infectious diseases	19	46.4	64	156.2	24	45.3	72	135.8	8	17.9	6	13.4				
Diseases of respiratory system	17	41.5	19	46.4	45	84.9	94	177.3	5	11.2	8	17.9				
Congenital anomalies	46	112.3	27	65.9	83	156.6	38	71.7	78	174.3	27	60.3				
Certain perinatal causes	615	1,501.5	91	222.2	749	1,412.9	55	103.8	399	891.8	25	55.9				
Maternal conditions	89	217.3	21	51.3	76	143.4	5	9.4	48	107.3	3	6.7				
Complications of pregnancy[b]	151	368.7	38	92.8	190	358.4	18	34.0	119	266.0	8	17.9				
Difficult labor, birth injury	81	197.8	5	12.2	159	299.9	10	18.9	40	89.4	2	4.5				
Conditions of placenta, cord	26	63.5	4	9.8	109	205.6	7	13.2	95	212.3	8	17.9				
Hemolytic disease	13	31.7	3	7.3	19	35.8	2	3.8	4	8.9	1	2.2				
Anoxic, hypoxic conditions	178	434.6	6	14.6	131	247.1	9	17.0	70	156.5	3	6.7				
Immaturity	55	134.3	6	14.6	57	107.5	1	1.9	19	42.5	—	—				
Other	22	53.7	8	19.5	8	15.1	3	5.7	4	8.9	—	—				
Other causes	28	68.4	19	46.4	71	133.9	16	30.2	6	13.4	6	13.4				

[a] Rates per 100,000 live births.
[b] Other complications of pregnancy and childbirth (769).

FIG. 45. Neonatal Mortality from Certain Perinatal and Other Causes as Underlying Causes for Two Age Groups in 15 Projects.



certain perinatal causes was very much lower, though considerable differences between projects were still found. Rates per 100,000 live births ranged between 47.1 and 55.9 in the Sherbrooke and California projects to 436.6 and 272.7 in San Juan and Chaco Provinces, respectively.

In the late neonatal period rates for other causes exceeded those for the perinatal causes in all 15 projects; this can be seen in the right section of Figure 45, which illustrates the excessive rates found in the Latin American projects.

The Investigation findings revealed that *immaturity* is a very serious problem in many areas of Latin America. This condition can be considered the most important factor in vulnerability to disease and death in the neonatal period. Its involvement as underlying or associated cause of death was found to be limited principally to that age period. Immaturity was assigned as cause of death whenever a birth weight of 2,500 grams or less or a clinical or pathological diagnosis of immaturity or prematurity was recorded. Table 41 provides information on immaturity reported for neonatal deaths. In nine of the 15 projects more than 60 per cent of neonatal deaths occurred in infants known to be immature. In all projects, with the exception of that in Bolivia where many births occurred at home and clinical data were not available, over half the neonatal deaths were known to be of immature infants.

The relationships between immaturity and the other perinatal causes of morbidity and mortality are exceedingly important from the standpoint of measuring degrees of risk attached to those conditions. Whenever immaturity as defined in Chapter III was diagnosed as an associated pathologic state in a neonatal death, efforts were made to establish the cause-effect relationship with

TABLE 41. Immaturity as Underlying or Associated Cause of Neonatal Mortality[a] in 15 Projects.

Project	Total neonata deaths		Total with immaturity		Immaturity							
					Underlying cause		Associated cause					
							Total		Contributory		Consequence	
	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate
ARGENTINA												
Chaco Province	568	3,227.3	294	1,670.5	50	284.1	244	1,386.4	136	772.7	108	613.6
San Juan Province	906	3,878.4	578	2,474.3	15	64.2	563	2,410.1	374	1,601.0	189	809.1
BOLIVIA project	1,091	2,900.8	483	1,284.2	43	114.3	440	1,169.9	294	781.7	146	388.2
BRAZIL												
Recife	1,073	3,529.6	699	2,299.3	59	194.1	640	2,105.3	465	1,529.6	175	575.7
Ribeirão Prêto	515	2,823.5	339	1,858.6	5	27.4	334	1,831.1	225	1,233.6	109	597.6
São Paulo	1,958	3,366.6	1,164	2,001.4	44	75.7	1,120	1,925.7	730	1,255.2	390	670.6
CANADA												
Sherbrooke	229	1,349.4	166	978.2	9	53.0	157	925.2	80	471.4	77	453.7
CHILE project	1,160	2,661.8	800	1,835.7	30	68.8	770	1,766.9	415	952.3	355	814.6
COLOMBIA												
Cali	536	2,540.3	310	1,469.2	19	90.0	291	1,379.1	156	739.3	135	639.8
Cartagena	401	2,240.2	248	1,385.5	13	72.6	235	1,312.8	117	653.6	118	659.2
Medellín	383	1,974.2	253	1,304.1	4	20.6	249	1,283.5	130	670.1	119	613.4
EL SALVADOR project	917	2,956.2	531	1,711.8	11	35.5	520	1,676.3	313	1,009.0	207	667.3
JAMAICA												
Kingston-St. Andrew	990	2,417.0	724	1,767.6	61	148.9	663	1,618.7	369	900.9	294	717.8
MEXICO												
Monterrey	1,377	2,597.6	700	1,320.5	58	109.4	642	1,211.1	326	615.0	316	596.1
UNITED STATES												
California project	570	1,274.0	443	990.2	19	42.5	424	947.7	164	366.6	260	581.1

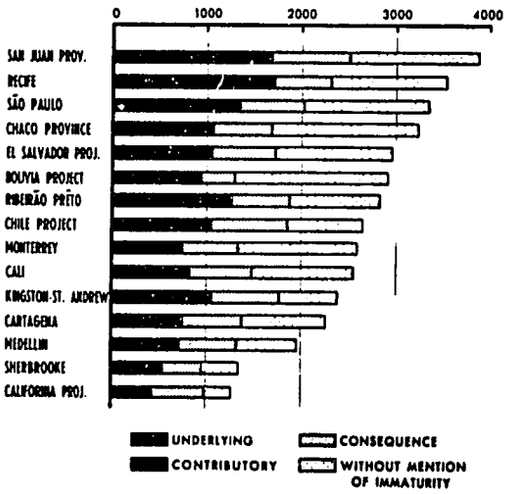
[a] Rates per 100,000 live births.

other perinatal conditions, that is, whether immaturity was a consequence of other causes or contributory to the fatal outcome.

Neonatal mortality with immaturity as an underlying or an associated cause is shown in Table 41 and Figure 46, the associated causes being divided into those in which immaturity was contributory and those in which it was a consequence of maternal or other conditions in pregnancy.

The rates for immaturity as underlying or associated cause ranged from 978.2 per 100,000 live births in Sherbrooke to 2,474.3 in San Juan Province, a rate 2.5 times as high. In all the Latin American projects the rates were higher than in the Northern American projects. Several factors such as the frequency of low-birth-weight babies

FIG. 46. Immaturity as Underlying or Associated Cause of Neonatal Mortality in 15 Projects.



and variations in the quality of medical services could account for these differences.

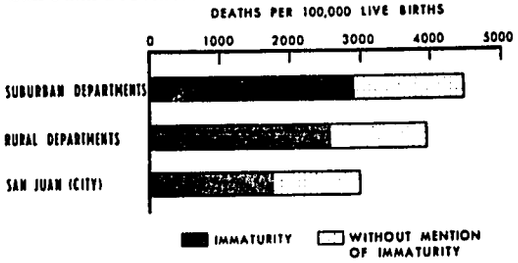
To illustrate the differences between urban and rural populations, data are provided in Table 42 and Figure 47 for the three areas of San Juan Province. In the city of San Juan immaturity was assigned as a cause in 1,786.9 neonatal deaths per 100,000 live births, while the rates in the suburban and rural areas were 2,904.0 and 2,536.4, respectively. Also a difference was noted between the city of Ribeirão Prêto and the interior city of Franca, with a higher rate in the latter.

TABLE 42. Immaturity as Underlying or Associated Cause of Neonatal Mortality[a] in Three Areas of San Juan Province.

Area	Neonatal deaths			
	Total		With immaturity	
	No.	Rate	No.	Rate
San Juan (city)	172	2,055.3	104	1,786.9
Suburban departments	353	4,457.1	230	2,904.0
Rural departments	381	3,960.5	244	2,536.4

[a] Rates per 100,000 live births.

FIG. 47. Immaturity as Underlying or Associated Cause of Neonatal Mortality in Three Areas of San Juan Province.



The reasons for these intriguing findings are not known. It is clear from the data on nutritional deficiency that this condition of high susceptibility is also frequently found as an underlying or associated cause in these same suburban and rural areas. Therefore, the possibility exists that in these areas low birth weights are more common than in urban areas of the same projects owing to the unfavorable nutritional state of mothers.

NEONATAL MORTALITY FROM MATERNAL CONDITIONS (760–763)

The group of maternal conditions affecting the health of the product of conception and the survival of the infant is classified into three main subgroups: conditions unrelated to pregnancy (760, 761), toxemia (762), and maternal antepartum and intrapartum infection (763). The group as a whole was responsible for 827 neonatal deaths in all 15 projects. The rates by projects are shown in Table 43 and Figure 48. Mortality from these causes exhibits great variations, from 92.1 deaths per 100,000 live births in Recife to 270.8 in the El Salvador project. Differences in quality of data according to place of birth and death and completeness of clinical records may be determining factors in these variations. However, the marked differences found between the projects in Northern America and some in Latin America are an indication of serious health conditions in the mother in the latter areas.

Conditions Unrelated to Pregnancy (760, 761)

An important group of morbid conditions can alter the normal course of pregnancy or delivery or interfere with the health of the

TABLE 43. Neonatal Mortality[a] from Specific Maternal Conditions as Underlying Causes and with Immaturity as Associated Cause (Consequence) in 15 Projects.

Project	Underlying cause												Associated cause	
	Total (760-763)		Conditions unrelated to pregnancy (760-761)						Toxemia (762)		Maternal infection (763)		Immaturity as consequence (777)	
			Total		Syphilis (761.0)	Diabetes (761.1)	Injury (761.5)	Other						
	No.	Rate	No.	Rate	No.	No.	No.	No.	No.	Rate	No.	Rate	No.	Rate
Total	827	174.5	360	75.9	27	44	100	189	334	70.5	133	28.1	681	143.7
ARGENTINA														
Chaco Province	25	142.0	13	73.9	1	—	4	8	11	62.5	1	5.7	20	113.6
San Juan Province	40	171.2	22	94.2	1	2	10	9	16	68.5	2	8.6	34	145.5
BOLIVIA project	55	146.2	27	71.8	4	1	16	6	28	74.4	—	—	45	119.6
BRAZIL														
Recife	28	92.1	16	52.6	1	1	9	5	9	29.6	3	9.9	22	72.4
Ribeirão Prêto	20	109.6	10	54.8	1	—	—	9	9	49.3	1	5.5	18	98.7
São Paulo	106	182.3	42	72.2	2	4	11	25	53	91.1	11	18.9	85	146.1
CANADA														
Sherbrooke	20	117.9	11	64.8	—	3	6	2	5	29.5	4	23.6	16	94.3
CHILE project	88	201.9	28	64.2	1	4	5	18	23	52.8	37	84.9	76	174.4
COLOMBIA														
Cali	50	237.0	25	118.5	2	2	8	13	19	90.0	6	28.4	41	194.3
Cartagena	32	178.8	11	61.5	—	1	2	8	19	106.1	2	11.2	26	145.3
Medellín	37	190.7	13	67.0	1	—	4	8	13	67.0	11	56.7	30	154.6
EL SALVADOR project	84	270.8	43	138.6	7	—	3	33	21	67.7	20	64.5	74	238.6
JAMAICA														
Kingston-St. Andrew	110	268.6	35	85.4	4	5	15	11	64	156.2	11	26.9	98	239.3
MEXICO														
Monterrey	81	152.8	39	73.6	2	15	6	16	35	66.0	7	13.2	50	94.3
UNITED STATES														
California project	51	114.0	25	55.9	—	6	1	18	9	20.1	17	38.0	46	102.8

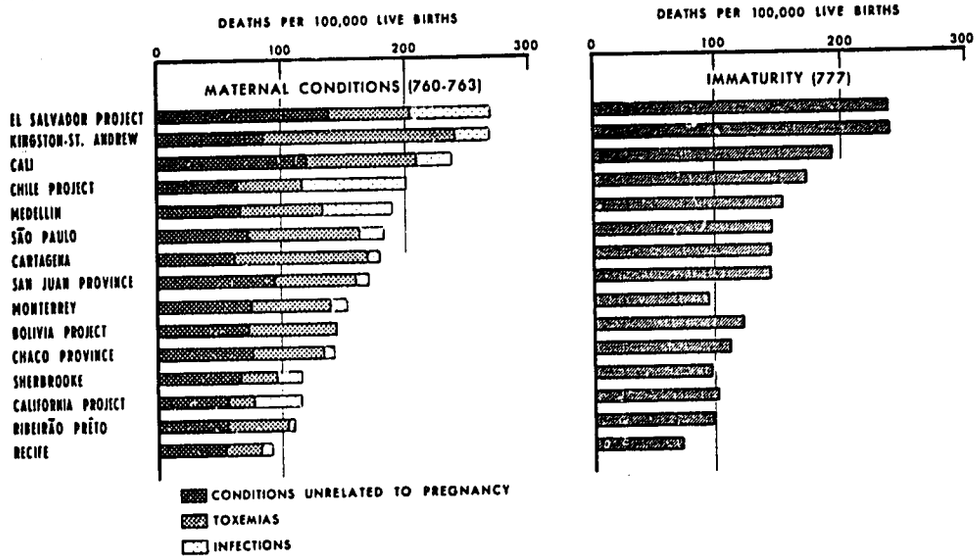
[a] Rates per 100,000 live births.

product although their occurrence is unrelated to the state of pregnancy. Included in this group are chronic cardiovascular and renal diseases, maternal diabetes, injury and specific infections (syphilis, rubella, influenza, toxoplasmosis) occurring during pregnancy, and any other abnormality affecting the health of the mother and/or fetus. The death rates for this group of maternal conditions (Table 43 and Figure 48) varied from 52.6 per 100,000 live births in Recife to 138.6 in El Salvador.

Certain specific maternal conditions as underlying or associated causes of death are given in Table 44 for the 15 projects combined. Maternal syphilis was found in all but one of the Latin American projects and it was an underlying cause in 27 deaths. It should be noted, however, that mortality due to syphilis was not included among the maternal conditions when the disease was found in the infant; the assignment in those cases was made to the specific infection and although the mother may have had the disease a single code was used. In 19 deaths maternal syphilis was found as an associated cause, increasing to 46 the number of neonatal deaths in which this maternal infection was a cause.

One-third of the 44 neonatal deaths in

FIG. 48. Neonatal Mortality from Maternal Conditions as Underlying Causes and with Immaturity as Associated Cause (Consequence) in 15 Projects.



which maternal diabetes mellitus was the underlying cause were found in Monterrey. In 16 additional neonatal deaths, maternal diabetes was an associated cause, thus making a total of 60 in which this condition was a cause.

TABLE 44. Specific Maternal Conditions as Underlying or Associated Causes of Death in 15 Projects Combined.

Cause	Underlying	Associated
Total (760-763)	827	424
Conditions unrelated to pregnancy (760, 761)	360	123
Syphilis (761.0)	27	10
Diabetes (761.1)	44	16
Injury (761.5)	100	8
Other (rest of 760 and 761)	189	80
Toxemia (762)	334	94
Maternal infection (763)	133	207

Injury to the mother during pregnancy was found to be the underlying cause of 100 neonatal deaths in all 15 projects and an associated cause in another eight. This code was assigned in all instances in which a trauma (accidental or provoked) was the triggering factor in premature delivery resulting in death of the newborn or was associated with other underlying causes.

Toxemia (762)

This group of maternal conditions represents a serious threat both to the mother and to the product of conception. The threat, however, can be significantly reduced by adequate medical care during pregnancy, delivery, and puerperium. The products of mothers affected by these conditions are at high risk of antepartum and

intrapartum asphyxia; for those born alive low birth weight is common and the chances of hypoxic complications are higher than under normal circumstances. The diagnosis of toxemia without or with convulsions (eclampsia) was based on clinical findings of hypertension, edema, proteinuria, and on the statement of such diagnosis in the records.

Neonatal death rates for toxemia as underlying cause varied between 156.2 per 100,000 live births in Kingston-St. Andrew and 20.1 in the California project (Table 43). In addition to the 334 neonatal deaths from toxemia as underlying cause in all 15 projects, 94 were found in which these conditions were assigned as associated causes (Table 44).

Maternal Antepartum and Intrapartum Infection (763)

This category includes infections of the genitourinary tract (pyelitis and pyelonephritis), chorio-amnionitis, and various other infections arising during pregnancy and childbirth.

In addition to the 133 neonatal deaths in which these conditions were found as underlying causes in all projects, in 207 others they acted as associated causes, usually as consequences of premature rupture of membranes. In the Chilean project, for instance, there were 37 deaths in which antepartum and intrapartum infections were assigned as underlying causes and 62 in which they were assigned as associated causes.

Relationship between Immaturity and Maternal Conditions

The association between the maternal conditions just discussed and immaturity is extremely close, as can be seen in Table 43 and Figure 48, where neonatal deaths from maternal conditions per 100,000 live births are shown to the left and deaths with immaturity as associated cause to the right. In those instances in which a specific infection (syphilis, toxoplasmosis, etc.) was found in the neonate, the assignment was made to the infectious disease; and if the infant was born immature, this condition was considered contributory and not a consequence of the infectious disease. In other words, only when the morbid condition was assigned to the mother was the immaturity considered a consequence.

Very few neonatal deaths from maternal conditions as underlying causes occurred after the first week of life, as can be seen in Table 40.

When neonatal deaths due to maternal conditions as underlying causes are distributed by birth-weight groups, interesting differences are observed (Table 45). Even though a certain number of babies dying from these causes in the neonatal period did not have birth weights recorded and the total numbers were small, the differences in percentages in some projects are worthy of note. Thus, while in Monterrey 37.7 per cent of these deaths occurred in neonates with birth weights above 2,500 grams and 13.2 per cent occurred in those weighing 1,000 grams or less, the percentages for the California project were 10.0 and 40.0 or almost the reverse. The explanation for these differences is not clear. Apart from the completeness of information on deaths of babies of low birth weight, factors such as quality of medical attention and incidence of diseases such as maternal diabetes could be responsible and these possibilities warrant clarification, through the recording of accurate basic data on birth weight and on condition of the product at birth and in succeeding days.

TABLE 45. Neonatal Deaths from Maternal Conditions as Underlying Causes by Birth Weight[a] in 15 Projects.

Birth weight in grams[b]	ARGENTINA Chaco Province		ARGENTINA San Juan Province		BOLIVIA project		BRAZIL Recife		BRAZIL Ribeirão Prêto		BRAZIL São Paulo		CANADA Sherbrooke		CHILE project	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Total	25	100.0	40	100.0	55	100.0	28	100.0	20	100.0	106	100.0	20	100.0	88	100.1
1000 or less	4	22.2	10	27.8	4	10.3	4	25.0	5	27.8	16	17.4	7	35.0	21	23.9
1100-1500	3	16.7	8	22.2	9	23.1	6	37.5	2	11.1	22	23.9	5	25.0	27	30.7
1600-2000	5	27.8	9	25.0	11	28.2	2	12.5	8	44.4	20	21.7	2	10.0	20	22.7
2100-2500	4	22.2	3	8.3	10	25.6	1	6.2	1	5.6	16	17.4	2	10.0	8	9.1
2501 and over	2	11.1	6	16.7	5	12.8	3	18.8	2	11.1	18	19.6	4	20.0	12	13.7
Unknown	7		4		16		12		2		14					

Birth weight in grams[b]	COLOMBIA Cali		COLOMBIA Cartagena		COLOMBIA Medellin		EL SALVADOR project		JAMAICA Kingston-St. Andrew		MEXICO Monterrey		UNITED STATES California project	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Total	50	99.9	32	99.9	37	100.0	84	100.1	110	99.9	81	100.0	51	100.0
1000 or less	4	10.8	5	17.2	8	21.2	18	24.0	26	25.5	7	13.2	20	40.0
1100-1500	12	32.4	4	13.8	9	27.3	23	30.7	34	33.3	9	17.0	12	24.0
1600-2000	10	27.0	8	27.6	7	21.2	20	26.7	23	22.5	10	18.9	9	18.0
2100-2500	4	10.8	7	24.1	3	9.1	5	6.7	10	9.8	7	13.2	4	8.0
2501 and over	7	18.9	5	17.2	6	18.2	9	12.0	9	8.8	20	37.7	5	10.0
Unknown	13		3		4		9		8		28		1	

[a] Percentage distribution based on deaths with weights known.
[b] Rounded to hundreds of grams except for 2501-2549, included in 2301 grams and over.

NEONATAL MORTALITY FROM CERTAIN COMPLICATIONS OF PREGNANCY AND CHILDBIRTH (769)

Category 769, other complications of pregnancy and childbirth, includes a group of important miscellaneous conditions such as multiple pregnancy, premature rupture of membranes, hydramnios, threatened abortion, antepartum and intrapartum hemorrhage unspecified, and others. Table 46 and Figure 49 illustrate the magnitude of mortality from these conditions in the various projects. The neonatal death rates from all these conditions combined varied between 599.3 per 100,000 live births in San Juan Province and 244.6 in the Bolivia project. Table 47 gives totals for the 15 projects combined.

Premature rupture of membranes, that is, rupture occurring prior to onset of labor, was the underlying cause of 550 neonatal deaths in all 15 projects and an associated cause in an additional 162 (Table 47). Its importance as underlying or associated cause lies mainly in its role as triggering factor in premature delivery (spontaneous or provoked rupture of membranes) and as a very common cause of ascendent intrauterine infection when the rupture is pro-

TABLE 46. Neonatal Mortality[a] from Certain Complications of Pregnancy and Childbirth as Underlying Causes and with Immaturity as Associated Cause (Consequence) in 15 Projects.

Project	Underlying cause										Associated cause	
	Total (769)		Premature rupture of membranes (769.1)		Hydramnios (769.2)		Multiple pregnancy (769.4)		Other complications (769.0, 769.3, 769.9)		Immaturity as consequence (777)	
	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate
Total	1,892	399.1	550	116.0	72	15.2	815	171.9	455	96.0	1,779	375.3
ARGENTINA												
Chaco Province	77	437.5	5	28.4	2	11.4	55	312.5	15	85.2	74	420.5
San Juan Province	140	599.3	29	124.1	4	17.1	79	338.2	28	119.9	131	560.8
BOLIVIA project	92	244.6	18	47.9	3	8.0	47	125.0	24	63.8	85	226.0
BRAZIL												
Recife	128	421.1	10	32.9	3	9.9	85	279.6	30	98.7	123	404.6
Ribeirão Prêto	80	438.6	15	82.2	3	16.4	48	263.2	14	76.8	75	411.2
São Paulo	250	429.8	50	86.0	7	12.0	117	201.2	76	130.7	240	412.7
CANADA												
Sherbrooke	44	259.3	7	41.2	1	5.9	9	53.0	27	159.1	44	259.3
CHILE project	228	523.2	108	247.8	10	22.9	68	156.0	42	96.4	221	507.1
COLOMBIA												
Cali	76	360.2	25	118.5	4	19.0	30	142.2	17	80.6	68	322.3
Cartagena	61	340.8	14	78.2	2	11.2	26	145.3	19	106.1	57	318.4
Medellín	75	386.6	25	128.9	—	—	35	180.4	15	77.3	68	350.5
EL SALVADOR project	117	377.2	39	125.7	6	19.3	42	135.4	30	96.7	109	351.4
JAMAICA												
Kingston-St. Andrew	189	461.4	80	195.3	3	7.3	56	136.7	50	122.1	178	434.6
MEXICO												
Monterrey	208	392.4	80	150.9	22	41.5	80	150.9	26	49.0	182	343.3
UNITED STATES												
California project	127	283.9	45	100.6	2	4.5	38	84.9	42	93.9	124	277.2

[a] Rates per 100,000 live births.

FIG. 49. Neonatal Mortality from Certain Complications of Pregnancy and Childbirth as Underlying Causes and with Immaturity as Associated Cause (Consequence) in 15 Projects.

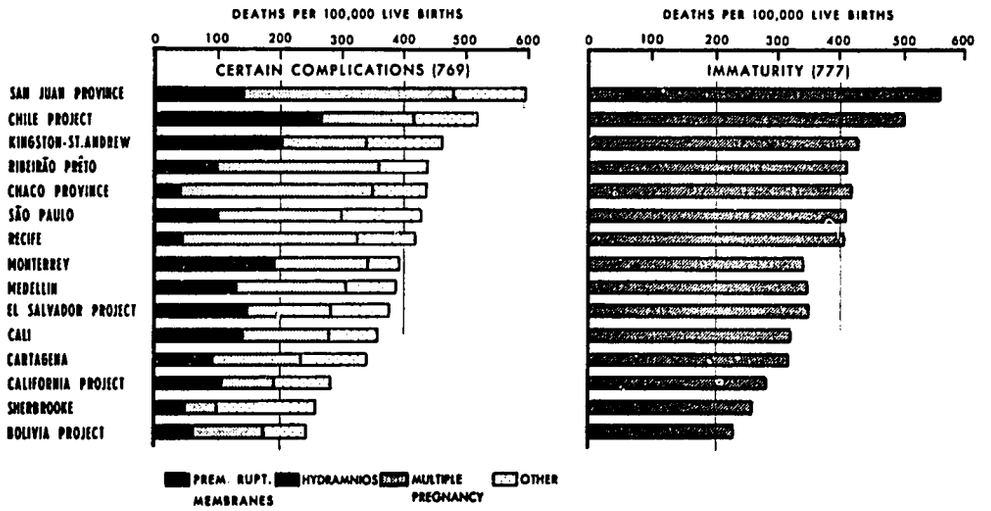


TABLE 47. Certain Complications of Pregnancy and Childbirth as Underlying or Associated Causes of Neonatal Deaths in 15 Projects Combined.

Cause	Underlying	Associated
Total (769)	1,892	785
Premature rupture of membranes (769.1)	550	162
Hydramnios (769.2)	72	67
Multiple pregnancy (769.4)	815	449
Other (rest of 769)	455	107

longed (Ferguson *et al.*, 1963). Death rates from this condition ranged from 247.8 per 100,000 live births in the Chilean project to 28.4 in Chaco Province.

Hydramnios is an abnormal condition commonly associated with severe congenital anomalies (anencephaly, spina bifida, esophageal atresia, anomalies of urinary tract, and others) as well as with maternal problems (toxemia, multiple pregnancy, diabetes, syphilis, cardiac and renal disease) and with umbilical cord obstruction and erythroblastosis fetalis (Murray, 1964). Hydramnios was found to be the underlying cause of few neonatal deaths (72) in 14 projects. As associated cause it was assigned in only 67 deaths.

Multiple pregnancy—a common source of babies born before term and at greater risk of mortality, morbidity, and complications of pregnancy—is a condition requiring special attention from the standpoint of early diagnosis and management (Behrman, 1965). In 815 neonatal deaths, multiple pregnancy was assigned as the underlying cause. Rates varied from 338.2 per 100,000 live births in San Juan Province to 53.0 in Sherbrooke. The close relationship between multiple pregnancy and low birth weight was previously discussed in Chapter III.

Other complications of pregnancy and childbirth. Three of these conditions were frequently found as underlying or associated cause: incompetent cervix (769.0), antepartum or intrapartum hemorrhage unspecified and threatened abortion (769.9 for both). Lack of sufficient information has not permitted assignment of the latter two conditions to more specific categories such as partial premature separation of placenta, placenta previa, difficult labor due to pelvic abnormalities, etc.

The conditions included under category 769, described above, are closely related to immaturity, as can be observed in the right portions of Figure 49 and Table 46. Immaturity in neonates dying from these conditions as underlying causes was considered to be a consequence in all instances, which indicates the need for their prevention and special management. In several instances the premature birth was precipitated by artificial rupture of membranes through "abortive" procedures (followed usually by intrauterine infection) and therefore prevention of mortality under these circumstances requires measures of a different nature.

The percentage distribution by birth weight of deaths from conditions included in category 769 is presented in Table 48 for the 15 projects. Between 75 and 98 per cent of all neonatal deaths from these causes occurred in babies born with weights of 2,000 grams or less. In the Sherbrooke and California projects 68.2 and 58.4 per cent weighed 1,000 grams or less at birth. Although this category includes multiple births, which have been considered the most important single cause of low birth weight, in some projects other causes of spontaneous and provoked interruption of pregnancy account for significant proportions of these neonatal deaths with very low birth weights.

TABLE 48. Neonatal Deaths from Certain Complications of Pregnancy and Childbirth as Underlying Causes by Birth Weight[a] in 15 Projects.

Birth weight in grams[b]	ARGENTINA Chaco Province		ARGENTINA San Juan Province		BOLIVIA project		BRAZIL Recife		BRAZIL Ribeirão Prêto		BRAZIL São Paulo		CANADA Sherbrooke		CHILE project	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Total	77	100.0	140	100.1	92	100.1	128	99.9	80	100.0	250	100.0	44	100.1	228	99.9
1000 or less	14	23.3	30	22.1	19	28.4	22	28.9	17	24.6	84	36.7	30	68.2	59	26.9
1100-1500	24	40.0	48	35.3	26	38.8	25	32.9	24	34.8	60	26.2	5	11.4	81	37.0
1600-2000	16	26.7	39	28.7	13	19.4	20	26.3	20	29.0	57	24.9	8	18.2	57	26.0
2100-2500	5	8.3	11	8.1	5	7.5	6	7.9	6	8.7	20	8.7	1	2.3	16	7.3
2501 and over	1	1.7	8	5.9	4	6.0	3	3.9	2	2.9	8	3.5	—	—	6	2.7
Unknown	17		4		25		52		11		21		—		9	

Birth weight in grams[b]	COLOMBIA Cali		COLOMBIA Cartagena		COLOMBIA Medellín		EL SALVADOR project		JAMAICA Kingston-St. Andrew		MEXICO Monterrey		UNITED STATES California project	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Total	76	100.0	61	100.1	75	100.0	117	100.0	189	99.9	208	99.9	127	100.0
1000 or less	17	31.5	20	36.4	21	29.2	37	37.0	58	32.6	32	21.3	73	58.4
1100-1500	17	31.5	18	32.7	26	36.1	26	26.0	72	40.4	50	33.3	31	24.8
1600-2000	12	22.2	10	18.2	15	20.8	23	23.0	34	19.1	30	20.0	13	10.4
2100-2500	4	7.4	4	7.3	6	8.3	8	8.0	4	2.2	18	12.0	5	4.0
2501 and over	4	7.4	3	5.5	4	5.6	6	6.0	10	5.6	20	13.3	3	2.4
Unknown	22		6		3		17		11		58		2	

[a] Percentage distribution based on deaths with weights known.
[b] Rounded to hundreds of grams except for 2501–2549, included in 2501 grams and over.

NEONATAL MORTALITY FROM CONDITIONS OF PLACENTA AND CORD (770, 771)

Certain conditions of the placenta and umbilical cord were the underlying causes of 801 deaths and were assigned as associated causes in 265 deaths, as is shown in the summary Table 49.

Conditions of Placenta (770)

These include principally placenta previa (770.0) and premature separation (770.1), both responsible for serious complications such as antepartum and intrapartum hemorrhage, fetal distress, and premature delivery. Other abnormalities of the placenta and membranes (rest of 770) were found much less frequently, as can be seen in Table 50 and Figure 50.

Neonatal death rates from placenta previa as underlying cause ranged from 145.3 per 100,000 live births in Cartagena to 16.4 in Ribeirão Prêto. Only 17 neonatal deaths were found in which this condition acted as associated cause. Among the causes of antepartum hemorrhage, placenta previa is usually the less common (Butler and Alberman, 1969). However, since it is also the one in which the serious complications (including fetal and neonatal death) are more

TABLE 49. Certain Conditions of Placenta and Cord as Underlying or Associated Causes of Neonatal Deaths in 15 Projects Combined.

Cause	Underlying	Associated
Total (770, 771)	801	265
Conditions of placenta (770)	590	84
Placenta previa (770.0)	305	17
Premature separation (770.1)	261	59
Other (rest of 770)	24	8
Conditions of cord (771)	211	181

susceptible of being prevented, early recognition and adequate management are obviously important.

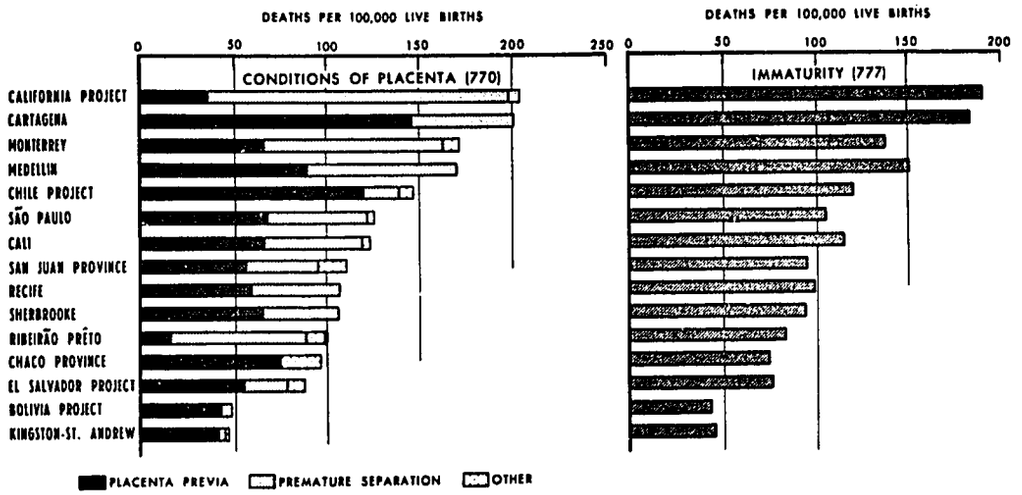
Premature separation of placenta (normally implanted) is ablation of the placenta occurring before the third stage of labor (expulsion period). Bleeding (concealed or apparent) is a constant sign. Abruptio placentae is an extensive separation and in certain studies has been reported to occur in about 20 per cent of patients with premature separation of placenta (Babson and Benson, 1966). Neonatal mortality from premature separation as underlying cause varied from 160.9 per 100,000 live births in the California project to 5.3 in Bolivia and 4.9 in Kingston-St. Andrew. In 59 deaths this condition was an associated cause.

TABLE 50. Neonatal Mortality[a] from Certain Conditions of Placenta and Cord as Underlying Causes and with Immaturity as Associated Cause in 15 Projects.

Project	Underlying cause										Associated cause			
	Conditions of placenta (770)								Conditions of cord (771)		Immaturity (777)			
	Total		Placenta previa (770.0)		Premature separation (770.1)		Other (rest of 770)				Consequence of conditions of placenta (770)		Contributory to conditions of cord (771)	
	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate
Total	590	124.5	305	64.3	261	55.1	24	5.1	211	44.5	513	108.2	80	16.9
ARGENTINA														
Chaco Province	17	96.6	13	73.9	4	22.7	—	—	7	39.8	13	73.9	—	—
San Juan Province	26	111.3	13	55.7	9	38.5	4	17.1	24	102.7	22	94.2	10	42.8
BOLIVIA project	18	47.9	16	42.5	2	5.3	—	—	24	63.8	16	42.5	12	31.9
BRAZIL														
Recife	33	108.6	18	59.2	15	49.3	—	—	25	82.2	30	98.7	16	52.6
Ribeirão Prêto	18	98.7	3	16.4	13	71.3	2	11.0	7	38.4	15	82.2	2	11.0
São Paulo	73	125.5	39	67.1	33	56.7	1	1.7	24	41.3	61	104.9	10	17.2
CANADA														
Sherbrooke	18	106.1	11	64.8	7	41.2	—	—	2	11.8	16	94.3	1	5.9
CHILE project	64	146.9	52	119.3	8	18.4	4	9.2	18	41.3	53	121.6	8	18.4
COLOMBIA														
Cali	26	123.2	14	66.4	11	52.1	1	4.7	7	33.2	24	113.7	—	—
Cartagena	36	201.1	26	145.3	10	55.9	—	—	4	22.3	33	184.4	—	—
Medellín	33	170.1	17	87.6	16	82.5	—	—	5	25.8	29	149.5	1	5.2
EL SALVADOR project	27	87.0	17	54.8	7	22.6	3	9.7	16	51.6	24	77.4	7	22.6
JAMAICA														
Kingston-St. Andrew	19	46.4	16	39.1	2	4.9	1	2.4	11	26.9	18	43.9	4	9.8
MEXICO														
Monterrey	91	171.7	34	64.1	52	98.1	5	9.4	25	47.2	73	137.7	4	7.5
UNITED STATES														
California project	91	203.4	16	35.8	72	160.9	3	6.7	12	26.8	86	192.2	5	11.2

[a] Rates per 100,000 live births.

FIG. 50. Neonatal Mortality from Conditions of Placenta as Underlying Causes and with Immaturity as Associated Cause (Consequence) in 15 Projects.



Other abnormalities of the placenta and membranes (rest of 770) had low rates and were not diagnosed in six of the 15 projects; the highest rate was in San Juan Province, 17.1 per 100,000 live births.

The conditions of placenta (placenta previa, premature separation, and other abnormalities) are important causes of low birth weight because of premature birth, intrauterine malnutrition, or both. Whenever one of these conditions was underlying cause of a neonatal death and immaturity was associated, the latter was considered to be a consequence.

However, when immaturity was found as an associated cause in those neonatal deaths due to conditions of the umbilical cord as underlying causes, it was considered to be a contributory condition and not a consequence. Figure 50 shows in the left portion the rates for placental conditions as underlying causes, and in the right portion for those same causes the rates for immaturity as a consequence. The pattern of the total rates in the two portions is strikingly similar. In fact, of 590 deaths from these conditions, 513 or 86.9 per cent occurred in immature neonates. It was evident, moreover, that almost all deaths from these causes occurred in the first week of life (Table 40).

When neonatal deaths from conditions of placenta and cord as underlying causes and with birth weight stated were distributed by birth weight, only the projects in California and Sherbrooke showed percentages above 40 in the group of 1,000 grams or less. The total numbers of deaths from these causes were small in most projects and in a few (as in Recife and Monterrey) a sizable portion did not have weights recorded and thus data were not incorporated in this report.

Conditions of Umbilical Cord (771)

These conditions include compression, prolapse, and other accidents and abnormalities of the umbilical cord (knots, entanglement, varices, etc.) and were considered to be the underlying causes of death of small numbers of neonates in all projects.

Rates per 100,000 live births ranged from 102.7 in San Juan Province to 11.8 in Sherbrooke (Table 50). In an additional 181 deaths cord conditions were assigned as associated causes because of their share in fatal outcome through asphyxia (Table 49). Congenital anomalies of the umbilical cord are excluded from this category.

NEONATAL MORTALITY FROM DIFFICULT LABOR AND FROM BIRTH INJURY WITHOUT MENTION OF CAUSE (764–768, 772)

Included in this group are the different types of difficult labor due to abnormality of bones, organs, or tissues of pelvis (764), with disproportion but no mention of pelvic abnormality (765), with malposition (766), with abnormality of forces of labor (767), and with other and unspecified complications (768). A fourth digit in each category is used to specify the type of lesion or effect on the product, such as lesion to central nervous system (.0), spinal cord (.1), bone or nerves (.2), or other unspecified injury (.3), with asphyxia (.4), and without mention of injury or anoxia (.9). The group also includes injury to fetus without mention of cause (772). Only one type of difficult labor was assigned to each death as underlying or associated cause.

Of all neonatal deaths, 1,552 were due to difficult labor and birth injury as underlying causes. The rates ranged from 693.5 per 100,000 live births in San Juan Province to 93.9 in the California project (Table 51 and Figure 51). In 863 deaths these conditions were associated causes (Table 52).

Two categories of difficult labor—764 (with abnormality of bones, organs, or tissues of pelvis) and 765 (with disproportion but no mention of pelvic abnormality) —were responsible for 127 neonatal deaths in all projects. In only 27 additional deaths were these conditions found to act as associated causes.

Among all types of difficult labor (764-768), malposition of fetus (766) produced the highest death rates in nine projects. The range was from 291.1 per 100,000 live births in San Juan Province to 24.6 in the California project. The explanation for these wide differences is not available at this moment. In 408 neonatal deaths in all projects this group of difficult labor acted as associated cause.

Categories 767 (with abnormality of forces of labor) and 768 (with other and unspecified complications) were underlying causes in 475 deaths in all projects. The rates went from 235.4 in San Juan Province to 17.7 in Sherbrooke. It is probable that in several instances deaths assigned to these types of difficult birth could have been assigned to better-defined types if more data on the circumstances of delivery had been available.

Neonatal deaths due to birth injury without mention of cause (772) were found in all projects, with rates ranging from 171.1 in Recife to 33.5 in the California project.

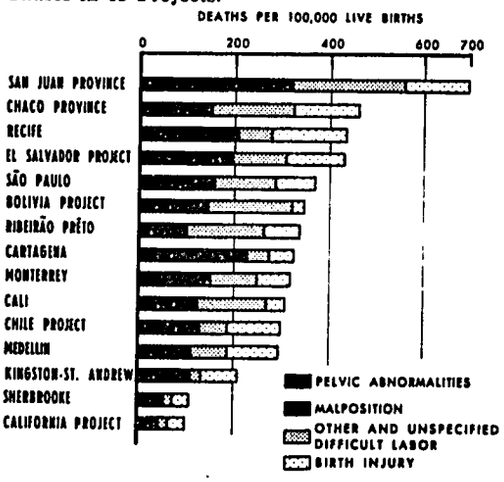
Mortality due to the various types of difficult labor (764–768) and birth injury (772) was found to be less frequently associated with immaturity than the maternal conditions. As can be seen in Table 51, 50 per cent or more of neonatal deaths from these causes occurred in immature infants

TABLE 51. Neonatal Mortality[a] from Specific Types of Difficult Labor and Birth Injury as Underlying Causes and with Immaturity as Associated Cause in 15 Projects.

Project	Underlying cause										Associated cause			
	Total (764–768, 772)		Pelvic abnormality, disproportion (764–765)		Malposition of fetus (766)		Other and unspecified difficult labor (767–768)		Birth injury unspecified (772)		Immaturity (777)			
											Contributory		Consequence	
	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate
Total	1,552	327.4	127	26.8	550	116.0	475	100.2	400	84.4	661	139.4	22	4.6
ARGENTINA														
Chaco Province	82	465.9	7	39.8	19	108.0	31	176.1	25	142.0	22	125.0	1	5.7
San Juan Province	162	693.5	7	30.0	68	291.1	55	235.4	32	137.0	69	295.4	2	8.6
BOLIVIA project	133	353.6	11	29.2	42	111.7	67	178.1	13	34.6	51	135.6	—	—
BRAZIL														
Recife	135	444.1	4	13.2	59	194.1	20	65.8	52	171.1	69	227.0	—	—
Ribeirão Prêto	62	339.9	3	16.4	15	82.2	30	164.5	14	76.8	18	98.7	—	—
São Paulo	214	368.0	20	34.4	71	122.1	76	130.7	47	80.8	91	156.5	2	3.4
CANADA														
Sherbrooke	18	106.1	2	11.8	7	41.2	3	17.7	6	35.4	8	47.1	1	5.9
CHILE project	132	302.9	13	29.8	43	98.7	26	59.7	50	114.7	77	176.7	1	2.3
COLOMBIA														
Cali	66	312.8	6	28.4	19	90.0	32	151.7	9	42.7	20	94.8	1	4.7
Cartagena	59	329.6	5	27.9	35	195.5	10	55.9	9	50.3	21	117.3	—	—
Medellín	58	299.0	3	15.5	19	97.9	15	77.3	21	108.2	28	144.3	2	10.3
EL SALVADOR project	134	432.0	9	29.0	51	164.4	37	119.3	37	119.3	80	257.9	—	—
JAMAICA														
Kingston-St. Andrew	86	210.0	4	9.8	40	97.7	11	26.9	31	75.7	39	95.2	—	—
MEXICO														
Monterrey	169	318.8	26	49.0	51	96.2	53	100.0	39	73.6	47	88.7	8	15.1
UNITED STATES														
California project	42	93.9	7	15.6	11	24.6	9	20.1	15	33.5	21	46.9	4	8.9

[a] Rates per 100,000 live births.

FIG. 51. Neonatal Mortality from Specific Types of Difficult Labor and Birth Injury as Underlying Causes in 15 Projects.



in only four projects (Recife, Chile, El Salvador, and California).

In nearly all deaths from difficult labor and birth injury associated with immaturity, this latter condition was a contributory cause. In a few deaths the underlying cause was assigned to an abnormality of the uterus (such as malformation, malposition, fibromyoma, or others causing premature delivery) and in these instances the immaturity was considered secondary to the uterine abnormality.

The distribution of neonatal deaths from difficult labor and birth injury by birth weight reveals interesting differences, in spite of the small numbers in some projects

TABLE 52. Specific Types of Difficult Labor and Birth Injury as Underlying or Associated Causes of Neonatal Deaths in 15 Projects Combined.

Cause	Underlying	Associated
Total (764-768, 772)	1,552	863
Pelvic abnormality or disproportion (764, 765)	127	27
Malposition of fetus (766)	550	408
Other and unspecified difficult labor (767, 768)	475	157
Birth injury unspecified (772)	400	271

and the significant proportions of deaths without birth weight recorded (Table 53). In nine of the 15 projects, 50 per cent or more of deaths from these causes occurred in babies weighing more than 2,500 grams. The lowest percentage in this weight group was found in El Salvador (33.0). In the weight group 1,000 grams or less there were no deaths in Cali, while in the California project the percentage was 23.8.

TABLE 53. Neonatal Deaths from Difficult Labor and Birth Injury as Underlying Causes by Birth Weight[a] in 15 Projects.

Birth weight in grams[b]	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
	ARGENTINA Chaco Province		ARGENTINA San Juan Province		BOLIVIA project		BRAZIL Recife		BRAZIL Ribeirão Prêto		BRAZIL São Paulo		CANADA Sherbrooke		CHILE project	
Total	82	100.0	162	100.0	133	100.0	135	100.1	62	100.0	214	100.0	18	100.1	132	100.1
1000 or less	1	1.7	1	0.6	2	2.2	1	1.3	2	4.0	14	7.3	2	11.8	3	2.4
1100-1500	1	1.7	24	15.5	9	10.0	13	16.7	—	—	14	7.3	4	23.5	21	16.5
1600-2000	8	13.6	26	16.8	16	17.8	17	21.8	7	14.0	28	14.6	1	5.9	27	21.3
2100-2500	5	8.5	18	11.6	16	17.8	11	14.1	5	10.0	28	14.6	2	11.8	27	21.3
2501 and over	44	74.6	86	55.5	47	52.2	36	46.2	36	72.0	108	56.2	8	47.1	49	38.6
Unknown	23		7		43		57		12		22		1		5	
	COLOMBIA Cali		COLOMBIA Cartagena		COLOMBIA Medellín		EL SALVADOR project		JAMAICA Kingston-St. Andrew		MEXICO Monterrey		UNITED STATES California project			
Total	66	100.0	59	100.0	58	99.9	134	100.0	86	99.9	169	100.0	42	99.9		
1000 or less	—	—	1	2.2	2	3.8	13	11.3	10	12.8	3	2.5	10	23.8		
1100-1500	2	7.4	7	15.6	10	19.2	21	18.3	10	12.8	7	5.9	8	19.0		
1600-2000	4	14.8	5	11.1	9	17.3	25	21.7	14	17.9	15	12.6	3	7.1		
2100-2500	4	14.8	5	11.1	9	17.3	18	15.7	5	6.4	15	12.6	4	9.5		
2501 and over	17	63.0	27	60.0	22	42.3	38	33.0	39	50.0	79	66.4	17	40.5		
Unknown	39		14		6		19		8		50		—			

[a] Percentage distribution based on deaths with weights known.
[b] Rounded to hundreds of grams except for 2501-2549, included in 2501 grams and over.

NEONATAL MORTALITY FROM ANOXIC AND HYPOXIC CONDITIONS (766)

Anoxia and hypoxia during the various stages of delivery or early neonatal period constitute serious problems for several reasons. They are acute conditions and usually the complications of a wide variety of causes, and frequently accurate and timely diagnosis is difficult because of the emergency character of the situation. The

knowledge of exact causes necessary for preventive action is thus very often lacking. On the other hand, while complications in themselves, they give rise to various other severe and progressive consequences which if not arrested result in death or in serious permanent damage. Finally, their occurrence worsens the already deficient adaptive mechanisms, particularly those of low-birth-weight infants, and limits the success of corrective measures.

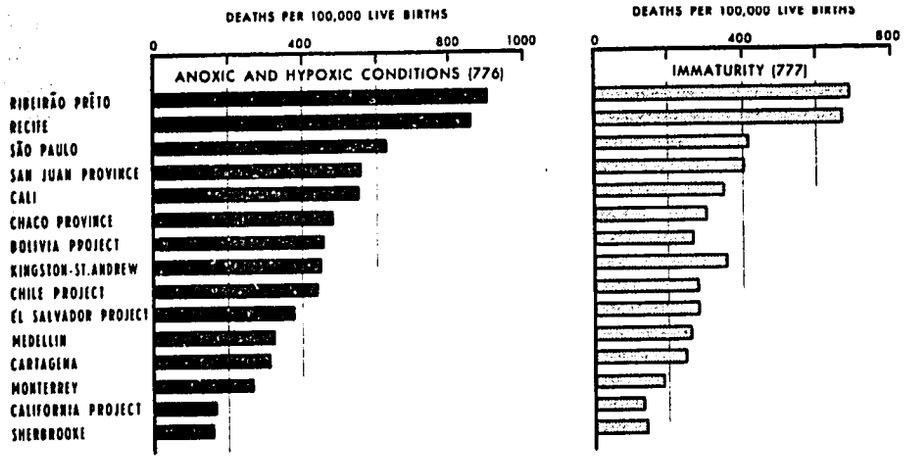
Anoxic or hypoxic conditions after birth can be the consequence of a number of obstetric causes, of acquired or congenital morbid conditions in the newborn, or other causes and factors, some of them acting through mechanisms not yet well understood. Table 54 and Figure 52 (left portion) show the neonatal deaths due to anoxic and hypoxic conditions (not elsewhere specified) as underlying causes. The rates ranged from 904.6 and 855.3 per 100,000 live births in Ribeirão Prêto and Recife to 163.2 and 153.2 in the California and Sherbrooke projects. Within this category (776), the conditions known as respiratory distress syndrome and hyaline membrane disease (776.2 and 776.1) are grouped together since the latter was not always confirmed by X-rays or autopsy studies and the two

TABLE 54. Neonatal Mortality[a] from Anoxic and Hypoxic Conditions as Underlying Causes and with Immaturity as Associated Cause (Contributory) in 15 Projects.

Project	Underlying cause										Associated cause	
	Total (776)		Fetal distress, anoxia (776.3, 776.4)		Aspiration of content of birth canal (776.0)		Respiratory distress (776.1, 776.2)		Asphyxia of newborn (776.9)		Immaturity as contributory (777)	
	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate
Total	2,147	452.9	206	43.5	209	44.1	1,075	226.8	657	138.6	1,524	321.5
ARGENTINA												
Chaco Province	85	483.0	6	34.1	10	56.8	20	113.6	49	278.4	54	306.8
San Juan Province	131	560.8	14	59.9	14	59.9	81	346.7	22	94.2	94	402.4
BOLIVIA project	173	460.0	3	8.0	11	29.2	47	125.0	112	297.8	101	268.5
BRAZIL												
Recife	260	855.3	25	82.2	15	49.3	105	345.4	115	378.3	204	671.1
Ribeirão Prêto	165	904.6	30	164.5	28	153.5	91	498.9	16	87.7	125	685.3
São Paulo	364	625.9	41	70.5	32	55.0	152	261.3	139	239.0	239	410.9
CANADA												
Sherbrooke	26	153.2	—	—	2	11.8	18	106.1	6	35.4	24	141.4
CHILE project	192	440.6	44	101.0	23	52.8	105	240.9	20	45.9	122	279.9
COLOMBIA												
Cali	117	554.5	6	28.4	15	71.1	68	322.3	28	132.7	74	350.7
Cartagena	56	312.8	4	22.3	9	50.3	35	195.5	8	44.7	44	245.8
Medellín	63	324.7	1	5.2	4	20.6	46	237.1	12	61.9	51	262.9
EL SALVADOR project	118	380.4	15	48.4	3	9.7	66	212.8	34	109.6	87	280.5
JAMAICA												
Kingston-St. Andrew	184	449.2	7	17.1	20	48.8	92	224.6	65	158.7	146	356.4
MEXICO												
Monterrey	140	264.1	7	13.2	22	41.5	94	177.3	17	32.1	99	186.8
UNITED STATES												
California project	73	163.2	3	6.7	1	2.2	55	122.9	14	31.3	60	134.1

[a] Rates per 100,000 live births.

FIG. 52. Neonatal Mortality from Anoxic and Hypoxic Conditions as Underlying Causes and with Immaturity as Contributory Cause in 15 Projects.



have a very similar clinical picture. Subcategories 776.4 and 776.9 should be considered as poorly defined underlying causes, their frequency being a sign of lack of diagnostic data. In various instances in which the only information available was that the newborn was a premature and suffered from some form of respiratory distress or hypoxia, the underlying cause was assigned to the hypoxic condition and the prematurity was considered a contributory cause. This procedure was adopted because of the international rules excluding the assignment of immaturity as underlying cause when another cause of perinatal mortality is present.

Figure 52 shows a fairly close correspondence between neonatal death rates from anoxic and hypoxic conditions (776) as underlying causes and those for immaturity as contributory cause, though the rates for immaturity were lower. In Ribeirão Prêto and Recife, for example, where the rates for these conditions were 904.6 and 855.3 per 100,000 live births, those for immaturity as contributory cause were 685.3 and 671.1 (Table 54); and in the California project the rates were 163.2 and 134.1, respectively.

The above-mentioned factors possibly involved in the different distribution patterns of neonatal deaths by birth weight also apply for deaths from anoxic and hypoxic conditions as underlying causes. There is, however, another factor related to classification procedures and affected by the availability of diagnostic data: many neonatal deaths of low-birth-weight infants are assigned to this category because there is no other specific cause to explain either the immaturity or the acute hypoxic condition and because in the presence of any specific condition (including hypoxia) and immaturity, the former is selected as underlying cause of death.

OTHER DISEASES OF THE NEWBORN (774, 775, and 778)

Erythroblastosis fetalis, a common hemolytic disorder of the fetus and the newborn, is the result of maternal isoimmunization to fetal blood group antigens. The *International Classification of Diseases* provides two categories for hemolytic disease of the newborn: 774 when complicated by kernicterus, and 775 without mention of kernicterus.

In the 15 projects 213 neonatal deaths were assigned to hemolytic disease as underlying cause, and in only 45 deaths was one of these conditions considered an associated cause (Table 55). The rates as underlying and associated causes combined ranged from 119.3 and 107.0 per 100,000 live births in the Chilean project and in San Juan Province to 20.1 in the California project. These differences could be the result of various factors, including frequency of blood type incompatibilities in various population groups and extent of therapeutic management.

TABLE 55. Neonatal Mortality[a] from Hemolytic Disease of Newborn as Underlying or Associated Cause in 15 Projects.

Project	Total (774,775)		Underlying		Associated	
	No.	Rate	No.	Rate	No.	Rate
Total	258	54.4	213	44.9	45	9.5
ARGENTINA						
Chaco Province	12	68.2	12	68.2	—	—
San Juan Province	25	107.0	23	98.5	2	8.6
BOLIVIA project	8	21.3	7	18.6	1	2.7
BRAZIL						
Recife	10	32.9	10	32.9	—	—
Ribeirão Prêto	4	21.9	4	21.9	—	—
São Paulo	38	65.3	25	43.0	13	22.4
CANADA						
Sherbrooke	14	82.5	13	76.6	1	5.9
CHILE project	52	119.3	40	91.8	12	27.5
COLOMBIA						
Cali	11	52.1	10	47.4	1	4.7
Cartagena	7	39.1	7	39.1	—	—
Medellín	9	46.4	9	46.4	—	—
EL SALVADOR project	16	51.6	11	35.5	5	16.1
JAMAICA						
Kingston-St. Andrew	18	43.9	16	39.1	2	4.9
MEXICO						
Monterrey	25	47.2	21	39.6	4	7.5
UNITED STATES						
California project	9	20.1	5	11.2	4	8.9

[a] Rates per 100,000 live births.

The condition known as postmaturity (778.1) was found as underlying cause in only four deaths but was an associated cause in 80 (Table 56). Postmaturity is not used as underlying cause whenever another perinatal cause is diagnosed. Of the 84 neonatal deaths from postmaturity, 28 occurred in Monterrey, two as underlying and 26 as associated cause.

In subcategory 778.2, conditions characterized by internal or external hemorrhage are included under the heading of hemorrhagic disease of the newborn. In the 15 projects 181 neonatal deaths were assigned to these conditions as underlying cause and in 380 additional deaths they were found as associated cause. In many instances the hemorrhage had been found in autopsy, and therefore no traumatic origin was assigned (it being impossible to determine the real origin). In several of these deaths, the bleeding in an organ (lungs, adrenal, and even digestive tract) could have been the effect of profound metabolic changes induced by severe asphyxia.

TABLE 56. Other Conditions of Newborn as Underlying or Associated Causes of Neonatal Deaths in 15 Projects Combined.

Cause	Underlying	Associated
Other conditions of newborn (778)	259	1,132
Postmaturity (778.1)	4	80
Hemorrhagic disease of newborn (778.2)	181	380
Other (rest of 778)	74	672

RELATIONSHIP BETWEEN NEONATAL MORTALITY AND MATERNAL AGE AND INFANT'S BIRTH ORDER

Maternal Age

In two of the Latin American countries with projects in the Investigation (Chile and El Salvador) the distributions of live births were reported by age of mother for geographic subdivisions, and in three projects (Chaco Province, São Paulo, and Monterrey) the principal collaborators provided these basic data. Similar information was obtained for Sherbrooke from the principal collaborator, and for San Francisco and the four counties in the California project from the State Health Department. However, because of the small numbers of live births and deaths in the specific groups of causes in two of these seven projects (Chaco Province and Sherbrooke), data are presented here only for the other five (São Paulo, Chile, El Salvador, Monterrey, and California). These data are of great value for the analysis of factors bearing on the health and survival of products of conception, as can be seen from the following examples.

In four of the five projects, a constant pattern was discernible in the relationship between neonatal mortality due to certain perinatal causes (760–778) and age of the mother, the neonatal death rates being higher in the case of mothers less than 20 years of age (from 2,807.6 to 1,286.5 deaths per 100,000 live births). On the other hand in all five projects mothers in the age groups 20–24 years and 25–29 years had the most favorable rates from these causes. Finally, neonatal mortality increased significantly as maternal age increased, with rates for mothers aged 35 years and over ranging from 2,297.0 to 1,025.1 per 100,000 live births in the São Paulo and California projects, respectively (Table 57 and Figure 53). The pattern in the Chilean project, where the rate for mothers under 20 years (1,914.7) was lower than that for mothers aged 35 and over (2,068.8), may be due to

FIG. 53. Neonatal Mortality Due to Certain Perinatal Causes as Underlying Causes by Age of Mother in Five Projects.

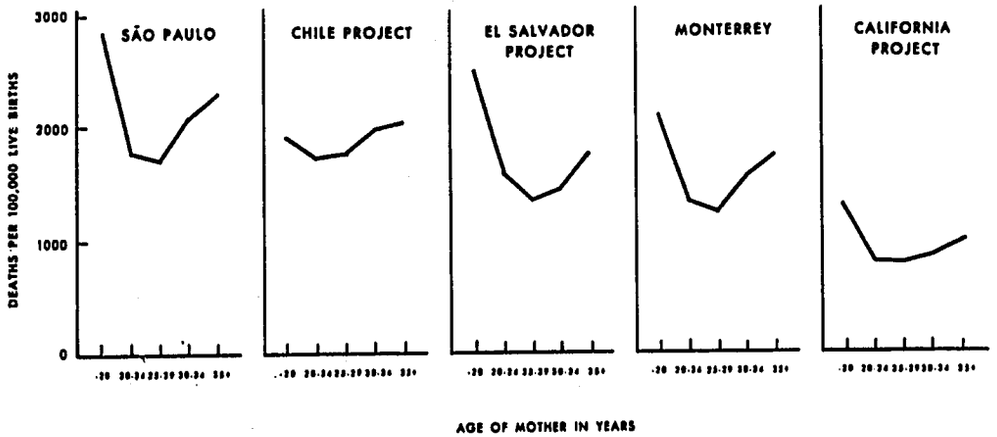


TABLE 57. Neonatal Mortality[a] Due to Certain Perinatal Causes as Underlying Causes by Age of Mother in Five Projects.

Age of mother	Brazil São Paulo	Chile project	El Salvador project	Mexico Monterrey	United States California project
Total	1,948.1	1,858.7	1,731.1	1,516.7	947.7
Under 20 years	2,807.6	1,914.7	2,522.2	2,113.5	1,286.5
20–24 years	1,768.7	1,752.5	1,612.4	1,356.6	864.4
25–29 years	1,706.4	1,781.2	1,368.5	1,290.8	856.0
30–34 years	2,065.5	1,999.8	1,484.2	1,600.0	935.1
35 years and over	2,297.0	2,068.8	1,811.0	1,768.5	1,025.1

[a] Rates per 100,000 live births.

a combination of factors, including family planning practices.

The analysis of neonatal mortality due to immaturity as underlying or associated cause by age of mother also reveals interesting relationships. There was a constant pattern in all five projects for which data on maternal age was utilized (Table 58 and Figure 54): rates for immaturity were consistently higher for young mothers (under 20 years) than for the remaining age groups, and they ranged from 3,682.9 to 1,456.0 per 100,000 live births in the São Paulo and California projects, respectively. In all projects the most favorable rates were those for products of mothers of intermediate age, and significant increases were noticed for neonates of mothers aged 35 years or over.

Table 59 and Figure 55 show the relationships between mother's age and neonatal mortality due to maternal conditions (760–763) as underlying causes in five projects. From these analyses it is apparent that the risk of dying in the neonatal period from these conditions is less for babies born to mothers in the age group 20–29 years than for those born to very young or older mothers.

For the deaths due to other complications of pregnancy and childbirth (769) a similar relationship is found with respect to mater-

FIG. 54. Neonatal Mortality Due to Immaturity as Underlying or Associated Cause by Age of Mother in Five Projects.

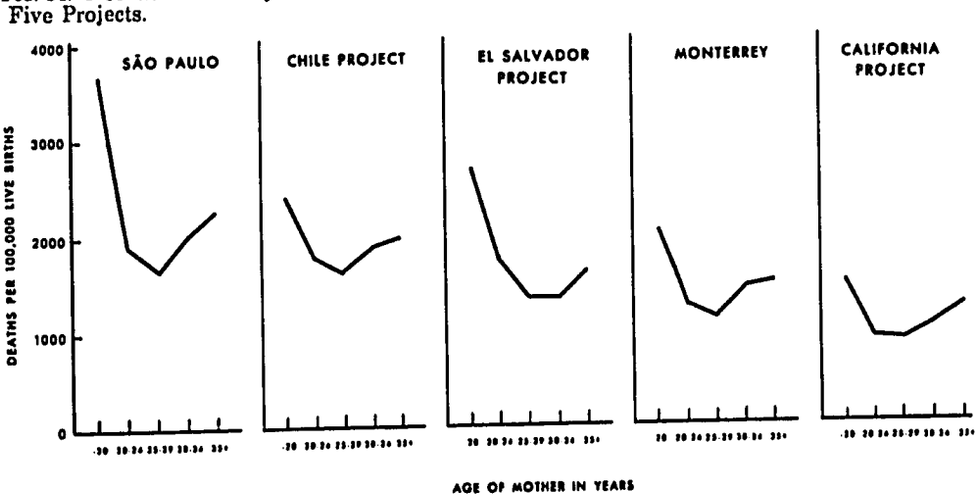


TABLE 58. Neonatal Mortality[a] Due to Immaturity as Underlying or Associated Cause by Age of Mother in Five Projects.

Age of mother	Brazil São Paulo	Chile project	El Salvador project	Mexico Monterrey	United States California project
Total	2,001.4	1,835.7	1,711.8	1,320.5	990.2
Under 20 years	3,682.9	2,364.9	2,658.0	1,993.0	1,456.0
20–24 years	1,867.3	1,735.8	1,701.2	1,222.6	882.5
25–29 years	1,613.0	1,601.4	1,305.0	1,075.0	824.5
30–34 years	1,998.4	1,859.4	1,297.0	1,398.7	988.0
35 years and over	2,223.5	1,946.2	1,575.9	1,483.7	1,208.0

[a] Rates per 100,000 live births.

TABLE 59. Neonatal Mortality[a] Due to Maternal Conditions as Underlying Causes by Age of Mother in Five Projects.

Age of mother	Brazil São Paulo	Chile project	El Salvador project	Mexico Monterrey	United States California project
Total	182.3	201.9	270.8	152.8	114.0
Under 20 years	195.4	229.1	369.7	256.6	183.4
20–24 years	136.8	171.5	257.7	97.1	78.9
25–29 years	166.3	145.9	209.9	80.5	86.2
30–34 years	191.2	290.0	279.1	203.1	158.4
35 years and over	323.9	263.6	259.8	272.3	182.6

[a] Rates per 100,000 live births.

FIG. 55. Neonatal Mortality Due to Maternal Conditions as Underlying Causes by Age of Mother in Five Projects.

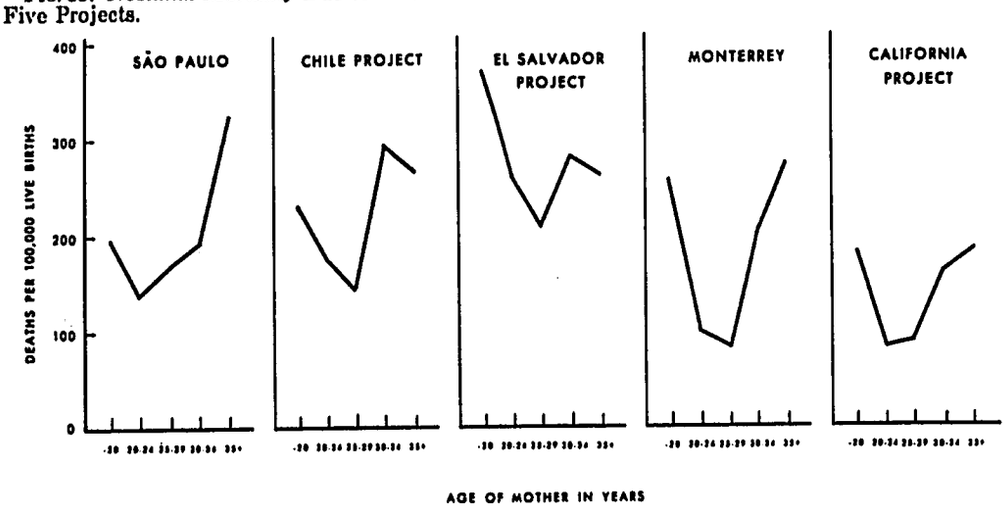


TABLE 60. Neonatal Mortality[a] Due to Complications of Pregnancy and Childbirth as Underlying Causes by Age of Mother in Five Projects.

Age of mother	Brazil São Paulo	Chile project	El Salvador project	Mexico Monterrey	United States California project
Total	429.8	523.2	377.2	392.4	283.9
Under 20 years	547.8	610.4	461.7	527.1	426.5
20–24 years	375.5	518.8	360.9	335.2	232.6
25–29 years	393.5	551.6	316.8	356.1	236.9
30–34 years	528.1	341.1	379.9	418.4	283.9
35 years and over	445.8	588.4	399.4	452.5	441.7

[a] Rates per 100,000 live births.

nal age (Table 60 and Figure 56), the babies born to mothers in the youngest and oldest age groups being at higher risk of dying from such conditions.

Anoxic and hypoxic conditions not elsewhere classified (776) exhibit an interesting pattern in the various projects included in this analysis. Mortality from these conditions was consistently higher in neonates of the youngest group of mothers, and tended to increase slightly in those born to the oldest mothers (at least in three of the five projects studied), as can be seen in Table 61 and Figure 57. Even in the most favorable maternal age groups differences are observed among the projects in these rates. Also worth noting are the great differences between the rates for neonates born to mothers in the youngest age group: mortality in São Paulo was nearly five times higher than in the California project (Figure 57 and Table 61).

FIG. 56. Neonatal Mortality Due to Complications of Pregnancy and Childbirth as Underlying Causes by Age of Mother in Five Projects.

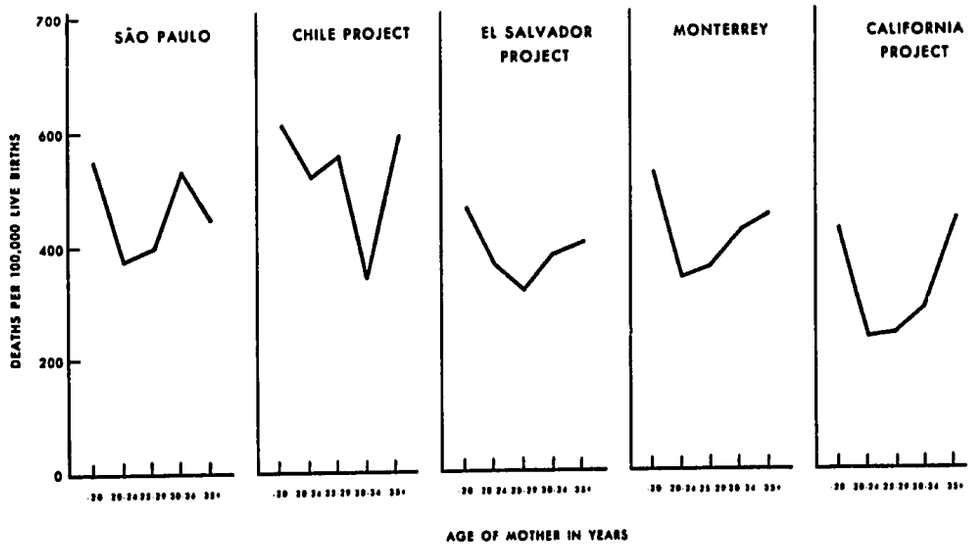
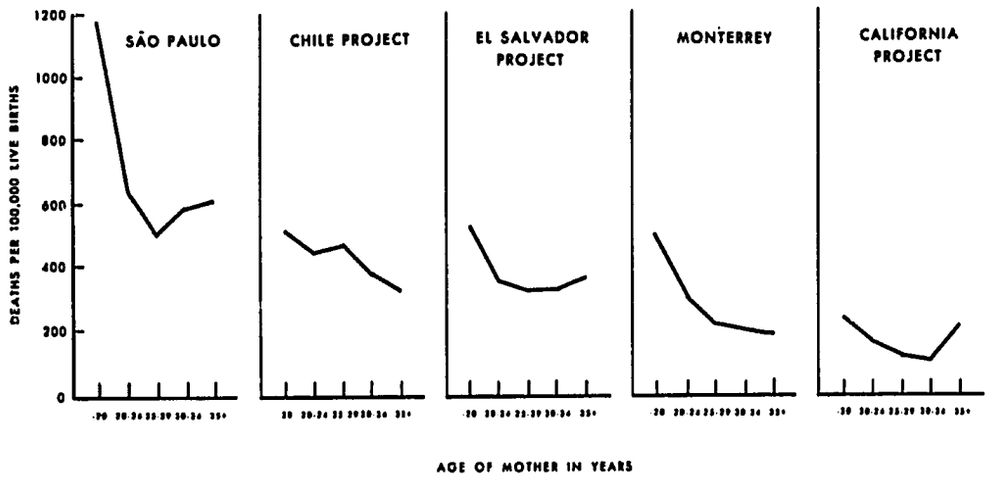


TABLE 61. Neonatal Mortality[a] Due to Anoxic and Hypoxic Conditions as Underlying Causes by Age of Mother in Five Projects.

Age of mother	Brazil São Paulo	Chile project	El Salvador project	Mexico Monterrey	United States California project
Total	625.9	440.6	380.4	264.1	163.2
Under 20 years	1,171.9	514.6	528.1	504.6	239.8
20–24 years	636.0	449.5	357.9	302.3	170.0
25–29 years	499.9	468.3	328.4	221.6	125.4
30–34 years	585.0	388.4	332.3	199.8	105.6
35 years and over	611.4	335.5	371.2	189.0	219.1

[a] Rates per 100,000 live births.

FIG. 57. Neonatal Mortality Due to Anoxic and Hypoxic Conditions as Underlying Causes by Age of Mother in Five Projects.



Birth Order

Data available on distribution of live births by birth order were suitable for use in only three projects (Chile, Monterrey, and California). The relationship between birth order and neonatal mortality from certain perinatal causes can be seen in Table 62 and Figure 58. The death rates increased rapidly after the first birth in two of the three projects and after the third birth in the Monterrey project. Infants of birth order 5 or higher were at the greatest risk of dying from perinatal causes during the neonatal period.

TABLE 62. Neonatal Mortality[a] Due to Certain Perinatal Causes as Underlying Causes by Birth Order in Three Projects.

Birth order	Chile project	Mexico Monterrey	United States California project
Total	1,858.7	1,516.7	947.7
1	1,361.9	1,218.8	646.1
2	1,626.9	1,201.7	853.8
3	1,999.9	1,151.4	1,239.4
4	2,168.1	1,335.1	1,703.0
5 and over	2,958.4	2,125.0	1,894.7

[a] Rates per 100,000 live births.

FIG. 58. Neonatal Mortality Due to Certain Perinatal Causes as Underlying Causes by Birth Order in Three Projects.

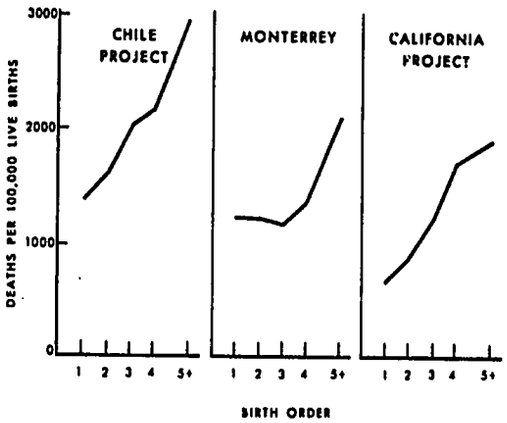
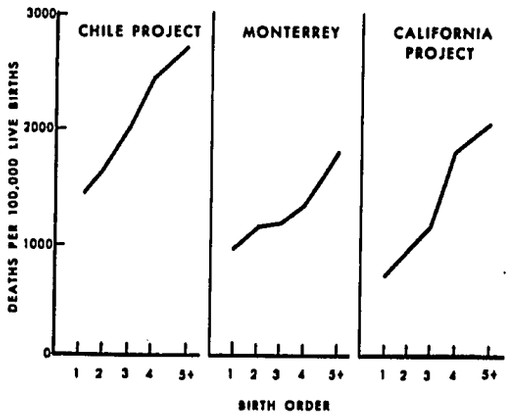


TABLE 63. Neonatal Mortality[a] Due to Immaturity as Underlying or Associated Cause by Birth Order in Three Projects.

Birth order	Chile project	Mexico Monterrey	United States California project
Total	1,835.7	1,320.5	990.2
1	1,378.5	902.8	692.8
2	1,606.9	1,127.4	923.3
3	1,975.2	1,153.2	1,143.8
4	2,423.1	1,305.2	1,802.7
5 and over	2,713.2	1,793.8	2,024.7

[a] Rates per 100,000 live births.

FIG. 59. Neonatal Mortality Due to Immaturity as Underlying or Associated Cause by Birth Order in Three Projects.



An even closer relationship was found in the same three projects between birth order and neonatal mortality from immaturity as underlying or associated cause (Table 63 and Figure 59). The death rates for immaturity for the first birth ranged from 1,378.5 per 100,000 live births in Chile to 692.8 in the California project. The rates for the same two projects for birth order 5 or higher were 2,713.2 and 2,024.7.

The relationships just described between neonatal mortality and maternal age and infant's birth order demonstrate the great importance of obtaining, recording, and utilizing information on age of mothers and the order of all births. The limited data presented above indicate the extent to which mortality from several perinatal causes varies with these two factors. Moreover, low-birth-weight babies are found more frequently among young mothers and thus data on birth weight as well need to be obtained for analyses of overall and specific mortality. Knowledge of these relationships would be extremely useful as bases for developing and evaluating programs in the field of maternal and child health.

NEONATAL MORTALITY FROM CAUSES OTHER THAN PERINATAL CAUSES

Neonatal death rates from the five other causes or groups of causes given in Table 40 (diarrheal disease, other infectious diseases, diseases of the respiratory system, congenital anomalies, and others) varied among the projects from 1,418.5 per 100,000 live births in São Paulo to 326.3 in the California project (Table 64 and Figure 60). These differences are due mainly to the high rates for diarrheal disease and diseases of the respiratory system, which in many of the Latin American projects acquire increasing importance after the first week of life, as was seen in Table 40. The variations also demonstrate that significant reductions in these causes of neonatal mortality could be achieved in certain areas, thus indicating the need for improvements in medical attention and health education.

Congenital anomalies constituted important causes of neonatal mortality and had rates of similar size in the various projects, with the exception of Sherbrooke, where the figure was very high because of the frequency of serious anomalies of the central nervous system, and the Bolivia project, which had a very low rate. Congenital anomalies are analyzed in detail in Chapter X.

Among the *infectious diseases,* diarrheal disease was by far the most important single underlying cause of death in the neonatal period. The rates ranged from 612.1 and 547.9 per 100,000 live births in São Paulo and San Juan Province to 4.5 in the California project. No diarrheal disease deaths were recorded in Sherbrooke. In the other 14 projects this morbid condition was responsible for 1,269 neonatal deaths as underlying cause (Table 40), of which only 89 occurred in the first week of life. In an additional 439 neonatal deaths, diarrheal disease acted as associated cause, making a total of 1,708 in which this disease was assigned either as underlying or as associated cause in 14 projects. Of the 1,269 deaths with this condition as underlying cause, immaturity was found as a contributory cause in 628 (49.5 per cent). Many of these latter deaths occurred during hospitalization for care of small-sized newborns, a fact that indicates the need for improving the facilities to prevent the spread of diarrheal disease in the hospital.

Certain other specific infections were found to be more frequently involved as underlying causes of death in the neonatal period than in the rest of the first five years of life. Among these, tetanus was the underlying cause of 172 deaths and of that number 155 occurred in the neonatal period and were the neonatorum type. Congenital syphilis was the underlying cause of death of 95 children under 5 years, and of these 49 were neonates. Maternal syphilis as underlying cause was responsible for 27 neonatal deaths, which raised to 76 the total due to this disease as underlying cause. Of the 33 deaths due to moniliasis as underlying cause in children under 5 years, 24 occurred in the neonatal period.

Diseases of the respiratory system were the underlying causes of 1,176 neonatal deaths in all projects and produced rates from 818.9 per 100,000 live births in the Bolivian project to 29.5 in Sherbrooke and 29.1 in the California project (Table 64). The magnitude of these rates is an indication of the important role of these diseases in neonatal mortality. However, their involvement is greatly increased when neo-

TABLE 64. Underlying and Associated Causes of Neonatal Deaths[a] and Immaturity as Associated Cause of Specific Underlying Causes in 15 Projects.

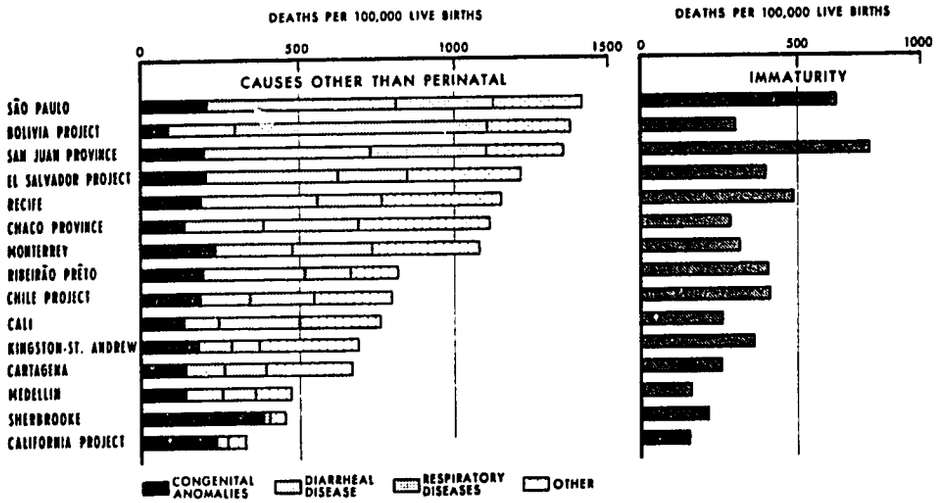
Cause	Underlying cause		Associated cause: Total		Associated cause: Immaturity	
	No.	Rate	No.	Rate	No.	Rate
ARGENTINA, Chaco Province						
All causes	568	3,227.3	487	2,767.0	244	1,386.4
Certain perinatal causes	370	2,102.3	375	2,130.7	193	1,096.6
Other causes	198	1,125.0	112	636.4	51	289.8
Diarrheal disease	46	261.4	4	22.7	13	73.9
Other infectious	39	221.6	19	108.0	9	51.1
Respiratory diseases	54	306.8	37	210.2	20	113.6
Congenital anomalies	23	130.7	8	45.5	4	22.7
Other	36	204.5	44	250.0	5	28.4
BRAZIL, Recife						
All causes	1,073	3,529.6	1,554	5,111.8	640	2,105.3
Certain perinatal causes	721	2,371.7	1,053	3,463.8	490	1,611.8
Other causes	352	1,157.9	501	1,648.0	150	493.4
Diarrheal disease	146	480.3	37	121.7	58	190.8
Other infectious	52	171.1	108	355.3	22	72.4
Respiratory diseases	62	203.9	133	437.5	35	115.1
Congenital anomalies	55	180.9	42	138.2	26	85.5
Other	37	121.7	181	595.4	9	29.6
CANADA, Sherbrooke						
All causes	229	1,349.4	366	2,156.7	157	925.2
Certain perinatal causes	152	895.7	282	1,661.8	119	701.2
Other causes	77	453.7	84	495.0	38	223.9
Diarrheal disease	—	—	—	—	—	—
Other infectious	1	5.9	3	17.7	1	5.9
Respiratory diseases	5	29.5	5	29.5	2	11.8
Congenital anomalies	65	383.0	63	371.2	31	182.7
Other	6	35.4	13	76.6	4	23.6
COLOMBIA, Cartagena						
All causes	401	2,240.2	629	3,514.0	235	1,312.8
Certain perinatal causes	280	1,564.2	429	2,396.6	188	1,050.3
Other causes	121	676.0	200	1,117.3	47	262.6
Diarrheal disease	23	128.5	9	50.3	14	78.2
Other infectious	31	173.2	41	229.1	6	33.5
Respiratory diseases	25	139.7	45	251.4	15	83.8
Congenital anomalies	23	128.5	34	189.9	6	33.5
Other	19	106.1	71	396.6	6	33.5
JAMAICA, Kingston-St. Andrew						
All causes	990	2,417.0	1,606	3,920.9	663	1,618.7
Certain perinatal causes	706	1,723.6	1,193	2,912.6	511	1,247.6
Other causes	284	693.4	413	1,008.3	152	371.1
Diarrheal disease	45	109.9	20	48.8	36	87.9
Other infectious	83	202.6	107	261.2	61	148.9
Respiratory diseases	36	87.9	104	253.9	24	58.6
Congenital anomalies	73	178.2	74	180.7	25	61.0
Other	47	114.7	108	263.7	6	14.6

Cause	Underlying cause		Associated cause: Total		Associated cause: Immaturity	
	No.	Rate	No.	Rate	No.	Rate
ARGENTINA, San Juan Province						
All causes	906	3,878.4	1,808	7,739.7	563	2,410.1
Certain perinatal causes	590	2,525.7	1,154	4,940.1	390	1,669.5
Other causes	316	1,352.7	654	2,799.7	173	740.6
Diarrheal disease	128	547.9	68	291.1	97	415.2
Other infectious	33	141.3	148	633.6	21	89.9
Respiratory diseases	88	376.7	161	689.2	41	175.5
Congenital anomalies	43	184.1	29	124.1	9	38.5
Other	24	102.7	248	1,061.6	5	21.4
BRAZIL, Ribeirão Prêto						
All causes	515	2,823.5	761	4,172.1	334	1,831.1
Certain perinatal causes	366	2,006.6	575	3,152.4	258	1,414.5
Other causes	149	816.9	186	1,019.7	76	416.7
Diarrheal disease	59	323.5	7	38.4	39	213.8
Other infectious	8	43.9	17	93.2	4	21.9
Respiratory diseases	29	159.0	56	307.0	16	87.7
Congenital anomalies	35	191.9	23	126.1	14	76.8
Other	18	98.7	83	455.0	3	16.4
CHILE project						
All causes	1,160	2,661.8	2,009	4,609.9	770	1,766.9
Certain perinatal causes	810	1,858.7	1,434	3,290.5	586	1,344.7
Other causes	350	803.1	575	1,319.4	184	422.2
Diarrheal disease	71	162.9	53	121.6	42	96.4
Other infectious	65	149.2	136	312.1	42	96.4
Respiratory diseases	89	204.2	180	413.0	47	107.8
Congenital anomalies	79	181.3	66	151.4	39	89.5
Other	46	105.6	140	321.2	14	32.1
COLOMBIA, Medellín						
All causes	383	1,974.2	666	3,433.0	249	1,283.5
Certain perinatal causes	291	1,500.0	498	2,567.0	217	1,118.6
Other causes	92	474.2	168	866.0	32	164.9
Diarrheal disease	23	118.6	7	36.1	10	51.5
Other infectious	10	51.5	51	262.9	5	25.8
Respiratory diseases	21	108.2	54	278.4	7	36.1
Congenital anomalies	26	134.0	18	92.8	8	41.2
Other	12	61.9	38	195.9	2	10.3
MEXICO, Monterrey						
All causes	1,377	2,597.6	2,178	4,108.7	642	1,211.1
Certain perinatal causes	804	1,516.7	1,354	2,554.2	471	888.5
Other causes	573	1,080.9	824	1,554.4	171	322.6
Diarrheal disease	130	245.2	51	96.2	55	103.8
Other infectious	96	181.1	156	294.3	48	90.5
Respiratory diseases	139	262.2	218	411.2	32	60.4
Congenital anomalies	121	228.3	60	113.2	33	62.3
Other	87	164.1	339	639.5	3	5.7

Cause	Underlying cause		Associated cause: Total		Associated cause: Immaturity	
	No.	Rate	No.	Rate	No.	Rate
BOLIVIA project						
All causes	1,091	2,900.8	1,072	2,850.3	440	1,169.9
Certain perinatal causes	572	1,520.9	721	1,917.0	324	861.5
Other causes	519	1,380.0	351	933.3	116	308.4
Diarrheal disease	83	220.7	20	53.2	23	61.2
Other infectious	27	71.8	38	101.0	14	37.2
Respiratory diseases	308	818.9	120	319.1	68	180.8
Congenital anomalies	27	71.8	21	55.8	4	10.6
Other	74	196.8	152	404.1	7	18.6
BRAZIL, São Paulo						
All causes	1,958	3,366.6	3,433	5,902.7	1,120	1,925.7
Certain perinatal causes	1,133	1,948.1	2,131	3,664.0	755	1,298.1
Other causes	825	1,418.5	1,302	2,238.7	365	627.6
Diarrheal disease	356	612.1	127	218.4	185	318.1
Other infectious	82	141.0	215	369.7	41	70.5
Respiratory diseases	184	316.4	334	574.3	82	141.0
Congenital anomalies	117	201.2	61	104.9	31	53.3
Other	86	147.9	565	971.5	26	44.7
COLOMBIA, Cali						
All causes	536	2,540.3	780	3,696.7	291	1,379.1
Certain perinatal causes	375	1,777.3	563	2,668.2	234	1,109.0
Other causes	161	763.0	217	1,028.4	57	270.1
Diarrheal disease	25	118.5	6	28.4	11	52.1
Other infectious	32	151.7	55	260.7	15	71.1
Respiratory diseases	54	255.9	77	364.9	24	113.7
Congenital anomalies	27	128.0	29	137.4	2	9.5
Other	23	109.0	50	237.0	5	23.7
EL SALVADOR project						
All causes	917	2,956.2	1,462	4,713.1	520	1,676.3
Certain perinatal causes	537	1,731.1	935	3,014.2	394	1,270.1
Other causes	380	1,225.0	527	1,698.9	126	406.2
Diarrheal disease	132	425.5	27	87.0	43	138.6
Other infectious	90	290.1	92	296.6	34	109.6
Respiratory diseases	69	222.4	185	596.4	25	80.6
Congenital anomalies	62	199.9	38	122.5	18	58.0
Other	27	87.0	185	596.4	6	19.3
UNITED STATES, California project						
All causes	570	1,274.0	1,163	2,599.5	424	947.7
Certain perinatal causes	424	947.7	872	1,949.0	351	784.5
Other causes	146	326.3	291	650.4	73	163.2
Diarrheal disease	2	4.5	3	6.7	2	4.5
Other infectious	14	31.3	29	64.8	7	15.6
Respiratory diseases	13	29.1	45	100.6	4	8.9
Congenital anomalies	105	234.7	170	380.0	54	120.7
Other	12	26.8	44	98.3	6	13.4

[a] Rates per 100,000 live births.

FIG. 60. Neonatal Mortality from Underlying Causes Other Than Certain Perinatal Causes, and with Immaturity as Associated Cause in 15 Projects.



natal deaths are studied by multiple causes. The death rates for these conditions as associated causes ranged from 689.2 and 596.4 in the San Juan Province and El Salvador projects to 29.5 in Sherbrooke. Of the 1,176 neonatal deaths from diseases of the respiratory system, 361 occurred within the first week of life and study of their records revealed that intrauterine infection or aspiration of amniotic fluid were two important determinants in these fatal respiratory conditions in neonates. Finally, in 442 (37.6 per cent) of the neonatal deaths due to respiratory diseases immaturity was assigned as a contributory cause.

The high death rates in the neonatal period for morbid conditions other than certain causes of perinatal mortality are observed principally after the first week of life, as was shown in Table 40. The causes are similar to those found in the postneonatal period and are due to exposure of infants to the hazards of unfavorable environment in hospitals and in the homes. Moreover, these same infants are highly vulnerable, as is indicated by the high rates found for immaturity as underlying or associated cause of death.

To reduce neonatal mortality, the health of the mother warrants first attention. Satisfactory weight at birth is essential for the infant's survival and health, and evidence has already been accumulated by Lechtig (1972) and Birch (1972) pointing to the relationship of birth weight to the mother's nutritional state and health. Many factors resulting from unfavorable environment produce their effects on the product of conception during intrauterine life through their influences on the mother. These same factors continue their adverse effects on the child directly as in the case of infection, or indirectly as with poor nutrition. Immaturity, then, is usually a consequence of complex factors in the mother and it constitutes a condition of increased vulnerability contributory to disease and death within this continuum of interrelationships.

Chapter VII

Mortality in Early Childhood

The excessive mortality recorded in Latin America for early childhood (as well as infancy) led to the specific recommendations for action that were adopted by the countries in the Charter of Punta del Este (Organization of American States, 1961). The period of early childhood (age 1–4 years) is the one in which mortality can be reduced to very low levels through application of existing knowledge. Studies of mortality in this age group, however, must take into account the experiences of infants in the first year of life, which to a great extent determine their chances of survival and future health. The infant is not necessarily healthy on reaching the first birthday, and in particular nutritional deficiencies may already be well established in many children by the time they reach late infancy and early childhood, as a result of poor intake of nutrients and/or repeated episodes of infectious diseases.

Horwitz (1960) used data for eight countries of the Americas to illustrate the excessive mortality in the age period 1–4 years, and singled out four socioeconomic values as having an inverse relation to mortality: countries with high death rates had low values in terms of availability of animal protein, provision of water supplies, per-capita income, and literacy levels. Even the crude data for the countries, without consideration of differences in urban and rural areas, clearly revealed the interrelationships. Horwitz pointed out that the problems' solution depended on a broad program for socioeconomic development as well as on specific health programs.

The data provided by this Investigation on mortality in relation to these socioeconomic values are much more complete and reliable than those previously available. However, data on per-capita income obtained from families were found to be inadequate in the pilot phase of the Investigation and were not included. The analysis of mortality by multiple causes has uncovered information on the effect of lack of protein and calories, as reflected in the data on nutritional deficiency as a cause of death.

Recent studies by Kitagawa and Hauser (1968) and Rosenwaike (1971) indicate the usefulness of referring to educational level of the mother as an overall measure of socioeconomic variables in relation to child mortality. In Chapter XIV mortality in early childhood is analyzed in relation to the mother's educational level. In Chapter XVI infant mortality is considered in relation to environmental factors, especially provision of water supplies.

This chapter presents first a broad view of mortality in this four-year age group, and then an analysis of mortality in the second year of life, a critical age period in develop-

ing countries, as was made clear by Gordon *et al.* (1967). Mortality in the ages 2–4 years is relatively low in many of these areas, and therefore is discussed for that three-year age group combined, and not by single years of life.

MORTALITY IN CHILDREN 1–4 YEARS OF AGE

In all areas in the Latin American projects, with but two exceptions, more than half the deaths in this four-year age group were in the second year of life, that is, at one year of age. The exceptions were the interior city of Franca and rural El Salvador.

The wide variations in mortality in this age group were illustrated previously in Figure 35 (Chapter IV).

When mortality was high, the group of infectious diseases usually was responsible for more than half the deaths. Table 65 gives the numbers and rates for all causes and for infectious diseases as underlying causes, with subdivisions for diarrheal disease, measles, and other infective and parasitic diseases. These data for the 25 areas are presented in two figures: the 13 areas with higher rates appear in Figure 61 and the 12 with lower rates in Figure 62 (with a smaller scale).

The role of the infectious diseases differs markedly in these two groups of areas; in the first, more than half the deaths from all causes were due to these diseases (with one exception, Franca). In fact in the rural *municipios* of El Salvador more than two-thirds of the deaths resulted from infectious diseases.

In the 12 areas with lower rates (Figure 62) infectious diseases were responsible for half the deaths in only one area, the city of Ribeirão Prêto. In cities such as San Juan and Santiago only 29 and 23 per cent of the deaths were due to this group of causes. In San Francisco only one of the 25 deaths of children aged 1–4 years had an infectious disease as underlying cause, and in the suburban counties of California only four of 89.

Although diarrheal disease was responsible for high death rates in several areas in this age group, measles also was an important contributor to mortality. In Recife and São Paulo it caused over twice as many deaths as did diarrheal disease. In Viacha and La Paz, the rates for measles were nearly as high as those for diarrheal disease.

In analyzing the role of infectious diseases as underlying causes in this age group, it is necessary to consider also the part played by nutritional deficiency as underlying or associated cause. These data are presented in Table 66. The associated causes have been divided into those in which nutritional deficiency was a contributor and those in which it appeared as a consequence.

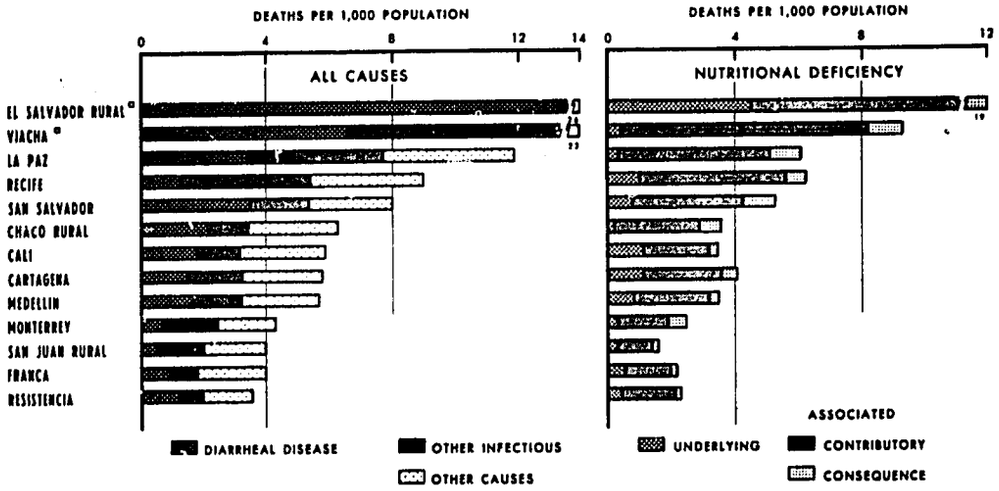
The close relationship between death rates for nutritional deficiency and those for all causes can be seen clearly in Figure 61. The rates for this deficiency as a contributory cause were high. It seems evident, therefore, that to reduce mortality from all causes, prevention of this condition as well as of infectious diseases is essential; deaths from infectious diseases often occur in precisely those children who are most susceptible, i.e., those with nutritional deficiency.

TABLE 65. Mortality[a] of Children 1–4 Years of Age from All Causes and from Infectious Diseases as Underlying Cause in 25 Areas of 15 Projects.

Area	All causes		Infectious diseases							
			Total		Diarrheal disease		Measles		Other	
	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate
ARGENTINA										
Chaco Province										
Resistencia	117	3.6	66	2.0	39	1.2	14	0.4	13	0.4
Rural departments	174	6.3	98	3.5	62	2.2	16	0.6	20	0.7
San Juan Province										
San Juan (city)	31	1.5	9	0.4	2	0.1	5	0.2	2	0.1
Suburban departments	84	2.9	24	0.8	7	0.2	13	0.5	4	0.1
Rural departments	141	4.0	72	2.0	19	0.5	35	1.0	18	0.5
BOLIVIA										
La Paz	1,430	11.9	922	7.7	420	3.5	403	3.4	99	0.8
Viacha	56	21.7	34	13.2	17	6.6	14	5.4	3	1.2
BRAZIL										
Recife	862	9.0	518	5.4	127	1.3	267	2.8	124	1.3
Ribierão Prêto										
Ribeirão Prêto (city)	64	1.9	34	1.0	6	0.2	21	0.6	7	0.2
Franca	70	4.0	31	1.8	16	0.9	7	0.4	8	0.5
Communities	33	2.4	14	1.0	7	0.5	5	0.4	2	0.1
São Paulo	524	2.8	218	1.2	51	0.3	104	0.6	63	0.3
CANADA										
Sherbrooke	61	0.8	3	0.0	1	0.0	1	0.0	1	0.0
CHILE										
Santiago	282	1.8	64	0.4	36	0.2	11	0.1	17	0.1
Comunas	28	2.2	11	0.8	10	0.8	—	—	1	0.1
COLOMBIA										
Cali	474	5.9	261	3.2	149	1.8	66	0.8	46	0.6
Cartagena	399	5.8	224	3.3	101	1.5	81	1.2	42	0.6
Medellín	424	5.7	244	3.3	128	1.7	72	1.0	44	0.6
EL SALVADOR										
San Salvador	644	8.0	436	5.4	279	3.5	81	1.0	76	0.9
Rural *municipios*	434	26.2	295	17.8	222	13.4	35	2.1	38	2.3
JAMAICA										
Metropolitan Kingston	276	2.1	84	0.6	53	0.4	5	0.0	26	0.2
St. Andrew, rural	38	3.1	12	1.0	9	0.7	—	—	3	0.2
MEXICO										
Monterrey	733	4.3	426	2.5	113	0.7	177	1.0	136	0.8
UNITED STATES										
San Francisco	25	0.8	1	0.0	—	—	1	0.0	—	—
California, suburban	89	0.7	4	0.0	—	—	—	—	4	0.0

[a] Rates per 1,000 population.

FIG. 61. Mortality of Children 1–4 Years of Age from Infectious Diseases as Underlying Cause and Nutritional Deficiency as Underlying or Associated Cause in 13 Areas with Higher Rates.



[a] For size and divisions of very high rates for Rural El Salvador and Viacha, see Tables 66 and 67.

FIG. 62. Mortality of Children 1–4 Years of Age from Infectious Diseases as Underlying Cause and Nutritional Deficiency as Underlying or Associated Cause in 12 Areas with Lower Rates.

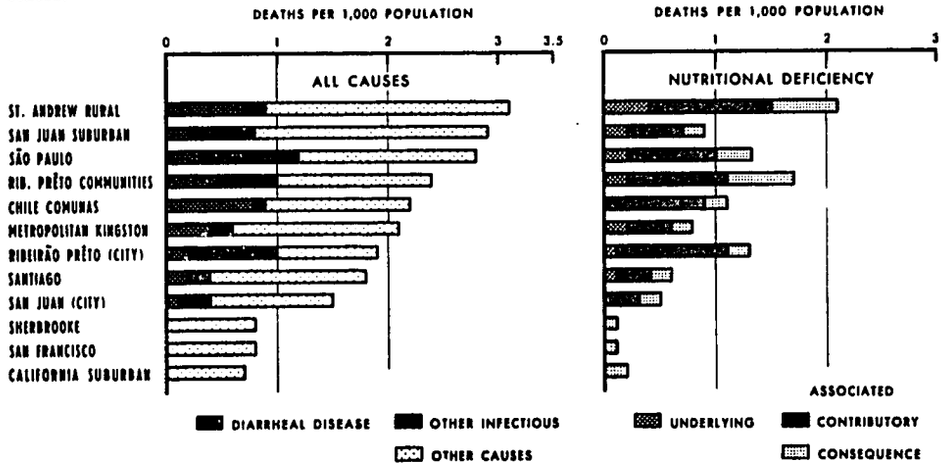


TABLE 66. Mortality[a] of Children 1–4 Years of Age with Nutritional Deficiency as Underlying or Associated Cause in 25 Areas of 15 Projects.

Area	Total		Underlying cause		Associated cause					
					Total		Contributory		Consequence	
	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate
ARGENTINA										
Chaco Province										
Resistencia	76	2.3	12	0.4	64	2.0	54	1.7	10	0.3
Rural departments	100	3.6	6	0.2	94	3.4	74	2.7	20	0.7
San Juan Province										
San Juan (city)	11	0.5	—	—	11	0.5	7	0.3	4	0.2
Suburban departments	27	0.9	7	0.2	20	0.7	13	0.5	7	0.2
Rural departments	58	1.6	10	0.3	48	1.4	39	1.1	9	0.3
BOLIVIA										
La Paz	737	6.1	33	0.3	704	5.9	575	4.8	129	1.1
Viacha	24	9.3	1	0.4	23	8.9	20	7.8	3	1.2
BRAZIL										
Recife	599	6.3	100	1.0	499	5.2	436	4.6	63	0.7
Ribierão Prêto										
Ribeirão Prêto (city)	44	1.3	5	0.1	39	1.2	32	1.0	7	0.2
Franca	39	2.2	8	0.5	31	1.8	28	1.6	3	0.2
Communities	23	1.7	3	0.2	20	1.4	12	0.9	8	0.6
São Paulo	251	1.3	38	0.2	213	1.1	143	0.8	70	0.4
CANADA										
Sherbrooke	6	0.1	—	—	6	0.1	—	—	6	0.1
CHILE										
Santiago	95	0.6	15	0.1	80	0.5	53	0.3	27	0.2
Comunas	14	1.1	—	—	14	1.1	12	0.9	2	0.2
COLOMBIA										
Cali	287	3.5	85	1.1	202	2.5	169	2.1	33	0.4
Cartagena	283	4.1	73	1.1	210	3.1	169	2.5	41	0.6
Medellín	262	3.5	50	0.7	212	2.8	178	2.4	34	0.5
EL SALVADOR										
San Salvador	421	5.3	62	0.8	359	4.5	282	3.5	77	1.0
Rural *municipios*	309	18.7	75	4.5	234	14.1	197	11.9	37	2.2
JAMAICA										
Metropolitan Kingston	101	0.8	25	0.2	76	0.6	53	0.4	23	0.2
St. Andrew, rural	26	2.1	5	0.4	21	1.7	13	1.1	8	0.6
MEXICO										
Monterrey	425	2.5	47	0.3	378	2.2	269	1.6	109	0.6
UNITED STATES										
San Francisco	3	0.1	—	—	3	0.1	—	—	3	0.1
California, suburban	20	0.2	—	—	20	0.2	1	0.0	19	0.1

[a] Rates per 1,000 population.

In 10 areas nutritional deficiency was one of the causes in over 60 per cent of the deaths:

	Per cent
El Salvador, rural	71.2
Cartagena	70.9
Ribeirão Prêto, communities	69.7
Recife	69.5
Ribeirão Prêto (city)	68.8
St. Andrew, rural	68.4
San Salvador	65.4
Resistencia	65.0
Medellín	61.8
Cali	60.5

The relationship of nutritional deficiency to mortality from all causes was not as close in the 12 areas with lower death rates (Figure 62). Rates from this morbid condition were low in Santiago and the city of San Juan. In San Francisco nutritional deficiency was an associated cause in only three deaths (as a consequence), while in the suburban counties of California it was reported in 20 deaths (as a consequence in 19). In the Sherbrooke project it was a consequence in six deaths.

The underlying and associated causes of death for children 1 year and 2–4 years of age are presented in greater detail in the following sections, and the complete data appear in the tables in Appendix 2.

MORTALITY IN THE SECOND YEAR OF LIFE

For the child who has reached the first birthday, the second year of life is the most hazardous one in early childhood. It is an especially dangerous period for those who have not attained a normal nutritional state and are therefore more vulnerable to infectious diseases. Of the 7,493 deaths in the age group 1–4 years, more than half (4,361) were of children in their second year of life, that is, one year of age.

The range in death rates for these children (Table 67 and Figure 63) was the greatest of all the age periods. The variations were from 0.8 per 1,000 population in the suburban California counties to 50.7 in Viacha, Bolivia. In Latin America rural and suburban areas had higher rates than those in cities in the same projects, with one exception (Ribeirão Prêto). In Argentina, Bolivia, and El Salvador the rural rates were much higher than in the cities. The differences were less in Chile and Jamaica, the rates being only slightly higher in the *comunas* near Santiago and in rural St. Andrew near Metropolitan Kingston. In the California project the rates were nearly the same for San Francisco and for the suburban counties (0.94 and 0.79 per 1,000 population). It would appear that differences between rates for rural and urban areas decrease as mortality becomes low.

In 10 areas the numbers of deaths were small (less than 50) and thus for the analysis by causes each of the projects is treated as a whole (Table 68). The only exception is El Salvador, where the number of deaths in the rural *municipios* (217) was sufficient for division by causes. Also the marked differences found in El Salvador are indicative of the wide variations in urban and rural areas when death rates are high.

TABLE 67. Mortality* of Children One Year of Age from All Causes in 25 Areas of 15 Projects.

Area	Deaths	Rate
ARGENTINA		
Chaco Province		
Resistencia	83	9.3
Rural departments	114	16.3
San Juan Province		
San Juan (city)	20	4.0
Suburban departments	50	7.0
Rural departments	83	9.4
BOLIVIA		
La Paz	899	27.2
Viacha	36	50.7
BRAZIL		
Recife	515	19.2
Ribeirão Prêto		
Ribeirão Prêto (city)	34	3.9
Franca	32	6.9
Communities	13	3.6
São Paulo	282	5.2
CANADA		
Sherbrooke project	20	1.2
CHILE		
Santiago	149	4.0
Comunas	17	5.4
COLOMBIA		
Cali	271	13.4
Cartagena	266	15.5
Medellín	233	12.5
EL SALVADOR		
San Salvador	398	17.4
Rural *municipios*	217	48.1
JAMAICA		
Metropolitan Kingston	154	4.3
St. Andrew, rural	21	6.3
MEXICO		
Monterrey	421	9.4
UNITED STATES		
San Francisco	8	0.9
California, suburban	25	0.8

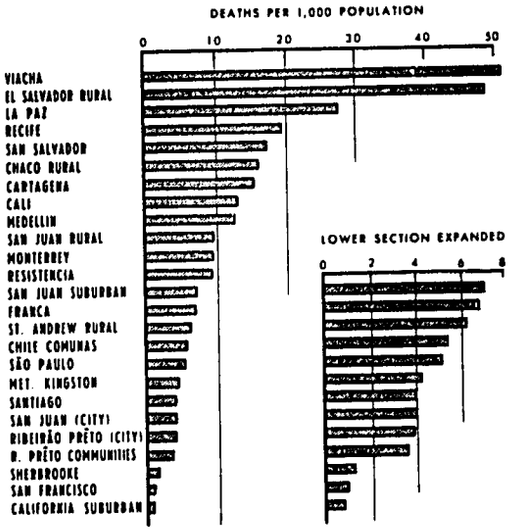
* Rates per 1,000 population.

The underlying and associated causes of death of children one year and 2–4 years of age are given in Table 68.

The rates* for two specific causes (diarrheal disease and measles) and five other groups of causes, both underlying and associated, are presented in Figure 64 for 14 projects, in descending order of the death rate of one-year-old children (given in the upper left corner). The differences in the rates for the Bolivia project (shown first) and those of the California project (shown last) are exceedingly great and indicate the degree to which mortality in this age period can be reduced through application of existing knowledge and methods of prevention. Diarrheal disease, measles, and diseases of the respiratory system as underlying causes were responsible for high mortality in the Bolivia project. In Recife, measles (second bar) caused more deaths as an underlying cause that did diarrheal disease or any one of the other five groups. Other projects in which measles caused more deaths than did diarrheal disease were Monterrey, San Juan Province, and São Paulo.

In the first seven projects shown in Figure 64, infectious diseases were underlying causes of more than half the deaths; nutritional deficiency as an associated cause con-

FIG. 63 Mortality of Children One Year of Age from All Causes in 25 Areas of 15 Projects.



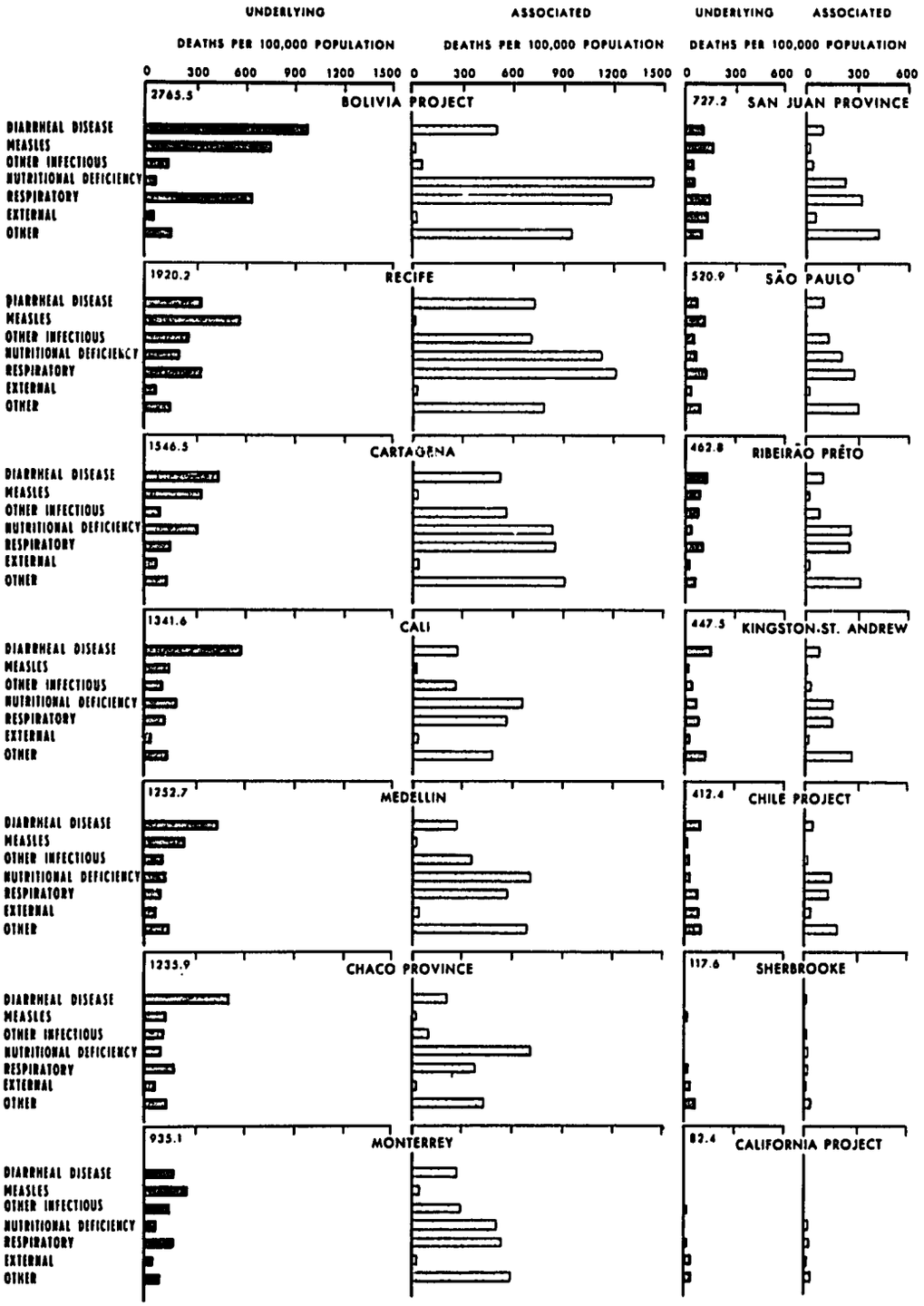
* In this report usually death rates have been presented per 1,000 population for groups of causes. However, rates for specific causes (in contrast to rates for groups) are almost always given per 100,000 population in the various age groups. The base of 100,000 is preferable when the numbers are small, as for a specific disease, and thus Table 68 and most of the tables in this chapter and those that follow show rates per 100,000 population or per 100,000 live births.

TABLE 68. Underlying and Associated Causes of Death[a] of Children One Year and 2–4 Years of Age in 15 Projects.[b]

Cause	1 year				2–4 years				1 year				2–4 years			
	Underlying		Associated		Underlying		Associated		Underlying		Associated		Underlying		Associated	
	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate
	ARGENTINA, Chaco Province								ARGENTINA, San Juan Province							
All causes	197	1,235.9	284	1,781.7	94	211.8	123	277.2	153	727.2	256	1,216.7	103	163.1	135	213.8
Diarrheal disease	81	503.2	31	194.5	20	45.1	20	45.1	23	109.3	22	104.6	5	7.9	9	14.3
Measles	20	125.5	1	6.3	10	22.5	2	4.5	34	161.6	2	9.5	19	30.1	3	4.8
Other infectious	18	112.9	14	87.8	15	33.8	4	9.0	9	42.8	8	38.0	15	23.8	4	6.3
Nutritional deficiency	16	100.4	111	696.4	2	4.5	47	105.9	11	52.3	52	247.1	6	9.5	27	42.8
Respiratory diseases	30	188.2	59	370.1	12	27.0	21	47.3	29	137.8	73	347.0	8	12.7	42	66.5
External causes	10	62.7	1	6.3	10	22.5	1	2.3	26	123.6	10	47.5	26	41.2	3	4.8
Other	22	138.0	67	420.3	25	56.3	28	63.1	21	99.8	89	423.0	24	38.0	47	74.4
	BOLIVIA project								BRAZIL, Recife							
All causes	935	2,765.5	1,417	4,191.1	551	620.0	702	789.9	515	1,920.2	1,219	4,545.1	347	503.0	875	1,268.3
Diarrheal disease	331	979.0	173	511.7	106	119.3	95	106.9	92	343.0	195	727.1	35	50.7	137	198.6
Measles	253	748.3	4	11.8	164	184.5	5	5.6	153	570.5	1	3.7	114	165.2	4	5.8
Other infectious	45	133.1	20	59.2	57	64.1	26	29.3	68	253.5	185	689.8	56	81.2	142	205.8
Nutritional deficiency	21	62.1	487	1,440.4	13	14.6	240	270.1	54	201.3	300	1,118.6	46	66.7	199	288.4
Respiratory diseases	217	641.8	404	1,194.9	117	131.7	221	248.7	90	335.6	322	1,200.6	39	56.5	199	288.4
External causes	17	50.3	4	11.8	38	42.8	3	3.4	16	59.7	4	14.9	14	20.3	2	2.9
Other	51	150.8	325	961.3	56	63.0	112	126.0	42	156.6	212	790.5	43	62.3	192	278.3
	BRAZIL, Ribeirão Prêto								BRAZIL, São Paulo							
All causes	79	462.8	179	1,048.6	88	183.3	166	345.8	282	520.9	576	1,063.9	242	180.2	449	334.4
Diarrheal disease	20	117.2	17	99.6	9	18.8	17	35.4	37	68.3	56	103.4	14	10.4	36	26.8
Measles	13	76.2	1	5.9	20	41.7	—	—	61	112.7	—	—	43	32.0	2	1.5
Other infectious	12	70.3	14	82.0	5	10.4	25	52.1	28	51.7	69	127.4	35	26.1	58	43.2
Nutritional deficiency	5	29.3	45	263.6	11	22.9	45	93.8	30	55.4	116	214.3	8	6.0	97	72.2
Respiratory diseases	17	99.6	44	257.8	5	10.4	37	77.1	63	116.4	159	293.7	42	31.3	113	84.2
External causes	3	17.6	2	11.7	10	20.8	1	2.1	17	31.4	5	9.2	33	24.6	5	3.7
Other	9	52.7	56	328.1	28	58.3	41	85.4	46	85.0	171	315.8	67	49.9	138	102.8
	CANADA, Sherbrooke								CHILE project							
All causes	20	117.6	17	100.0	41	71.5	21	36.6	166	412.4	236	586.3	144	113.2	154	121.0
Diarrheal disease	—	—	1	5.9	1	1.7	—	—	34	84.5	17	42.2	12	9.4	10	7.9
Measles	1	5.9	—	—	—	—	—	—	5	12.4	—	—	6	4.7	—	—
Other infectious	—	—	1	5.9	1	1.7	2	3.5	7	17.4	3	7.5	11	8.6	9	7.1
Nutritional deficiency	—	—	4	23.5	—	—	2	3.5	10	24.8	65	161.5	5	3.9	29	22.8
Respiratory diseases	3	17.6	4	23.5	2	3.5	6	10.5	31	77.0	59	146.6	16	12.6	39	30.6
External causes	6	35.3	1	5.9	22	38.4	1	1.7	38	94.4	12	29.8	38	29.9	7	5.5
Other	10	58.8	6	35.3	15	26.2	10	17.4	41	101.9	80	198.8	56	44.0	60	47.2
	COLOMBIA, Cali								COLOMBIA, Cartagena							
All causes	271	1,341.6	441	2,183.2	203	334.4	340	560.1	266	1,546.5	635	3,691.9	133	257.8	335	649.2
Diarrheal disease	118	584.2	52	257.4	31	51.1	56	92.3	77	447.7	88	511.6	24	46.5	35	67.8
Measles	33	163.4	1	5.0	33	54.4	2	3.3	60	348.8	3	17.4	21	40.7	1	1.9
Other infectious	23	113.9	49	242.6	23	37.9	38	62.6	16	93.0	95	552.3	26	50.4	70	135.7
Nutritional deficiency	39	193.1	130	643.6	46	75.8	72	118.6	54	314.0	143	831.4	19	36.8	67	129.8
Respiratory diseases	25	123.8	111	549.5	17	28.0	83	136.7	26	151.2	145	843.0	15	29.1	64	124.0
External causes	7	34.7	5	24.8	23	37.9	6	9.9	10	58.1	5	29.1	7	13.6	2	3.9
Other	26	128.7	93	460.4	30	49.4	83	136.7	23	133.7	156	907.0	21	40.7	96	186.0
	COLOMBIA, Medellín								EL SALVADOR, San Salvador							
All causes	233	1,252.7	481	2,586.0	191	341.1	339	605.4	398	1,741.8	857	3,750.5	246	430.1	492	860.3
Diarrheal disease	82	440.9	49	263.4	46	82.1	32	57.1	184	805.3	87	380.7	95	166.1	45	78.7
Measles	46	247.3	2	10.8	26	46.4	1	1.8	55	240.7	1	4.4	26	45.5	1	1.7
Other infectious	20	107.5	64	344.1	24	42.9	59	105.4	37	161.9	91	398.2	39	68.2	78	136.4
Nutritional deficiency	25	134.4	129	693.5	25	44.6	83	148.2	44	192.6	218	954.0	18	31.5	141	246.5
Respiratory diseases	19	102.2	105	564.5	13	23.2	62	110.7	41	179.4	155	678.3	17	29.7	71	124.1
External causes	14	75.3	6	32.3	28	50.0	3	5.4	6	26.3	1	4.4	18	31.5	3	5.2
Other	27	145.2	126	677.4	29	51.8	99	176.8	31	135.7	304	1,330.4	33	57.7	153	267.5
	EL SALVADOR, Rural municipios								JAMAICA, Kingston-St. Andrew							
All causes	217	4,811.5	431	9,556.5	217	1,802.3	445	3,696.0	175	447.5	283	723.6	139	133.1	161	154.1
Diarrheal disease	115	2,549.9	45	997.8	107	888.7	65	539.9	55	140.6	28	71.6	7	6.7	5	4.8
Measles	21	465.6	—	—	14	116.3	1	8.3	2	5.1	1	2.6	3	2.9	—	—
Other infectious	22	487.8	67	1,485.6	16	132.9	80	664.5	13	33.2	13	33.2	16	15.3	10	9.6
Nutritional deficiency	25	554.3	122	2,705.1	50	415.3	112	930.2	25	63.9	65	166.2	5	4.8	32	30.6
Respiratory diseases	17	376.9	69	1,529.9	8	66.4	57	473.4	28	71.6	64	163.6	20	19.1	41	39.2
External causes	5	110.9	2	44.3	5	41.5	1	8.3	8	20.5	3	7.7	26	24.9	4	3.8
Other	12	266.1	126	2,793.8	17	141.2	129	1,071.4	44	112.5	109	278.7	62	59.4	69	66.1
	MEXICO, Monterrey								UNITED STATES, California project							
All causes	421	935.1	967	2,147.9	312	250.0	704	564.1	33	82.4	39	97.4	81	67.0	78	64.5
Diarrheal disease	75	166.6	113	251.0	38	30.4	70	56.1	—	—	—	—	—	—	1	0.8
Measles	113	251.0	15	33.3	64	51.3	11	8.8	—	—	—	—	1	0.8	—	—
Other infectious	65	144.4	122	271.0	71	56.9	115	92.1	1	2.5	—	—	3	2.5	7	5.8
Nutritional deficiency	28	62.2	219	486.5	19	15.2	159	127.4	—	—	8	20.0	—	—	15	12.4
Respiratory diseases	80	177.7	229	508.7	39	31.2	155	124.2	2	5.0	12	30.0	3	2.5	13	10.7
External causes	17	37.8	10	22.2	28	22.4	9	7.2	14	35.0	3	7.5	33	27.3	5	4.1
Other	43	95.5	259	575.3	53	42.5	185	148.2	16	40.0	16	40.0	41	33.9	37	30.6

[a] Rates per 100,000 population.
[b] Both urban and rural areas in San Salvador project are given.

FIG. 64. Underlying and Associated Causes of Mortality[a] of Children One Year of Age in 14 Projects.



[a]The death rate per 100,000 population is given in the upper left corner of each project.

tributed to more than half the deaths from all causes in all projects except Cali.

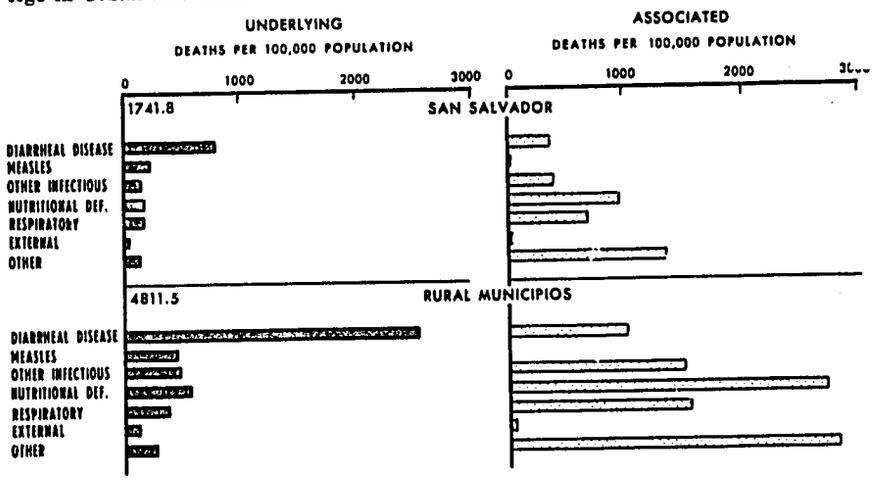
The pattern is distinctly different in the other seven projects with lower death rates. Infectious diseases as underlying causes were responsible for less than half the deaths in all projects except Ribeirão Prêto. Chile had the lowest rate for the Latin American projects; as underlying causes, external causes led to more deaths in that project than did diarrheal disease, and the group of other causes (which includes congenital anomalies and diseases of the nervous system) was the largest.

In both Sherbrooke and California the death rates were very low, with external causes and the group of "others" constituting nearly all the underlying causes (16 out of 20 in Sherbrooke and 30 out of 33 in California).

The death rates for the two areas in El Salvador, shown in Figure 65, illustrate the excessive mortality in a rural area compared with that in a neighboring city: the rate for the rural *municipios*—4,811.5 per 100,000 population—was nearly three times that in the city of San Salvador (1,741.8). Actually, by comparison with the cities in other projects, San Salvador's rate was third, following that of La Paz (2,716.0) and Recife (1,920.2).

Diarrheal disease was the leading cause in both areas of El Salvador. The rate for measles (second bar in Figure 65) was higher in the rural area than in the city. The rate for nutritional deficiency (fourth bar) was high as both underlying and associated cause in the rural area, and high in the city as an associated cause. These high death rates for one-year-old children in the rural *municipios*, an area close to San Salvador and served by health facilities, suggest even more serious health problems in more remote rural areas.

FIG. 65. Underlying and Associated Causes of Mortality[a] of Children One Year of Age in Urban and Rural Areas of El Salvador Project.



[a] The death rate per 100,000 population is given in the left upper corner of each area.

MORTALITY IN CHILDREN 2–4 YEARS OF AGE

While total death rates of children one year of age varied from 0.8 to 50.7 per 1,000 population, in the remainder of early childhood the variation was much less, from 0.7 to 18.0 (Table 69 and Figure 66). Among children 2–4 years of age, mortality was highest in two rural areas, namely, Viacha (10.7) and the *municipios* of El Salvador (18.0).

In this age period, mortality in certain Latin American areas is approaching the low rates in the Sherbrooke and California projects. In fact the rates were as low as 0.7 to 1.4 per 1,000 population in nine areas (including those in Northern America):

Resistencia	1.4
Metropolitan Kingston	1.3
Ribeirão Prêto (city)	1.2
Chile, *comunas*	1.1
Santiago	1.1
San Juan (city)	0.7
Sherbrooke	0.7
San Francisco	0.7
California, suburban	0.7

The death rates for specific causes, per 100,000 population, are given for 15 projects in Table 68, along with the data for one-year-old children. The differences in the projects with high and low rates are striking.

In the 2–4 year age group, measles (second bar in Figure 67) caused more deaths

TABLE 69. Mortality[a] of Children 2-4 Years of Age from All Causes in 25 Areas of 15 Projects.

Area	Deaths	Rate
ARGENTINA		
Chaco Province		
Resistencia	34	1.4
Rural departments	60	2.9
San Juan Province		
San Juan (city)	11	0.7
Suburban departments	34	1.6
Rural departments	58	2.2
BOLIVIA		
La Paz	531	6.1
Viacha	20	10.7
BRAZIL		
Recife	347	5.0
Ribeirão Prêto		
Ribeirão Prêto (city)	30	1.2
Franca	38	2.0
Communities	20	2.0
São Paulo	242	1.8
CANADA		
Sherbrooke	41	0.7
CHILE		
Santiago	133	1.1
Comunas	11	1.1
COLOMBIA		
Cali	203	3.3
Cartagena	133	2.6
Medellín	191	3.4
EL SALVADOR		
San Salvador	246	4.3
Rural *municipios*	217	18.0
JAMAICA		
Metropolitan Kingston	122	1.3
St. Andrew, rural	17	1.9
MEXICO		
Monterrey	312	2.5
UNITED STATES		
San Francisco	17	0.7
California, suburban	64	0.7

[a] Rates per 1,000 population.

FIG. 66. Mortality of Children 2–4 Years of Age from All Causes in 25 Areas of 15 Projects.

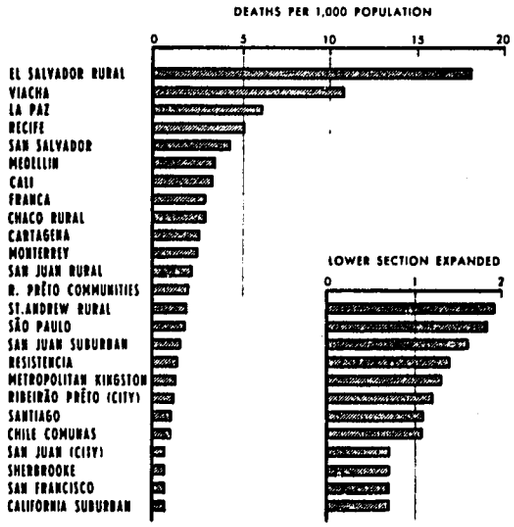
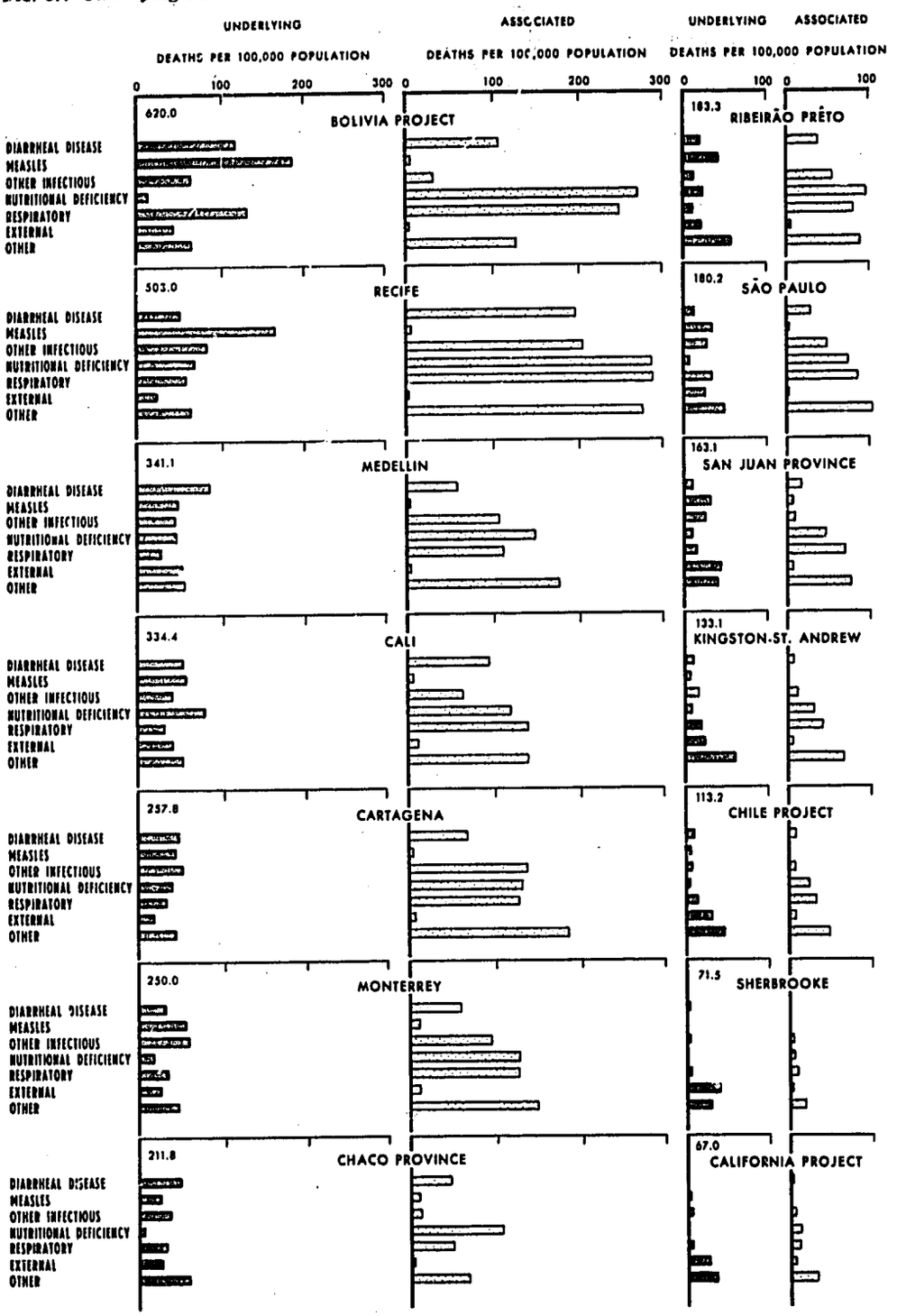


FIG. 67. Underlying and Associated Causes of Mortality[a] of Children 2–4 Years of Age in 14 Projects.



[a] The death rate per 100,000 population is given in the upper left corner of each project.

than did diarrheal disease as an underlying cause in seven projects. These projects, with the death rates per 100,000 population, were:

Bolivia	184.5
Recife	165.2
Cali	54.4
Monterrey	51.3
Ribeirão Prêto	41.7
São Paulo	32.0
San Juan Province	30.1

In Sherbrooke one death from measles was reported in a one-year-old child, and in the California project one in a 3-year-old child in San Francisco.

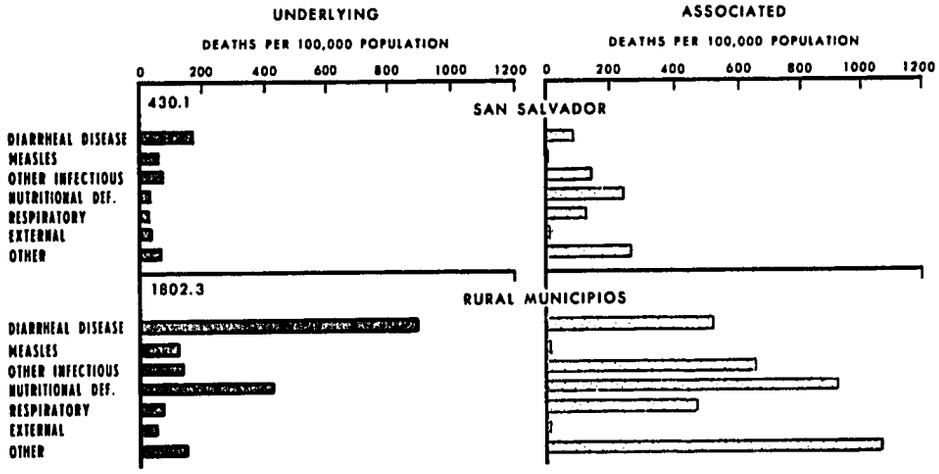
In the first nine projects shown in Figure 67, nutritional deficiency contributed to mortality in the 2–4 year age group as an associated cause with high rates. The Chilean project had the lowest rate of all those in Latin America. External causes and the group of other causes were responsible for high proportions of the deaths in the Chilean, Sherbrooke, and California projects. Malignant neoplasms were also one of the leading causes in the group of "others."

The death rates in two areas of the El Salvador project are shown in Figure 68. In this age group the rate of 1,802.3 per 100,000 population in the rural *municipios* was more than four times that in San Salvador (430.1). The rate for diarrheal disease in these *municipios* was high both as underlying and as associated cause, as was also the rate for nutritional deficiency. These figures provide another indication of the excessive mortality in rural areas.

* * *

In summary, mortality in the age period 1–4 years shows extremely wide variations in the 15 projects, from very high rates to very low ones. However, mortality in 2–4 year-old children in certain areas is approaching the very low rates attained in the Canadian and California projects. The differences observed in the two areas of El Salvador make it clear that rural populations experience much higher rates even in the age period 2–4 years. To reduce mortal-

FIG. 68. Underlying and Associated Causes of Mortality[a] of Children 2–4 Years of Age in Urban and Rural Areas of El Salvador Project.



[a] The death rate per 100,000 population is given in the upper left corner of each area.

ity in childhood in Latin America, major attention must be given to rural areas in many of the countries. Because of the lack of registration of many deaths—as revealed by this Investigation—the extent and seriousness of health problems in most rural areas remain obscure. The true extent of those problems must be uncovered if progress is to be made in improving health and lowering mortality.

Chapter VIII

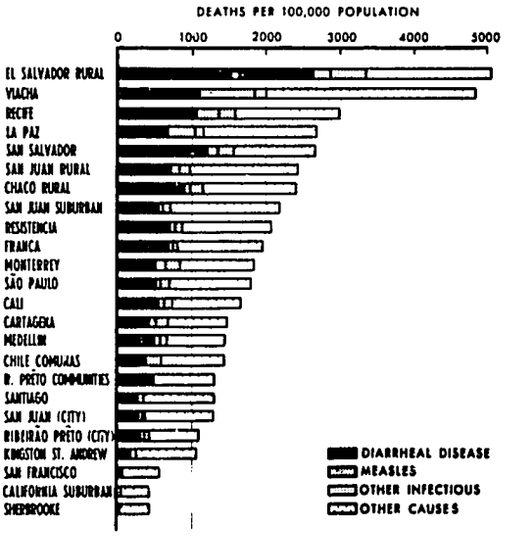
Infectious Diseases*

Infectious and parasitic diseases continue to be important causes of mortality in childhood in many parts of the world. The Investigation reveals that in nearly all the projects in Latin America sizable reductions in death rates for certain of these diseases could be attained if vaccination programs were conducted and other public health measures applied. Moreover, evidence was uncovered to show that highly vulnerable infants who recover from one infectious disease often die from another. One example of such causal interrelationships is that of a child who, after a prolonged siege of whooping cough that weakened his nutritional state, acquired measles and finally succumbed to pulmonary complications. Nutritional deficiency was one of the multiple causes involved in this death. As the Investigation findings have clearly shown, associated as well as underlying causes must be taken into account as a basis for designing health programs.

Chapter IX on nutritional deficiency contains data showing interrelationships of causes of death. In the present chapter the infectious diseases are considered principally as underlying causes, though for a few diseases their involvement as associated causes is analyzed as well.

Figure 69 and Table 70 show the role of the group of infectious diseases as underlying causes in children under 5 years of age. When the death rate for all causes is high, the rate for infectious diseases is usually high also. In the rural *municipios* of El Salvador, for example, where the rate for all causes in this age group was 5,049.0 per 100,000 population, that for infectious diseases was 3,317.8, or two-thirds the rate for all deaths under 5 years. For the areas with

FIG. 69. Mortality from All Causes and from Infectious Diseases in Children Under 5 Years of Age in 24 Areas of 15 Projects.



* The name of the Section in the *Classification* is infective and parasitic diseases. Since the number of deaths due to the parasitic diseases is relatively small, these causes are referred to here as infectious diseases, as a short title.

low death rates, shown in the lower portion of Figure 69, mortality from these diseases was very low; in fact in the California project only 5.3 per cent of deaths under 5 years of age were attributed to an infectious disease.

TABLE 70. Deaths from Specific Infective and Parasitic Diseases as Underlying Causes[a] in Children Under 5 Years of Age in 25 Areas of 15 Projects.

Area	Total (000–136)		Amebiasis (006)		Diarrheal disease (009)		Other intestinal diseases (rest of 000–009)		Tuberculosis (010–019)		Diphtheria (032)		Whooping cough (033)	
	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate
Total	14,568	694.1	303	14.4	10,052	478.9	291	13.9	330	15.7	91	4.3	290	13.8
ARGENTINA, Resistencia	362	867.3	—	—	287	687.6	1	2.4	25	59.9	—	—	1	2.4
Chaco, rural	400	1,140.9	—	—	307	875.6	1	2.9	12	34.2	—	—	20	57.0
San Juan (city)	90	356.6	—	—	64	253.6	—	—	—	—	—	—	3	11.9
San Juan, suburban	244	686.6	—	—	177	498.0	1	2.8	3	8.4	—	—	4	11.3
San Juan, rural	406	929.5	—	—	297	679.9	2	4.6	9	20.6	—	—	13	29.8
BOLIVIA, La Paz	1,757	1,135.7	2	1.3	1,011	653.5	11	7.1	64	41.4	—	—	57	36.8
Viacha	66	1,970.1	—	—	36	1,074.6	—	—	1	29.9	—	—	4	119.4
BRAZIL, Recife	1,929	1,556.8	1	0.8	1,268	1,023.3	16	12.9	63	50.8	29	23.4	31	25.0
Ribeirão Prêto (city)	172	403.5	—	—	121	283.8	2	4.7	1	2.3	—	—	3	7.0
Franca	175	783.3	—	—	150	671.4	2	9.0	—	—	—	—	3	13.4
Ribeirão Prêto communities	82	467.8	—	—	66	376.5	2	11.4	1	5.7	—	—	1	5.7
São Paulo	1,629	668.4	1	0.4	1,200	492.4	68	27.9	26	10.7	7	2.9	35	14.4
CANADA, Sherbrooke	7	7.7	—	—	3	3.3	—	—	—	—	—	—	—	—
CHILE, Santiago	641	334.5	—	—	486	253.6	32	16.7	7	3.7	2	1.0	4	2.1
Comunas	88	545.9	—	—	58	359.8	15	93.1	1	6.2	—	—	3	18.6
COLOMBIA, Cali	701	692.7	7	6.9	511	504.9	15	14.8	17	16.8	9	8.9	12	11.9
Cartagena	550	639.5	32	37.2	323	375.6	6	7.0	9	10.5	—	—	18	20.9
Medellín	588	630.2	17	18.2	417	446.9	10	10.7	15	16.1	3	3.2	3	3.2
EL SALVADOR, San Salvador	1,584	1,525.1	65	62.6	1,240	1,193.9	34	32.7	7	6.7	19	18.3	13	12.5
Rural *municipios*	711	3,317.8	22	102.7	559	2,608.5	6	28.0	3	14.0	5	23.3	17	79.3
JAMAICA														
Metropolitan Kingston	513	306.2	—	—	370	220.9	11	6.6	4	2.4	14	8.4	17	10.1
St. Andrew, rural	35	222.8	—	—	26	165.5	—	—	—	—	—	—	1	6.4
MEXICO, Monterrey	1,790	821.3	156	71.6	1,063	487.7	56	25.7	62	28.4	3	1.4	26	11.9
UNITED STATES, San Francisco	17	39.5	—	—	9	20.9	—	—	—	—	—	—	—	—
California, suburban	31	19.3	—	—	3	1.9	—	—	—	—	—	—	1	0.6

Area	Tetanus (037)		Septicemia (038)		Measles (055)		Congenital syphilis (090)		Moniliasis (112)		Helminthiases (120–129)		Other (rest of 000–136)	
	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate
Total	172	8.2	424	20.2	2,108	100.4	95	4.5	33	1.6	69	3.3	310	14.8
ARGENTINA, Resistencia	9	21.6	3	7.2	23	55.1	3	7.2	3	7.2	—	—	7	16.8
Chaco, rural	15	42.8	7	20.0	30	85.6	6	17.1	—	—	—	—	2	5.7
San Juan (city)	1	4.0	6	23.8	10	39.6	1	4.0	—	—	—	—	5	19.8
San Juan, suburban	1	2.8	12	33.8	31	87.2	2	5.6	—	—	—	—	13	36.6
San Juan, rural	1	2.3	10	22.9	55	125.9	3	6.9	3	6.9	—	—	13	29.8
BOLIVIA, La Paz	—	—	22	14.2	554	358.1	3	1.9	1	0.6	1	0.6	31	20.0
Viacha	—	—	—	—	25	746.3	—	—	—	—	—	—	—	—
BRAZIL, Recife	29	23.4	28	22.6	397	320.4	22	17.8	2	1.6	16	12.9	27	21.8
Ribeirão Prêto (city)	—	—	3	7.0	29	68.0	—	—	1	2.3	—	—	12	28.1
Franca	—	—	3	13.4	10	44.8	—	—	—	—	—	—	7	31.3
Ribeirão Prêto communities	1	5.7	—	—	7	39.9	1	5.7	—	—	1	5.7	2	11.4
São Paulo	7	2.9	41	16.8	156	64.0	26	10.7	9	3.7	5	2.1	48	19.7
CANADA, Sherbrooke	—	—	1	1.1	1	1.1	—	—	—	—	—	—	2	2.2
CHILE, Santiago	—	—	60	31.3	20	10.4	6	3.1	—	—	—	—	24	12.5
Comunas	—	—	7	43.4	1	6.2	—	—	—	—	—	—	3	18.6
COLOMBIA, Cali	11	10.9	14	13.8	80	79.1	5	4.9	1	1.0	5	4.9	14	13.8
Cartagena	19	22.1	19	22.1	105	122.1	1	1.2	—	—	10	11.6	8	9.3
Medellín	1	1.1	8	8.6	89	95.4	3	3.2	—	—	6	6.4	16	17.1
EL SALVADOR, San Salvador	17	16.4	31	29.8	127	122.3	6	5.8	3	2.9	10	9.6	12	11.6
Rural *municipios*	29	135.3	8	37.3	51	238.0	—	—	2	9.3	4	18.7	5	23.3
JAMAICA														
Metropolitan Kingston	15	9.0	58	34.6	9	5.4	5	3.0	4	2.4	—	—	6	3.6
St. Andrew, rural	2	12.7	3	19.1	—	—	—	—	—	—	3	19.1	—	—
MEXICO, Monterrey	14	6.4	68	31.2	297	136.3	2	0.9	4	1.8	8	3.7	31	14.2
UNITED STATES, San Francisco	—	—	2	4.6	1	2.3	—	—	—	—	—	—	5	11.6
California, suburban	—	—	10	6.2	—	—	—	—	—	—	—	—	17	10.6

[a] Rates per 100,000 population.

TABLE 71. Number of Deaths of Children Under 5 Years of Age from Specific Infective and Parasitic Diseases as Underlying Causes in 15 Projects.

Project	Streptococcal sore throat (034)	Meningococcal infection (036)	Poliomyelitis (040-046)	Smallpox (050)	Chickenpox (052)	Infectious hepatitis (070)	Rabies (071)	Mumps (072)	Other viral diseases (053-079)	Chagas' disease (086)	Toxoplasmosis (130)	Other infective and parasitic diseases (rest of 000-136)[a]
Total	3	30	31	4	55	44	4	9	62	13	18	37
ARGENTINA												
Chaco Province	—	—	—	—	5	—	—	—	1	1	1	1
San Juan Province	—	1	—	—	6	3	1	1	10	7	—	2
BOLIVIA project	—	1	2	—	6	3	—	—	8	—	1	10
BRAZIL												
Recife	—	—	5	—	5	4	1	2	7	—	—	3
Ribeirão Prêto	1	2	2	3	1	2	—	—	3	3	3	1
São Paulo	1	11	1	1	11	7	—	1	2	—	8	5
CANADA												
Sherbrooke	—	2	—	—	—	—	—	—	—	—	—	—
CHILE project	—	—	1	—	2	4	—	—	12	2	1	5
COLOMBIA												
Cali	—	—	4	—	1	3	2	—	2	—	1	1
Cartagena	—	2	5	—	—	—	—	—	1	—	—	—
Medellín	1	1	2	—	3	4	—	2	1	—	1	1
EL SALVADOR project	—	1	—	—	3	4	—	3	1	—	1	4
JAMAICA												
Kingston-St. Andrew	—	—	—	—	—	1	—	—	4	—	—	1
MEXICO												
Monterrey	—	—	5	—	12	8	—	—	3	—	—	3
UNITED STATES												
California project	—	9	4	—	—	1	—	—	7	—	1	—

[a] Rest of causes in 000–136 not given in detail in Tables 70 and 71.

As can be seen in Figure 69, mortality from infectious diseases was usually much higher in rural than in urban areas; for example, the rate in the rural departments of San Juan Province (929.5) was over two and a half times greater than that in the city of San Juan (356.6). The reverse was found in the California project, where the rate, though very low, was higher in San Francisco than in the suburban counties. The many factors involved in these variations in the Latin American projects will be clarified in later chapters.

The numbers of deaths from 13 infectious diseases are presented in Table 70 for the 25 areas in the 15 projects. In addition, data for the rest of the group of infectious diseases (last column of Table 70) causing only a few deaths are provided in Table 71.

The two major infectious diseases as underlying causes of death in the Latin American areas were diarrheal disease and measles (Figure 69). In only three areas were the death rates from measles relatively unimportant (Kingston-St. Andrew, Santiago, and *comunas* of Chile). Detailed data on these important causes are presented below.

DIARRHEAL DISEASE

Diarrheal disease, category 009 of the *International Classification of Diseases,* constitutes the major underlying cause of death for 10,052 of the 35,095 deaths of

children under 5 years of age. No other single category had as many deaths.

Prior to the 1965 Revision of the *Classification*, deaths stated to be due to diarrheal disease were assigned to several different categories. In countries where Spanish and Portuguese are spoken, the term *toxicosis* (Spanish) and *toxicose* (Portuguese) are often used to signify a specific clinical syndrome that is in essence the result of severe and rapid dehydration from diarrheal disease. In the 1948 and 1955 Revisions of the *Classification*, when toxicosis was stated as the cause of death signifying infant diarrheal disease it was classed as 764.0 (diarrhea of newborn) for deaths under 4 weeks of age, in the section on diseases peculiar to early infancy. The inclusion of deaths due to toxicosis in this category of early infancy contributed to high death rates for that group and likewise to low rates for diarrheal disease (at that time classed as 543, 571, and 572). In 1955 in Chile the group of diseases of early infancy was reported to be the leading cause of death because of the inclusion of these diarrheal disease deaths; but in Venezuela toxicosis was coded to 571 and the group gastritis-enteritis (543, 571, and 572) was the leading cause. There were difficulties also in the assignment of toxicosis for deaths in other age groups (Verhoestraete and Puffer, 1958-b).

An analysis of mortality from cardiovascular diseases and in particular arteriosclerotic heart disease in different countries of the world was prepared for the WHO Study Group on the Classification of Atherosclerotic Lesions (WHO, 1958). The marked geographic differences in death rates from these causes which were pointed out in a working document (Puffer and Verhoestraete, 1958) led to the adoption of recommendations for the improvement of mortality statistics on cardiovascular disease. The Study Group suggested that comparative studies be made of death certificates in different countries in order to review the terminology in use and promote the utilization of comparable procedures. The Inter-American Investigation of Mortality in adults was designed to ascertain whether the death rates for coronary heart disease were lower in the Latin American countries or whether the differences were due to the terminology in use and the classification of such causes, or to a combination of these factors. Thus nosological and classification problems led to the first large research project and subsequently to this Investigation.

In the 15 projects whenever the diagnostic evidence and laboratory findings indicated amebiasis (006) or another specific intestinal disease (000-008), such categories were used, though the numbers of such deaths were small (303 and 291, respectively) in comparison with the 10,052 from diarrheal disease.

For analysis of the role of diarrheal disease as underlying and as associated cause, the numbers and rates are given in Table 72 for deaths in infancy and in children one year and 2-4 years of age in the 15 projects. The mortality was much more serious in infancy than in the two other age groups. As can be seen in Figure 70, rates for diarrheal disease of infants were much higher as an underlying cause than as an associated cause, while in the second year of life this difference narrowed and even was reversed (as in Recife).

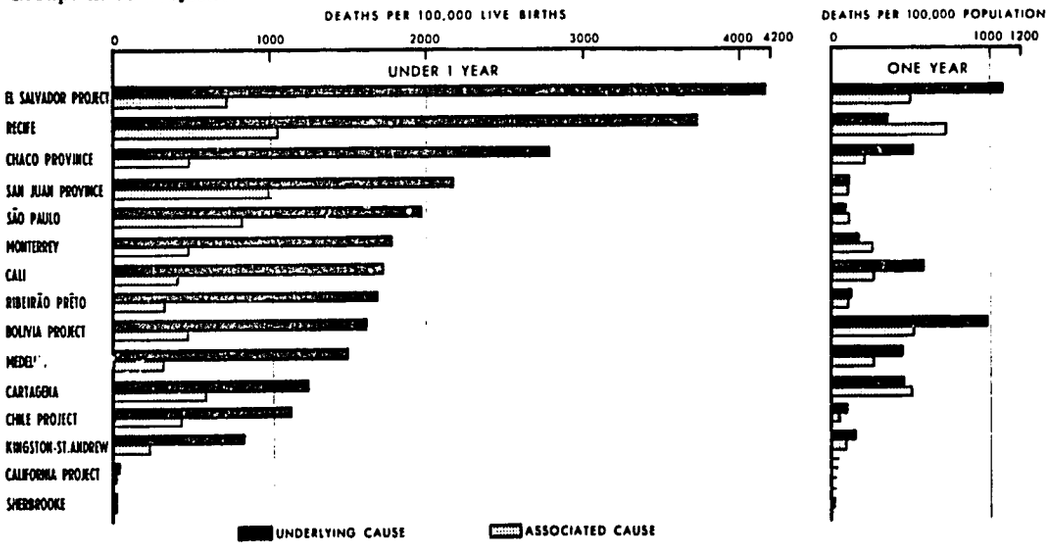
Aside from differences due to terminology, other difficulties are encountered in classifying diarrheal disease as a cause of death. For example, in many children there is a history of repeated diarrheal disease episodes which combined with inadequate food intake result in nutritional deficiency. These

TABLE 72. Diarrheal Disease as Underlying and Associated Cause of Death[a] in Three Age Groups in 15 Projects.

Project	Total				Under 1 year				1 year				2–4 years			
	Underlying		Associated		Underlying		Associated		Underlying		Associated		Underlying		Associated	
	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate
ARGENTINA																
Chaco Province	594	773.4	133	173.2	493	2,801.1	82	465.9	81	508.2	31	194.5	20	45.1	20	45.1
San Juan Province	538	515.0	263	251.8	510	2,183.2	232	993.2	23	109.3	22	104.6	5	7.9	9	14.3
BOLIVIA project	1,047	662.4	451	285.4	610	1,621.9	183	486.6	331	979.0	173	511.7	106	119.3	95	106.9
BRAZIL																
Recife	1,268	1,023.3	648	523.0	1,141	3,753.3	316	1,039.5	92	343.0	195	727.1	35	50.7	137	198.6
Ribeirão Prêto	337	238.5	90	109.1	308	1,688.6	56	307.0	20	117.2	17	99.6	9	18.8	17	35.4
São Paulo	1,200	492.4	568	233.1	1,149	1,975.6	476	818.4	37	68.3	56	103.4	14	10.4	36	26.8
CANADA																
Sherbrooke	3	3.3	3	3.3	2	11.8	2	11.8	—	—	1	5.9	1	1.7	—	—
CHILE project	544	261.8	216	104.0	498	1,142.7	189	433.7	34	84.5	17	42.2	12	9.4	10	7.9
COLOMBIA																
Cali	511	504.9	190	187.7	362	1,715.6	82	388.6	118	584.2	52	257.4	31	51.1	56	92.3
Cartagena	323	375.6	226	262.8	222	1,240.2	103	575.4	77	447.7	88	511.6	24	46.5	35	67.8
Medellín	417	446.9	137	146.8	289	1,489.7	56	288.7	82	440.9	49	263.4	46	82.1	32	57.1
EL SALVADOR project	1,799	1,435.9	461	367.9	1,298	4,184.4	219	706.0	299	1,092.8	132	482.5	202	291.8	110	158.9
JAMAICA																
Kingston-St. Andrew	396	216.1	126	68.8	334	815.4	93	227.1	55	140.6	28	71.6	7	6.7	5	4.8
MEXICO																
Monterrey	1,063	487.7	426	195.5	950	1,792.1	243	458.4	75	166.6	113	251.0	38	30.4	70	56.1
UNITED STATES																
California project	12	5.9	7	3.4	12	26.8	6	13.4	—	—	—	—	—	—	1	0.8

[a] Rates under 1 year per 100,000 live births; others per 100,000 population.

FIG. 70. Mortality from Diarrheal Disease as Underlying and Associated Cause of Death in Two Age Groups in 15 Projects.

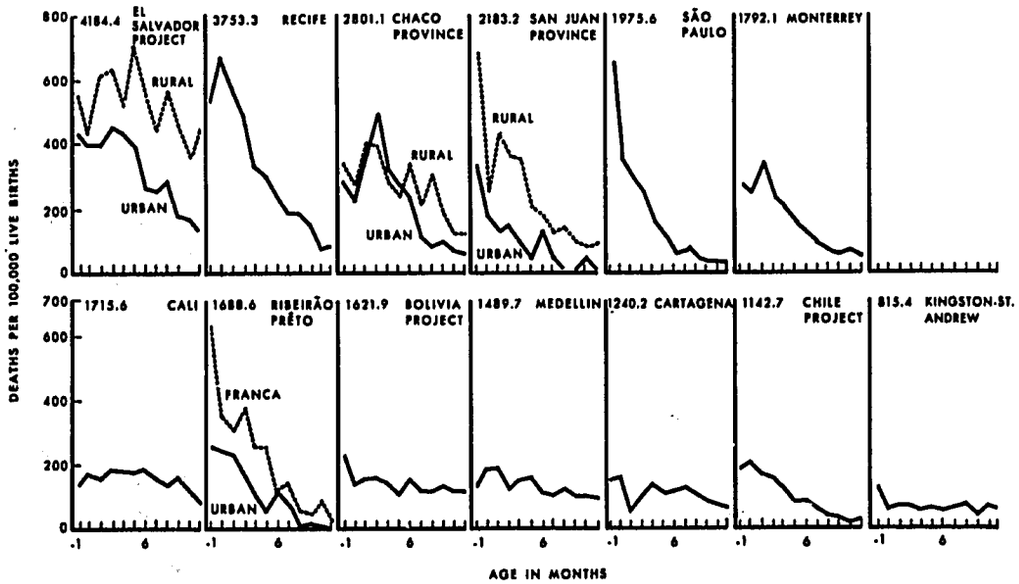


children, if they survive infancy, are at high risk of dying later in life from another diarrheal episode or from other infectious diseases. Thus a vicious cycle is often established and it is difficult to know which of the conditions should be considered as underlying cause (diarrheal disease or nutritional deficiency) because of their reciprocal implications.

Another difficulty is frequently encountered when the duration of the illness is to be determined in cases where diarrheal disease recurred at various times within short intervals: for one informant the onset could have been that of the first episode, while for another it could have been the last. Likewise, the treating physician could state that the child was suffering from an acute or from a chronic gastroenteritis, which have different categories and fall in different sections of the *International Classification*. Finally, the assignment by etiologic agent becomes complicated because often more than one pathogenic agent is isolated in bacteriologic culture; also, if cultures are performed and are positive they may have been taken during a previous episode and the current manifestations may not be due to the same agent. It is highly possible that as frequency and quality of diagnostic methods are improved an increasing number of deaths now included in category 009 will be assigned to more specific categories.

Mortality from diarrheal disease by month of age in the first year of life differed markedly in Latin America, as can be seen in Table 73 and in Figure 71, where 13 projects are shown in descending order accord-

FIG. 71. Infant Mortality from Diarrheal Disease by Month of Age in First Year of Life for 13 Projects.[a]

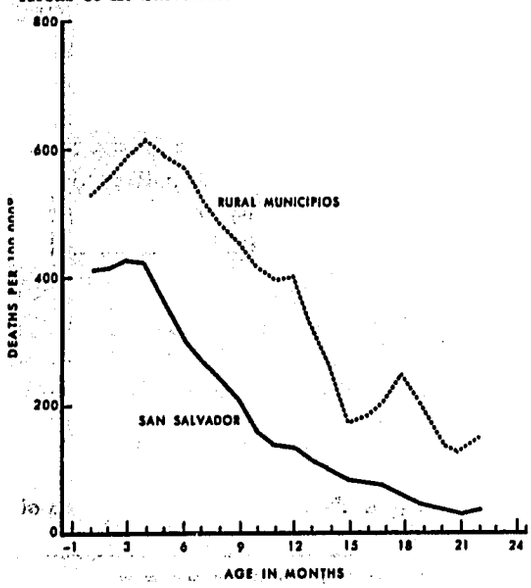


ing to size of the total infant death rate, with the El Salvador project appearing first. In six projects the concentration of diarrheal disease deaths in the first six months is clear, though there is variation. Among the cities, São Paulo had an unusually high rate in the first month, with lower rates in the remainder of infancy. In two projects, El Salvador and San Juan Province, the rates in rural areas where higher than in the cities, and in the interior city of Franca the rate was higher than in the city of Ribeirão Prêto. Possible explanations for these differences are the inadequate supplies of drinking water, poor feeding practices, and insufficient medical services in the rural areas. The differences were less clear in Chaco Province. A distinctly different pattern of diarrheal disease mortality was found in the three cities of Colombia, in Bolivia, and in

TABLE 73. Mortality from Diarrheal Disease by Month of Age in First Year of Life in 19 Areas of 13 Latin American Projects.

Project	No. of deaths by month of age												Deaths per 100,000 live births by month of age												
	Total	-1	1	2	3	4	5	6	7	8	9	10	11	Total	-1	1	2	3	4	5	6	7	8	9	10	11
ARGENTINA																										
Chaco Province																										
Resistencia	248	27	21	35	48	31	26	22	11	7	9	6	5	2,530.6	275.5	214.3	357.1	489.8	316.3	265.3	224.5	112.2	71.4	91.8	61.2	51.0
Rural departments	245	26	21	31	30	22	18	26	16	23	14	9	9	3,141.0	333.3	269.2	397.4	384.6	282.1	230.8	333.3	205.1	294.9	179.5	115.4	115.4
San Juan Province																										
San Juan (city)	62	19	10	7	8	5	2	7	2	—	—	2	—	1,065.3	326.5	171.8	120.3	137.5	85.9	34.4	120.3	34.4	—	—	34.4	—
Suburban departments	170	49	19	17	24	16	11	12	10	4	3	2	3	2,146.5	618.7	239.9	214.6	303.0	202.0	138.9	151.5	126.3	50.5	37.9	25.3	37.9
Rural departments	278	65	24	41	34	33	19	16	11	12	8	7	8	2,889.8	675.7	240.5	426.2	353.4	343.0	197.5	166.3	114.3	124.7	83.2	72.8	83.2
BOLIVIA project	610	85	51	56	59	51	38	54	43	43	47	43	40	1,921.9	226.0	135.6	1,8.9	156.9	135.6	101.0	143.6	114.3	114.3	125.0	114.3	106.4
BRAZIL																										
Recife	1,141	162	203	175	147	99	89	72	55	52	42	22	23	3,753.3	532.9	667.8	575.7	483.6	325.7	292.8	236.8	180.9	171.1	138.2	72.4	75.7
Ribeirão Prêto																										
Ribeirão Prêto (city)	115	23	22	21	15	9	4	10	7	1	2	1	—	1,235.2	247.0	236.3	225.6	161.1	96.7	43.0	107.4	75.2	10.7	21.5	10.7	—
Franca	134	32	18	16	19	13	13	6	7	3	2	4	1	2,632.6	628.7	353.6	314.3	373.3	255.4	255.4	117.9	137.5	58.9	39.3	78.6	19.6
Communities	59	5	6	13	11	11	3	3	4	—	2	1	—	1,536.5	130.2	156.3	338.5	286.5	286.5	78.1	78.1	104.2	—	52.1	26.0	—
São Paulo	1,149	376	203	163	140	86	61	27	35	21	13	13	11	1,975.6	646.5	349.0	280.3	240.7	147.9	104.9	46.4	60.2	36.1	22.4	22.4	18.9
CHILE project	498	79	87	70	65	55	34	38	24	13	13	7	13	1,142.7	181.3	199.6	160.6	149.2	126.2	78.0	87.2	55.1	29.8	29.8	16.1	29.8
COLOMBIA																										
Cali	362	26	34	31	37	36	35	37	31	26	30	23	16	1,715.6	123.2	161.1	146.9	175.4	170.6	165.9	175.4	146.9	123.2	142.2	109.0	75.8
Cartagena	222	26	28	9	17	23	19	21	22	19	14	13	11	1,240.2	145.3	156.4	50.3	95.0	128.5	106.1	117.3	122.9	106.1	78.2	72.6	61.5
Medellín	289	24	35	36	23	27	30	21	19	22	17	18	17	1,489.7	123.7	180.4	185.6	118.6	139.2	154.6	108.2	97.9	113.4	87.6	92.8	87.6
EL SALVADOR																										
San Salvador	961	111	102	102	116	109	99	67	65	72	44	42	32	3,751.0	433.3	398.1	398.1	452.8	425.4	386.4	261.5	253.7	281.0	171.7	163.9	124.9
Rural *municipios*	337	30	23	33	34	28	38	30	24	30	24	19	24	6,240.7	555.6	425.9	611.1	629.6	518.5	703.7	555.6	444.4	555.6	444.4	351.9	444.4
JAMAICA																										
Kingston-St. Andrew	334	52	24	28	25	24	27	25	27	29	18	29	26	815.4	127.0	58.6	68.4	61.0	58.6	65.9	61.0	65.9	70.8	43.9	70.8	63.5
MEXICO																										
Monterrey	950	140	123	176	117	99	78	61	45	34	26	31	20	1,792.1	264.1	232.0	332.0	220.7	186.8	147.1	115.1	84.9	64.1	49.0	58.5	37.7

FIG. 72. Mortality[a] from Diarrheal Disease by Month of Age in First Two Years of Life in Two Areas of El Salvador.



[a]Smoothed averages of death rates, under 1 year per 100,000 live births and 12-23 months per 100,000 population.

Kingston-St. Andrew, which had relatively low rates through the first year of life. These are areas where mothers continue breast feeding for a longer time than in the Brazilian and El Salvador areas. Although deaths in the Chile project were concentrated in early life, the death rates were low.

In El Salvador diarrheal disease mortality continued to be very high even at 11 months of age. Only by the end of the second year did the rates become lower. Figure 72 shows the rates for the rural *municipios* and for San Salvador in the first two years of age (smoothed averages were plotted to eliminate the variation by month of age due to small numbers in the *municipios*). The excessive mortality in the rural *municipios* indicates that diarrheal disease constitutes a very serious health problem in children throughout the first two years of life.

AMEBIASIS AND OTHER INFECTIOUS INTESTINAL DISEASES

Amebiasis was the underlying cause of 303 deaths (Table 70). These occurred in only nine of the 25 areas, and half of them were in Monterrey, Mexico (where the rate was 71.6 per 100,000 population). The rates were also high in the rural *municipios* of El Salvador (102.7) and in San Salvador (62.6). Deaths from amebiasis occurred in all three cities in Colombia.

Although water-borne outbreaks occur, amebic infection is usually spread from person to person through food handling. In the amebiasis deaths in the Investigation serious complications were noted, particularly of the hepatic-abscess type. Also the fact that infants died early in life (even in the neonatal period) indicates the serious need for sanitation measures and health education in those areas. In Monterrey, eight deaths from amebiasis occurred in the neonatal period and 60 in the age period 28 days-5 months (Table 74).

As shown in Table 75, there were four projects (São Paulo, Chile, El Salvador, and Monterrey) in which at least 40 deaths occurred due to other intestinal infectious diseases (typhoid fever, paratyphoid, other salmonellosis, bacillary dysentery, and enteritis due to other specified organisms). In these projects, typhoid fever (001) was the underlying cause of only six deaths, three of which occurred in Chile. Other

TABLE 74. Mortality[a] from Amebiasis as Underlying Cause by Age Group in Four Projects.

Age group	Colombia				El Salvador project		Mexico Monterrey	
	Cartagena		Medellín					
	No.	Rate	No.	Rate	No.	Rate	No.	Rate
Total	32	37.2	17	18.2	87	69.4	156	71.6
Under 28 days	—	—	—	—	—	—	8	15.1
28 days–5 months	10	55.9	3	15.5	18	58.0	60	113.2
6–11 months	11	61.5	3	15.5	29	93.5	42	79.2
1–4 years	11	16.0	11	14.7	40	41.4	46	27.1

[a] Rates under 1 year per 100,000 live births; others per 100,000 population.

TABLE 75. Number of Deaths from Specific Intestinal Infectious Diseases as Underlying Cause by Age Group in Four Projects.

Age group	Total	Typhoid fever (001)	Para-typhoid fever (002)	Other Salmonella infections (003)	Bacillary dysentery (004)	Enteritis due to other specified organism (008)
	São Paulo					
Total	68	—	2	31	—	35
Under 28 days	15	—	—	6	—	9
28 days–11 months	49	—	2	22	—	25
1–4 years	4	—	—	3	—	1
	Chile project					
Total	47	3	—	24	6	14
Under 28 days	7	1	—	—	—	6
28 days–11 months	38	—	—	24	6	8
1–4 years	2	2	—	—	—	—
	El Salvador project					
Total	40	1	—	3	11	25
Under 28 days	7	—	—	—	1	6
28 days–11 months	25	1	—	3	5	16
1–4 years	8	—	—	—	5	3
	Monterrey					
Total	56	2	—	3	1	50
Under 28 days	14	—	—	—	—	14
28 days–11 months	36	—	—	3	—	33
1–4 years	6	2	—	—	1	3

Salmonella infections (003) and enteritis due to other specified organisms (008), of which pathogenic *Escherichia coli* was the most commonly found, were the main causes of death among this group of intestinal infections excluding diarrheal disease (category 009). These deaths occurred principally in infancy.

MEASLES

Soon after the beginning of the field work in the Investigation in 1968, many deaths from measles were reported in two projects: in Recife, where it was believed to be the usual occurrence and not an epidemic, and in the project in Bolivia. In the past the size of the measles death rate in Recife was not known because the terminal cause (usually a lower respiratory infection) was commonly the assignment made. (Chapter XVII will show the differences in assignments based on death certificates and the information collected in the Investigation.) In La Paz, moreover, a problem of terminology was uncovered and had to be solved in order to arrive at a correct interpretation of the data.

These early findings in regard to measles were reported to the Special Meeting of Ministers of Health in Buenos Aires (October 1968) and led that body to recommend the establishment of vaccination programs against the disease throughout the Americas (PAHO, 1969). Fortunately, vaccine was obtained for a massive program in Recife in the second year of the study. Also, vaccination against measles was started in La Paz.

Of the 35,095 deaths under 5 years of age studied in the Investigation, 2,108 or 6.0 per cent were due to measles as underlying cause. If the neonatal period is excluded, the percentage comes to 9.4. In the second year of life measles accounted for 19.9 per cent of deaths from all causes, and in one project (Recife) for 29.7 per cent.

Mortality from measles in children under 5 years is shown in Figure 73 and Table 76 for 23 areas. The highest rates were in the Bolivia project (746.3 per 100,000 population for Viacha and 358.1 for La Paz), and the rate of 320.4 for Recife also indicated unusual mortality from this common disease of childhood. Measles mortality in rural areas was usually much higher than in the corresponding cities. Viacha's rate, for example, was more than twice that of

FIG. 73. Mortality from Measles in Children Under 5 Years of Age in 23 Areas of 15 Projects.

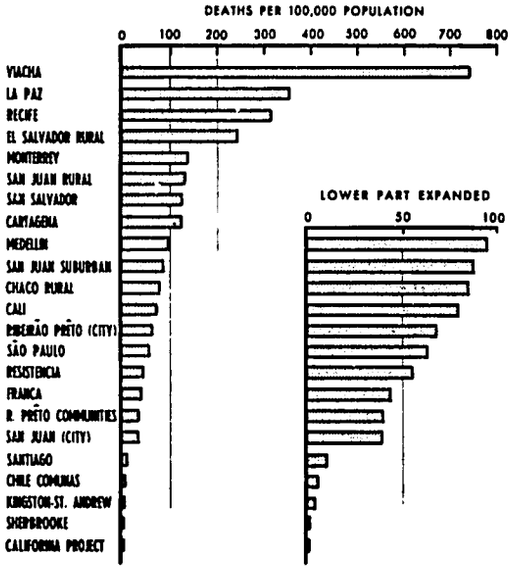


TABLE 76. Deaths from Measles[a] in Children Under 5 Years of Age in 23 Areas of 15 Projects.

Project	No.	Rate
Total	2,108	100.4
ARGENTINA		
Chaco Province	53	69.0
Resistencia	23	55.1
Rural departments	30	85.6
San Juan Province	96	91.9
San Juan (city)	10	39.6
Suburban departments	31	87.2
Rural departments	55	125.9
BOLIVIA project	579	366.3
La Paz	554	358.1
Vincha	25	746.3
BRAZIL		
Recife	397	320.4
Ribeirão Prêto	46	55.8
Ribeirão Prêto (city)	29	68.0
Franca	10	44.8
Communities	7	39.9
São Paulo	156	64.0
CANADA		
Sherbrooke	1	1.1
CHILE project	21	10.1
Santiago	20	10.4
Comunas	1	6.2
COLOMBIA		
Cali	80	79.1
Cartagena	105	122.1
Medellín	89	95.4
EL SALVADOR project	178	142.1
San Salvador	127	122.3
Rural *municipios*	51	238.0
JAMAICA		
Kingston-St. Andrew	9	4.9
MEXICO		
Monterrey	297	136.3
UNITED STATES		
California project	1	0.5

[a] Rates per 100,000 population.

La Paz, and in San Juan Province the rate of 125.9 in the rural departments was over three times that in the city of San Juan. The differences in mortality between urban and rural areas are probably due to differences in susceptibility of the population. As was shown in earlier chapters, the death rates for nutritional deficiency were higher in the rural areas, and the child who died from measles frequently had nutritional deficiency as an associated cause.

The death rate was low in the Chilean project, an area in which a successful vaccination program had been conducted (as will be shown in Table 86, p. 159). The seriousness of measles in Chile and the increase in death rates in the 1950's were documented by Ristori *et al.* (1962), who pointed out the importance of introducing vaccination. A massive immunization campaign was undertaken in Chile in 1963 (Ristori *et al.*, 1964) and was followed by a sustained program that resulted in a dramatic reduction in measles mortality, as evidenced by the low rate found in the areas of Chile in this Investigation. The rate was low also in Kingston-St. Andrew, but the fact that six of the nine deaths occurred in the last month of the Investigation might indicate the beginning of a seasonal increase. One death from measles occurred in the project in California and one in Sherbrooke.

In only 88 deaths in the 15 projects was measles found to be an associated cause. Of this total of 88, measles was a contributory cause of 36 deaths from all forms of tuberculosis (including 17 in Monterrey, 7 in Bolivia, and 6 in Recife); 14 deaths from diarrheal disease; 12 from amebiasis (of which 10 were in Monterrey); 12 deaths from other specific infections such as diphtheria, whooping cough, and poliomyelitis; 4 deaths from congenital anomalies; and 10 deaths from other causes.

Because of the seriousness of this disease and the need for preventive programs, the findings in the Investigation are reported in detail. Table 77 provides the number of deaths by months. In several projects, as in Cali and Medellín, deaths occurred nearly every month throughout the 24-month period of the study. In the Bolivia project the numbers of deaths were large in the first few months, July-November 1968, and large

TABLE 77. Number of Deaths from Measles by Calendar Month in 15 Projects.

Month and year	Argentina		Bolivia project	Brazil			Canada Sherbrooke	Chile project	Colombia			El Salvador project	Jamaica Kingston-St. Andrew	Mexico Monterrey	United States California project
	Chaco	San Juan		Recife	Ribeirão Prêto	São Paulo			Cali	Cartagena	Medellín				
Total	53	96	579	397	46	156	1	21	80	105	89	178	9	297	1
1968															
June						4							1		
July			37	17	2	9		—	2	3	1		—		
August	11	—	37	21	7	3		—	1	3	1		1	17	
September	12	3	47	46	6	6		1	—	5	1	4	—	14	
October	6	18	28	32	6	5		—	4	—	—	7	—	15	
November	5	10	34	44	3	6		—	3	1	2	9	—	14	
December	6	19	16	40	3	13		—	5	—	1	6	—	6	
1969															
January	5	9	19	33	4	6		1	6	—	6	8	—	8	
February	1	2	5	32	2	8		1	5	—	6	16	—	6	
March	—	—	9	19	1	3		1	4	1	3	13	—	25	
April	—	—	4	15	—	6		—	8	—	5	22	1	17	
May	—	—	6	14	—	12		2	5	1	7	18	—	8	
June	—	—	2	14	2	8		1	6	3	4	12	—	9	—
July	1	—	8	12	5	15		1	5	2	3	11	—	12	—
August	—	—	12	5	—	15		3	5	1	7	3	—	5	—
September	2	2	18	3	1	9		—	3	4	5	—	—	5	—
October	—	—	49	10	—	7		—	4	1	4	1	—	8	—
November	1	2	65	7	1	8		2	2	2	1	3	—	4	—
December	—	2	51	4	1	3		3	4	5	5	5	—	7	—
1970															
January	1	—	46	5	—	—	—	1	1	5	3	3	—	13	1
February	1	1	27	7	—	2	—	—	—	5	1	4	—	10	—
March	—	—	14	5	1	3	—	—	3	16	4	10	—	13	—
April	—	2	9	10	—	3	—	1	2	16	4	8	—	14	—
May	—	1	13	—	—	2	1	1	—	18	6	4	6	27	—
June	—	5	23	2	1		—	2	2	13	9	5		24	
July	1	11					—					5		16	
August							—					1			

= Indicates a change in sampling which has to be considered in evaluating distribution by months.

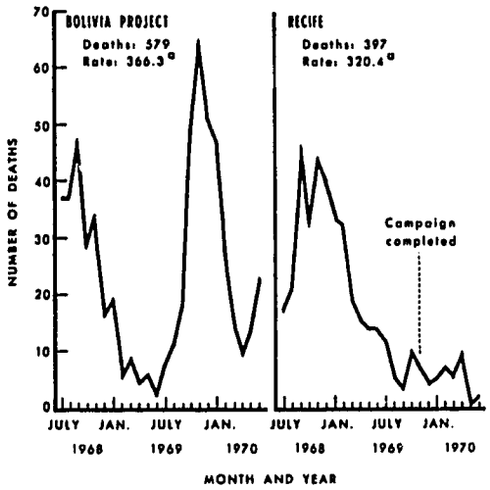
again in October-November-December 1969 and January 1970, which indicated a seasonal variation (Figure 74). The coverage of vaccination in 1969 did not appear to diminish the seasonal increase.

In Recife, however, a seasonal increase did not occur in 1969-1970 (Figure 74). The immunization campaign, which reached 80-85 per cent of the susceptible population in the area of the Investigation, was completed in November 1969. After that date relatively few deaths occurred and at least half were of children too young to have been vaccinated at the time of the campaign.

The monthly variations in measles deaths in São Paulo and in the El Salvador project are shown in Figure 75. El Salvador's seasonal fluctuation, with increases in April and May, is similar to that in the United States while in São Paulo a distinct pattern is not discernible.

Deaths from measles occurred early in life (Table 78 and Figure 76). The highest rates were either in infancy or among one-

FIG. 74. Number of Deaths from Measles by Calendar Month in Two Projects.



[a] Rate per 100,000 population.

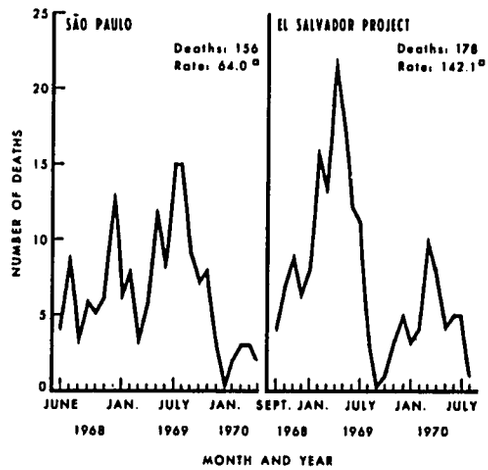
year-old children. Data are given for three-month age groups in Table 78 in order to show the groups with the high death rates. In several projects (such as El Salvador and Monterrey) infants aged 9-11 months had the highest death rates.

Of the 674 measles deaths in the first year of life, 357 occurred before the infant reached 9 months of age. Since the vaccine is usually recommended for infants aged at least 9 months, many infants would not be protected in a vaccination campaign. Therefore, in view of the deaths from measles occurring in infants of less than 9 months, when a vaccination program against measles is first started it would seem advisable to include in the attack phase infants from 6 months of age, at least in Latin America. During the program's maintenance phase, however, vaccinations could be given beginning at age 9 months.

The higher measles mortality in early life in the rural areas is another indication of the serious health problems of these populations. This is illustrated in Figure 77, for the El Salvador project, where the highest rates by three-month age groups were for infants 9-11 months of age in the rural *municipios*.

The study of the associated causes in deaths due to measles as underlying cause reveals important relationships and interactions (Table 79). Of the 2,106 deaths from measles in the 13 Latin American projects, 1,061 or 50.4 per cent had diarrheal disease as a complication (consequence). In only 2.5 per cent was diarrheal disease a contributory or pre-existing condition to the onset of the underlying cause. This complicating condition has been recognized for a long time and has been attributed to inflammatory changes in the jejunal mucosa (Sheehy *et al.*, 1964) and to malnutrition commonly present in children suffering from measles (Gosh and Dhatt, 1961). Various studies have indicated that several forms

FIG. 75. Number of Deaths from Measles by Calendar Month in Two Projects.



[a] Rate per 100,000 population.

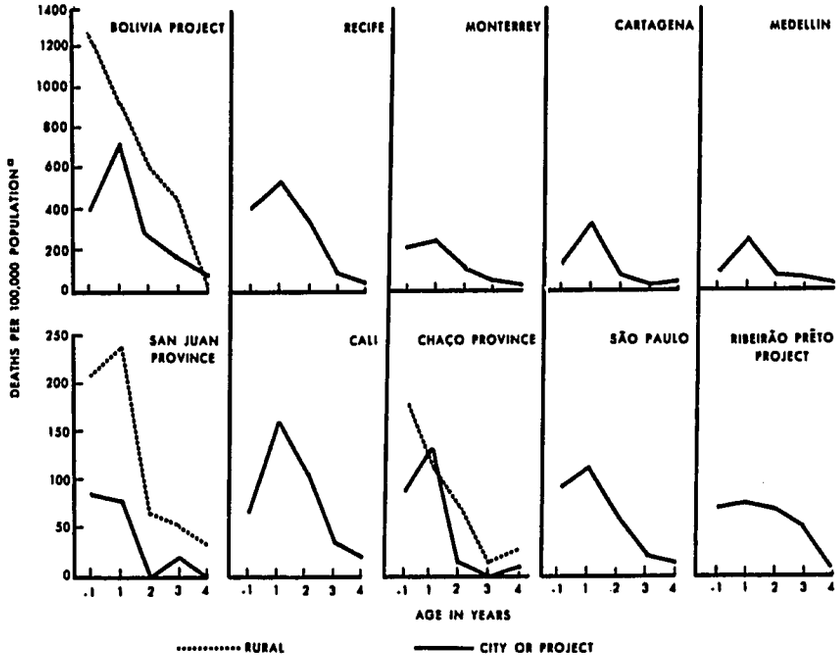
TABLE 78. Deaths from Measles as Underlying Cause by Age Groups in 20 Areas of 15 Projects.

Area	Total under 5 years	Under 1 year: Total	Under 1 year: Age in months 0-2	3-5	6-8	9-11	1 year: Total	1 year: Age in months 12-14	15-17	18-20	21-23	2 years	3 years	4 years	Total under 5 years	Under 1 year: Total	Under 1 year: Age in months 0-2	3-5	6-8	9-11	1 year: Total	1 year: Age in months 12-14	15-17	18-20	21-23	2 years	3 years	4 years
	No. of deaths														Deaths per 100,000[a]													
Total	2,108	674	21	106	230	317	870	307	234	186	143	332	157	75	100.4	142.2	4.4	22.4	48.5	66.9	200.7	70.8	54.0	42.9	33.0	81.6	38.6	18.4
ARGENTINA																												
Chaco Province	53	23	3	2	11	7	20	8	5	4	3	6	1	3	69.0	130.7	17.0	11.4	62.5	39.8	125.5	50.2	31.4	25.1	18.8	40.6	6.8	20.3
Resistencia	23	9	1	—	5	3	12	6	2	3	1	1	—	1	55.1	91.6	10.2	—	51.0	30.6	134.2	67.1	22.4	33.6	11.2	12.7	—	12.7
Rural departments	30	14	2	2	6	4	8	2	3	1	2	5	1	2	85.6	179.5	25.6	25.6	76.9	51.3	114.3	28.6	42.9	14.3	28.6	72.2	14.4	28.9
San Juan Province	96	43	1	9	16	17	34	14	11	6	3	8	8	3	91.9	184.1	4.3	38.5	68.5	72.8	161.6	66.5	52.3	28.5	14.3	38.0	38.0	14.3
San Juan (city)	10	5	—	1	2	2	4	1	1	1	1	—	1	—	39.6	85.9	—	17.2	34.4	34.4	79.1	19.8	19.8	19.8	19.8	—	19.8	—
Suburban departments	31	18	—	2	7	9	9	5	2	2	—	2	2	—	87.2	227.3	—	25.3	88.4	113.6	125.7	69.8	27.9	27.9	—	28.0	28.0	—
Rural departments	55	20	1	6	7	6	21	8	8	3	2	6	5	3	125.9	207.9	10.4	62.4	72.8	62.4	238.1	90.7	90.7	34.0	22.7	67.9	56.6	33.9
BOLIVIA																												
La Paz	554	151	11	20	41	79	246	84	64	56	42	84	49	24	358.1	410.8	29.9	54.4	111.5	214.9	743.2	253.8	193.4	169.2	126.9	289.7	169.0	82.8
Viacha	25	11	—	2	3	6	7	4	2	1	—	4	3	—	746.3	1294.1	—	235.3	352.9	705.9	985.9	563.4	281.7	140.8	—	641.7	481.3	—
BRAZIL																												
Recife	397	130	1	20	49	60	153	45	53	29	26	83	21	10	320.4	427.6	3.3	65.8	161.2	197.4	570.5	167.8	197.6	108.1	96.9	360.9	91.3	43.5
Ribeirão Prêto	46	13	—	4	3	6	13	4	6	1	2	11	8	1	55.8	71.3	—	21.9	16.4	32.9	76.2	23.4	35.1	5.9	11.7	68.8	50.0	6.2
São Paulo	156	52	—	6	23	23	61	26	13	14	8	27	9	7	64.0	99.4	—	10.3	39.5	39.5	112.7	48.0	24.0	25.9	14.8	60.3	20.1	15.6
CANADA																												
Sherbrooke	1	—	—	—	—	—	1	—	—	1	—	—	—	—	1.1	—	—	—	—	—	5.9	—	—	5.9	—	—	—	—
CHILE project	21	10	—	4	3	3	5	1	1	1	2	—	4	2	10.1	22.9	—	9.2	6.9	6.9	12.4	2.5	2.5	2.5	5.0	—	9.4	4.7
COLOMBIA																												
Cali	80	14	—	3	5	6	33	18	6	6	3	22	7	4	79.1	66.4	—	14.2	23.7	28.4	163.4	89.1	29.7	29.7	14.9	108.7	34.6	19.8
Cartagena	105	24	—	—	8	16	60	23	15	10	12	12	4	5	122.1	134.1	—	—	44.7	89.4	348.8	133.7	87.2	58.1	69.8	69.8	23.3	29.1
Medellín	89	17	1	1	7	8	46	15	13	12	6	13	10	3	95.4	87.6	5.2	5.2	36.1	41.2	247.3	80.6	69.9	64.5	32.3	69.9	53.6	16.1
EL SALVADOR																												
San Salvador	127	46	2	5	12	27	55	21	16	11	7	11	11	4	122.3	179.5	7.8	19.5	46.8	105.4	240.7	91.9	70.0	48.1	30.6	57.7	57.7	21.0
Rural *municipios*	51	16	1	1	6	8	21	6	5	5	5	8	2	4	238.0	296.3	18.5	18.5	111.1	148.1	465.6	133.0	110.9	110.9	110.9	199.3	49.8	99.7
JAMAICA																												
Kingston-St. Andrew	9	4	—	1	—	3	2	1	—	—	1	2	1	—	4.9	9.8	—	2.4	—	7.3	5.1	2.6	—	—	2.6	5.7	2.9	—
MEXICO																												
Monterrey	297	120	1	28	43	48	113	37	24	29	23	41	18	5	136.3	226.4	1.9	52.8	81.1	90.5	251.0	82.2	53.3	64.4	51.1	98.6	43.3	12.0
UNITED STATES																												
California project	1	—	—	—	—	—	—	—	—	—	—	—	1	—	0.5	—	—	—	—	—	—	—	—	—	—	—	2.5	—

[a] Rates under 1 year per 100,000 live births; others per 100,000 population.

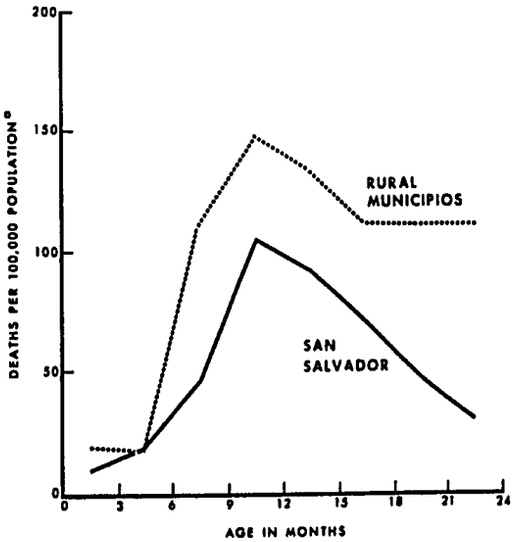
of malnutrition (in particular the multiple form) and dietary changes can induce alterations in the type, concentration, distribution, and localization of intestinal bacteria. This plus the changes in intestinal absorption and motility produced by malnutrition are additional explanations for the diarrheal complication (Scrimshaw *et al.*, 1966). On the other hand, one of the consequences of this complication is the reduction of intake and impairment of assimilation of food in the affected children, which explains in part the onset of malnutrition and, more frequently, the worsening to severe degrees of already existing nutritional deficiencies in survivors of measles (Morley, 1962). Other factors worsening the nutritional state are the anorexia and the changes from ordinary to liquid diet (Scrimshaw *et al.*, 1966).

FIG. 76. Mortality from Measles for Single Years of Age Under 5 Years in 11 Projects.



[a]Under 1 year per 100,000 live births.

FIG. 77. Mortality from Measles by Three-Month Age Groups in First Two Years of Life in Rural *Municipios* and San Salvador in El Salvador.



[a]Under 1 year per 100,000 live births.

Nutritional deficiency of the protein-calorie type was found as a contributory or pre-existing cause in 1,248 or 59.3 per cent of all deaths from measles, and in 65 deaths (3.1 per cent) malnutrition was considered secondary (consequence) to the underlying cause. The highest percentages of deaths from measles with nutritional deficiency as a contributory cause were found in Cartagena (83.8), Medellín (76.4), and Recife (71.8). Unfortunately, it was not always possible to evaluate the nutritional state of these children because of factors such as impossibility of finding the home or of obtaining another source of information.

Categories 480-486 of the *International Classification of Diseases,* which group the pneumonias and bronchopneumonias, were found as complications (usually as terminal

TABLE 79. Diarrheal Disease, Nutritional Deficiency, and Pneumonia as Consequences and Contributory Causes of Deaths from Measles in 13 Projects.[a]

Project	Total measles deaths	Diarrheal disease				Nutritional deficiency				Pneumonia			
		Consequence		Contributory		Consequence		Contributory		Consequence		Contributory	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Total	2,106	1,061	50.4	53	2.5	65	3.1	1,248	59.3	1,689	80.2	2	0.1
ARGENTINA													
Chaco Province	53	33	62.3	3	5.7	3	5.7	29	54.7	28	52.8	—	—
San Juan Province	96	30	31.2	1	1.0	5	5.2	29	30.2	80	83.3	—	—
BOLIVIA project	579	230	39.7	2	0.3	12	2.1	277	47.8	452	78.1	—	—
BRAZIL													
Recife	397	249	62.7	16	4.0	9	2.3	285	71.8	341	85.9	1	0.3
Ribeirão Preto	46	19	41.3	2	4.3	—	—	31	67.4	43	93.5	—	—
São Paulo	156	62	39.7	2	1.3	5	3.2	69	44.2	138	88.5	—	—
CHILE project	21	4	19.0	1	4.8	—	—	11	52.4	19	90.5	—	—
COLOMBIA													
Cali	80	36	45.0	5	6.2	2	2.5	49	61.2	73	91.2	—	—
Cartagena	105	67	63.8	4	3.8	3	2.9	88	83.8	67	63.8	—	—
Medellín	89	44	49.4	2	2.2	1	1.1	68	76.4	74	83.1	—	—
EL SALVADOR project	178	132	74.2	5	2.8	10	5.6	117	65.7	118	66.3	—	—
JAMAICA													
Kingston-St. Andrew	9	3	#	1	#	1	#	2	#	5	#	—	—
MEXICO													
Monterrey	297	152	51.2	9	3.0	14	4.7	193	65.0	251	84.5	1	0.3

[a] The projects in Sherbrooke and California (with one death each) are not included.
Percentage is not calculated when the base is less than 10.

causes) in 1,689 or 80.2 per cent of the deaths due to measles, and only in two instances were pneumonias considered to be a contributory cause. This very high proportion of measles deaths complicated by respiratory conditions is probably an indication of the severity of the disease, determined by the state of decreased resistance of the host.

The foregoing discussion is an example of the complexity of mortality in childhood. If each one of the principal components—namely, measles, diarrheal disease, nutritional deficiency, and respiratory conditions—were to be analyzed in its own context and the concept of interaction of causes omitted, a distorted picture would be obtained.

TUBERCULOSIS

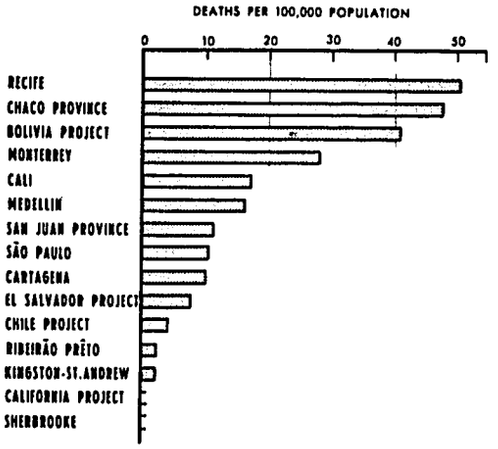
Deaths from tuberculosis as the underlying cause numbered 330 in 13 Latin American projects (Table 80). No deaths from this cause occurred in California or Sherbrooke, Canada. Three projects (Recife, Chaco Province, and Bolivia) had tuberculosis death rates in excess of 40 per 100,000 population. The rates in the Chilean,

TABLE 80. Deaths from Tuberculosis as Underlying Cause[a] in Three Age Groups Under 5 Years in 15 Projects.

Project	No.				Rates per 100,000 population			
	Under 5 years	Under 1 year	1 year	2–4 years	Under 5 years	Under 1 year	1 year	2–4 years
Total	330	91	105	134	15.7	19.2	24.2	11.0
ARGENTINA								
Chaco province	37	16	11	10	48.2	90.0	69.0	22.5
San Juan Province	12	4	1	7	11.5	17.1	4.8	11.1
BOLIVIA project	65	12	19	34	41.1	31.0	56.2	38.3
BRAZIL								
Recife	63	18	21	24	50.8	59.2	78.3	34.8
Ribeirão Prêto	2	1	1	—	2.4	5.5	5.9	—
São Paulo	26	6	10	10	10.7	10.3	18.5	7.4
CANADA								
Sherbrooke	—	—	—	—	—	—	—	—
CHILE project	8	3	1	4	3.9	6.9	2.5	3.1
COLOMBIA								
Cali	17	5	9	3	16.8	23.7	44.6	4.9
Cartagena	9	5	1	3	10.5	27.9	5.8	5.8
Medellín	15	1	7	7	16.1	5.2	37.6	12.5
EL SALVADOR project	10	3	1	6	8.0	9.7	3.7	8.7
JAMAICA								
Kingston-St. Andrew	4	—	2	2	2.2	—	5.1	1.9
MEXICO								
Monterrey	62	17	21	24	28.4	32.1	46.6	19.2
UNITED STATES								
California project	—	—	—	—	—	—	—	—

[a] Rates under 1 year per 100,000 live births; others per 100,000 population.

FIG. 78. Mortality from Tuberculosis in Children Under 5 Years of Age in 15 Projects.



Kingston-St. Andrew, and Ribeirão Prêto projects were very low (Figure 78). Since the numbers are small, the data are shown for each project as a whole. The total numbers of deaths in infancy and in the second year of life were of similar size, 91 and 105, while for children 2-4 years of age there were 134 deaths, or an average of 45 for each year of age. Tuberculosis as an associated cause* (contributory to other causes) was assigned in only 45 deaths in the 13 Latin American projects.

* The number of assignments as associated causes as given in the Appendix tables was larger due to coding of more than one type as tuberculous meningitis and pulmonary tuberculosis.

DIPHTHERIA, WHOOPING COUGH, AND TETANUS

The numbers of deaths from these three preventable diseases of childhood were relatively few:

Diphtheria	91
Whooping cough	290
Tetanus	172

Only eight of the 15 projects had deaths from diphtheria (Table 81). Recife and El Salvador had the highest rates.

Whooping cough deaths, however, occurred in all projects except Sherbrooke, the highest rate being in Bolivia (Table 82 and Figure 79).

Tetanus was an unusually serious problem in infancy in Chaco Province, Recife, Cartagena, and El Salvador, but at least one death occurred in all projects except those in Bolivia, Sherbrooke, Chile, and California (Table 83). Of the 172 tetanus deaths, 166 were of infants and nearly all occurred in the neonatal period, which indi-

TABLE 81. Deaths from Diphtheria as Underlying Cause[a] in Children Under 5 Years in Three Age Groups in 15 Projects.

Project	Total		Under 1 year		1 year		2–4 years	
	No.	Rate	No.	Rate	No.	Rate	No.	Rate
Total	91	4.3	16	3.4	35	8.1	40	3.3
ARGENTINA								
Chaco Province	—	—	—	—	—	—	—	—
San Juan Province	—	—	—	—	—	—	—	—
BOLIVIA project	—	—	—	—	—	—	—	—
BRAZIL								
Recife	29	23.4	9	29.6	16	59.7	4	5.8
Ribeirão Prêto	—	—	—	—	—	—	—	—
São Paulo	7	2.9	2	3.4	1	1.8	4	3.0
CANADA								
Sherbrooke	—	—	—	—	—	—	—	—
CHILE project	2	1.0	—	—	1	2.5	1	0.8
COLOMBIA								
Cali	9	8.9	—	—	2	9.9	7	11.5
Cartagena	—	—	—	—	—	—	—	—
Medellín	3	3.2	—	—	—	—	3	5.4
EL SALVADOR project	24	19.2	1	3.2	10	36.5	13	18.8
JAMAICA								
Kingston-St. Andrew	14	7.6	4	9.8	5	12.8	5	4.8
MEXICO								
Monterrey	3	1.4	—	—	—	—	3	2.4
UNITED STATES								
California project	—	—	—	—	—	—	—	—

[a] Rates under 1 year per 100,000 live births; others per 100,000 population.

TABLE 82. Deaths from Whooping Cough as Underlying Cause[a] Under 5 Years, in Three Age Groups, in 15 Projects.

Project	Total		Under 1 year		1 year		2–4 years	
	No.	Rate	No.	Rate	No.	Rate	No.	Rate
Total	290	13.8	159	33.5	84	19.4	47	3.9
ARGENTINA								
Chaco Province	21	27.3	12	68.2	5	31.4	4	9.0
San Juan Province	20	19.1	14	59.9	5	23.8	1	1.6
BOLIVIA project	61	38.6	30	79.8	17	50.3	14	15.8
BRAZIL								
Recife	31	25.0	16	52.6	8	29.8	7	10.1
Ribeirão Prêto	7	8.5	1	5.5	6	35.1	—	—
São Paulo	35	14.4	22	37.8	7	12.9	6	4.5
CANADA								
Sherbrooke	—	—	—	—	—	—	—	—
CHILE project	7	3.4	7	16.1	—	—	—	—
COLOMBIA								
Cali	12	11.9	5	23.7	6	29.7	1	1.6
Cartagena	18	20.9	7	39.1	6	34.9	5	9.7
Medellín	3	3.2	3	15.5	—	—	—	—
EL SALVADOR project	30	23.9	16	51.6	12	43.9	2	2.9
JAMAICA								
Kingston-St. Andrew	18	9.8	11	26.9	4	10.2	3	2.9
MEXICO								
Monterrey	26	11.9	14	26.4	8	17.8	4	3.2
UNITED STATES								
California project	1	0.5	1	2.2	—	—	—	—

[a] Rates under 1 year per 100,000 live births; others per 100,000 population.

cates the need for improvement in care of the newborn soon after delivery. These deaths from tetanus neonatorum also provide justification for immunization of pregnant women in localities where significant numbers of deliveries take place at home.

FIG. 79. Mortality from Whooping Cough in Children Under 5 Years of Age in 15 Projects.

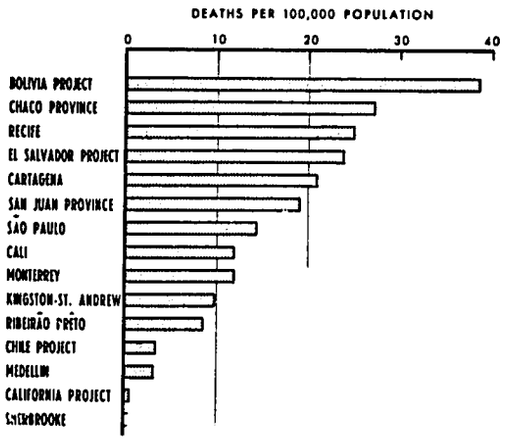


TABLE 83. Deaths from Tetanus as Underlying Cause[a] in Infants and Children 1–4 Years of Age in 15 Projects.

Project	Under 1 year		1–4 years	
	No.	Rate	No.	Rate
Total	166	35.0	6	0.4
ARGENTINA				
Chaco Province	24	136.4	—	—
San Juan Province	3	12.8	—	—
BOLIVIA project	—	—	—	—
BRAZIL				
Recife	27	88.8	2	2.1
Ribeirão Prêto	1	5.5	—	—
São Paulo	7	12.0	—	—
CANADA				
Sherbrooke	—	—	—	—
CHILE project	—	—	—	—
COLOMBIA				
Cali	10	47.4	1	1.2
Cartagena	17	95.0	2	2.9
Medellín	1	5.2	—	—
EL SALVADOR project	46	148.3	—	—
JAMAICA				
Kingston-St. Andrew	16	39.1	1	0.7
MEXICO				
Monterrey	14	26.4	—	—
UNITED STATES				
California project	—	—	—	—

[a] Rates under 1 year per 100,000 live births; others per 100,000 population.

OTHER INFECTIOUS DISEASES

In Table 71 the numbers of deaths from other specific infective and parasitic diseases were presented to complete the account of morbid conditions belonging to this important broad group.

Among the bacterial diseases, meningococcal infections (036) were found responsible for 30 deaths, of which 11 occurred in São Paulo and nine in the California project. Streptococcal infections (034) were assigned as the underlying cause of only three deaths in the entire Investigation.

As for the viral diseases, poliomyelitis (040-046) was underlying cause of 31 deaths (Table 84) in 10 of the 15 projects. Cartagena, Recife, and Monterrey had five apiece and the other projects from one to four. Only four deaths were known to have occurred from smallpox (050) as underlying cause, three in Ribeirão Prêto and one in São Paulo. Infectious hepatitis (070) caused 44 deaths in 12 of the 15 projects: eight occurred in Monterrey and seven in São Paulo. Rabies (071) produced four deaths, two in Cali and one each in Recife and San Juan Province. Mumps (072) caused nine deaths distributed in five projects. Other viral diseases such as viral encephalitis, cytomegalic inclusion disease, and others caused 62 deaths, of which 12 occurred in the Chilean project, 10 in San Juan Province, and eight in the Bolivia project.

Among the parasitic diseases, Chagas' disease (086) caused 13 deaths: seven in San Juan Province, three in Ribeirão Prêto, two in Chile, and one in Chaco Province. Finally, congenital toxoplasmosis (130) was responsible for 18 deaths, of which eight occurred in São Paulo and three in Ribeirão Prêto, while seven other projects had one each.

Congenital syphilis (090) resulted in 95 deaths and was an associated cause in 25 more in all projects (Table 85). These totals do not include those deaths in which syphilis in the mother (761.0) was the underlying or an associated cause of an infant death and was therefore included among the so-called perinatal causes of morbidity and mortality discussed in Chapter VI.

TABLE 84. Deaths from Poliomyelitis as Underlying Cause[a] in Children Under 5 Years of Age in 15 Projects.

Project	No.	Rate
Total	31	1.5
ARGENTINA		
Chaco Province	—	—
San Juan Province	—	—
BOLIVIA project	2	1.3
BRAZIL		
Recife	5	4.0
Ribeirão Prêto	2	2.4
São Paulo	1	0.4
CANADA		
Sherbrooke	—	—
CHILE project	1	0.5
COLOMBIA		
Cali	4	4.0
Cartagena	5	5.8
Medellín	2	2.1
EL SALVADOR project	—	—
JAMAICA		
Kingston-St. Andrew	—	—
MEXICO		
Monterrey	5	2.3
UNITED STATES		
California project	4	2.0

[a] Rates per 100,000 population.

INFECTIOUS DISEASES AS ASSOCIATED CAUSES OF DEATH

Major attention has been given above to the infective and parasitic diseases as underlying causes of death. Several of these diseases, however, are usually classed as associated causes—namely, moniliasis, septicemia, and helminthiases (Table 85). Only 33 deaths were attributed to moniliasis (category 112) as underlying cause but in 1,038 deaths this disease was assigned as associated cause. Usually deaths in which moniliasis was found to be a cause occurred in small infants and the condition was of the oral type, interfering with food intake; in certain instances it produced esophageal lesions discovered on autopsy, and in a few instances it was found to be systemic.

In the group of helminthiases (120–129) ascaris infestation was found to be the main entity. In El Salvador 11 of the 14 deaths due to helminthiases as underlying cause were produced by *Ascaris lumbricoides*, and in seven of these 11 deaths mechanical intestinal obstruction was found as a serious complication. In Recife 10 of the 16 helminthiases deaths were due to ascariasis, and six of these had intestinal obstruction. In Cartagena two of the four children dying from ascariasis presented intestinal obstruc-

TABLE 85. Five Infectious Diseases as Underlying and as Associated Causes of Death[a] in Children Under 5 Years of Age in 15 Projects.

Project	Amebiasis (006)				Septicemia (038)				Syphilis (090)				Moniliasis (112)				Helminthiases (120–129)			
	Underlying		Associated		Underlying		Associated		Underlying		Associated		Underlying		Associated		Underlying		Associated	
	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate
Total	303	14.4	80	3.8	424	20.2	1,889	90.0	95	4.5	25	1.2	33	1.6	1,038	49.5	69	3.3	1,076	51.3
ARGENTINA																				
Chaco Province	—	—	—	—	10	13.0	30	39.1	9	11.7	—	—	3	3.9	42	54.7	—	—	—	—
San Juan Province	—	—	—	—	28	26.8	94	90.0	6	5.7	—	—	3	2.9	204	195.3	—	—	—	—
BOLIVIA project	2	1.3	1	0.6	22	13.9	41	25.9	3	1.9	1	0.6	1	0.6	35	22.1	1	0.6	10	6.3
BRAZIL																				
Recife	1	0.8	1	0.8	28	22.6	201	162.2	22	17.8	2	1.6	2	1.6	110	88.8	16	12.9	346	279.2
Ribeirão Prêto	—	—	—	—	6	7.3	31	37.6	1	1.2	3	3.6	1	1.2	17	20.6	1	1.2	32	38.8
São Paulo	1	0.4	—	—	41	16.8	190	78.0	26	10.7	2	0.8	9	3.7	362	148.5	5	2.1	92	37.7
CANADA																				
Sherbrooke	—	—	—	—	1	1.1	8	8.8	—	—	—	—	—	—	—	—	—	—	—	—
CHILE project	—	—	—	—	67	32.2	226	108.8	6	2.9	4	1.9	—	—	8	3.9	—	—	—	—
COLOMBIA																				
Cali	7	6.9	2	2.0	14	13.8	104	102.8	5	4.9	2	2.0	1	1.0	32	31.6	5	4.9	51	50.4
Cartagena	32	37.2	18	20.9	19	22.1	98	114.0	1	1.2	1	1.2	—	—	32	37.2	10	11.6	120	139.5
Medellín	17	18.2	7	7.5	8	8.6	109	116.8	3	3.2	3	3.2	—	—	16	17.1	6	6.4	72	77.2
EL SALVADOR project	87	69.4	10	8.0	39	31.1	142	113.3	6	4.8	4	3.2	5	4.0	61	48.7	14	11.2	268	213.9
JAMAICA																				
Kingston-St. Andrew	—	—	—	—	61	33.3	117	63.9	5	2.7	1	0.5	4	2.2	33	18.0	3	1.6	5	2.7
MEXICO																				
Monterrey	156	71.6	41	18.8	68	31.2	450	206.5	2	0.9	2	0.9	4	1.8	84	38.5	8	3.7	80	36.7
UNITED STATES																				
California project	—	—	—	—	12	5.9	48	23.6	—	—	—	—	—	—	2	1.0	—	—	—	—

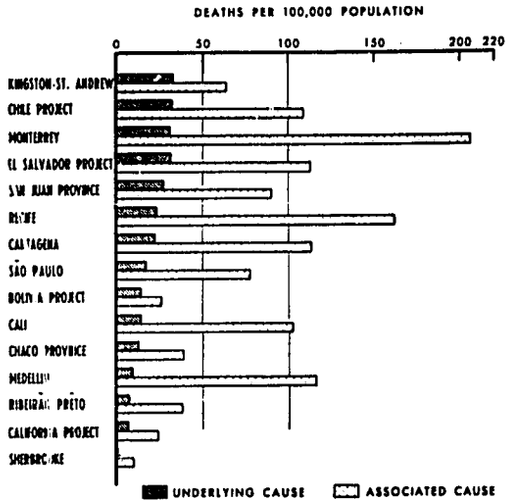
[a] Rates per 100,000 population.

tion. Helminthiases were the underlying cause of 69 deaths in all the projects, but were diagnosed as associated causes in 1,076 (for several deaths more than one disease was an associated cause).

Septicemia (038) was the underlying cause of 424 deaths in all projects and the associated cause of 1,889. To illustrate the importance of this condition, Figure 80 presents the death rates for septicemia as an underlying as well as an associated cause. The completeness of clinical records influences the size of these rates for septicemia as associated cause, and this may account in part for the low figures in Ribeirão Prêto, Bolivia, and Chaco Province. The rates were very low in the Sherbrooke and California projects.

In addition to 303 deaths in which amebiasis was the underlying cause in all projects, it was an associated cause in 80. Monterrey had 41 deaths due to amebiasis as associated cause; this brought the total deaths from that condition to 197 for the Monterrey project, or a death rate of 90.4 per 100,000 population for children under 5 years of age.

FIG. 80. Mortality from Septicemia as Underlying and as Associated Cause of Death in Children Under 5 Years of Age in 15 Projects.



VACCINATIONS

In the interviews of families of deceased children, information was requested regarding vaccinations the children had received. Although some vaccinations may have been forgotten by the families, the information obtained provides a general measure of immunizations in the population studied. The data for vaccinations against six diseases and a group termed "other" are given in Table 86 for deceased children 1–4 years of age. Figure 81 shows in the left section death rates from measles, diphtheria, and poliomyelitis (scales adapted to the death rates) and in the right section the percentages of the deceased children vaccinated. Unfortunately, data were not available for the California project as home interviews were not conducted.

Of the other 14 projects, vaccination against measles had been carried out for a relatively large proportion of deceased children only in Chile (that project had one of the lowest death rates for measles). In La Paz and Recife measles immunization programs were started during the period of the Investigation, but only 7.5 and 6.7

TABLE 86. Vaccinations Reported for Deceased Children 1–4 Years of Age in 14 Projects.

Project	Total children[a]	Smallpox		Whooping cough		Diphtheria		Tetanus		Poliomyelitis		Measles		Other	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
ARGENTINA															
Chaco Province	287	7	2.4	21	7.3	22	7.7	21	7.3	53	18.5	—	—	16	5.6
San Juan Province	247	14	5.7	111	44.9	111	44.9	127	51.4	192	77.7	—	—	97	39.3
BOLIVIA project	972	193	19.9	52	5.3	49	5.0	50	5.1	20	2.1	73	7.5	227	23.4
BRAZIL															
Recife	760	35	4.6	69	9.1	66	8.7	70	9.2	106	13.9	51	6.7	14	1.8
Ribeirão Prêto	146	50	34.2	77	52.7	78	53.4	77	52.7	124	84.9	1	0.7	38	26.0
São Paulo	436	76	17.4	132	30.3	141	32.3	129	29.6	296	67.9	16	3.7	116	26.6
CANADA															
Sherbrooke	53	2	3.8	25	47.2	25	47.2	25	47.2	22	41.5	10	18.9	22	41.5
CHILE project	252	62	24.6	169	67.1	170	67.5	21	8.3	147	58.3	91	36.1	187	74.2
COLOMBIA															
Cali	328	109	33.2	117	35.7	114	34.8	115	35.1	71	21.6	29	8.8	16	4.9
Cartagena	298	77	25.8	47	15.8	50	16.8	48	16.1	29	9.7	3	1.0	79	26.5
Medellín	327	171	52.3	165	50.5	165	50.5	163	49.8	100	30.6	6	1.8	45	13.8
EL SALVADOR project	1,033	93	9.0	304	29.4	309	29.9	308	29.8	223	21.6	41	4.0	158	15.3
JAMAICA															
Kingston-St. Andrew	281	24	8.5	34	12.1	41	14.6	41	14.6	35	12.5	—	—	1	0.4
MEXICO															
Monterrey	605	41	6.8	156	25.8	150	24.8	153	25.3	453	74.9	21	3.5	53	8.8

[a] In families in which home interviews were conducted and information was provided.

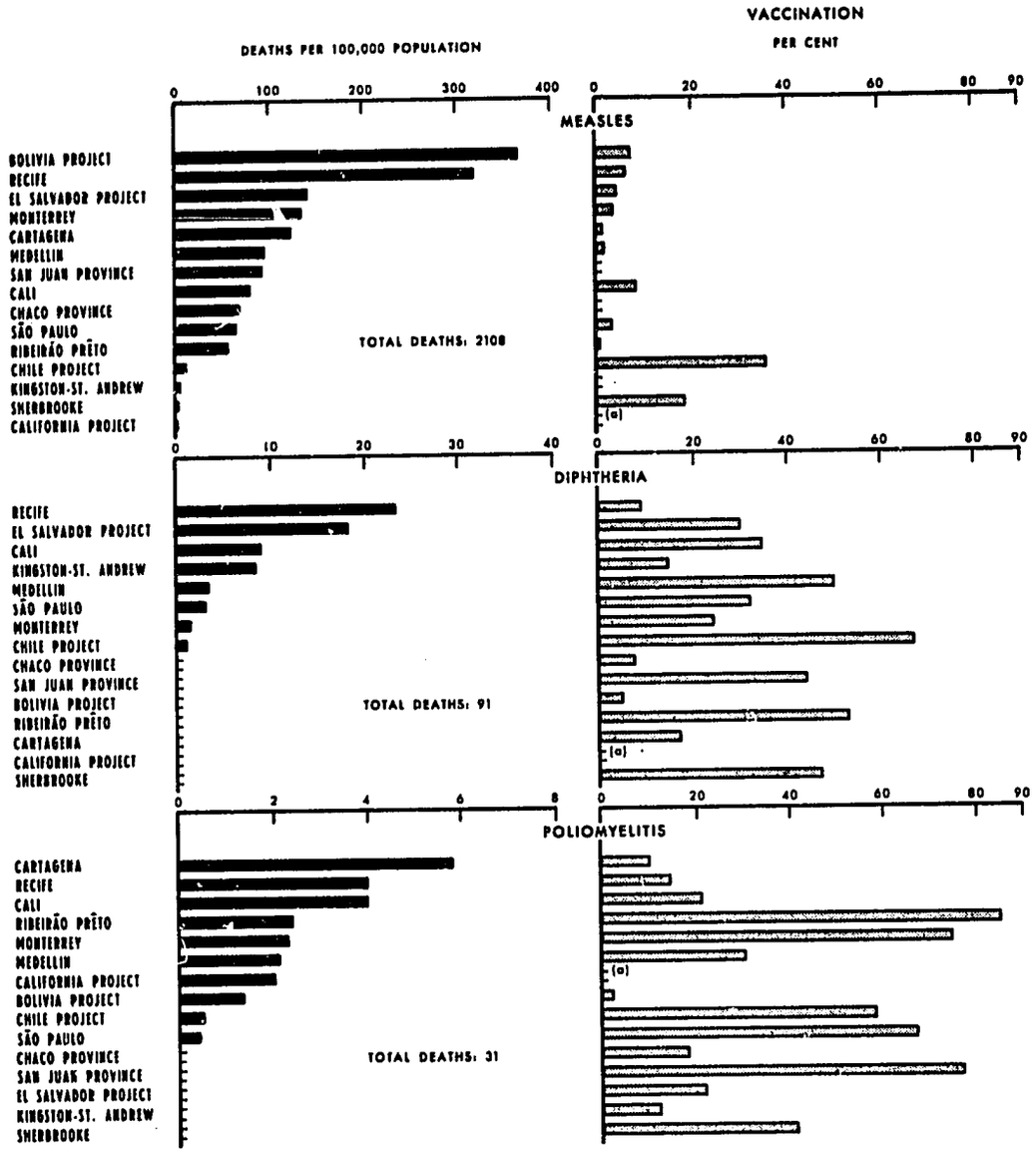
per cent, respectively, of the deceased children aged 1–4 years had been vaccinated. As the campaigns were carried out in the second year of the study, between one-half and three-fourths of the children had died before vaccination was introduced, and some of the others were not in the correct age group for immunization at the time it was given. The high death rates from measles in 11 projects, in contrast to the successful results achieved in Chile, indicate the great need for additional vaccination programs in the Region.

Immunization against diphtheria was applied to higher proportions of the deceased children 1–4 years of age. In Recife, which had the highest diphtheria death rate, the percentage vaccinated was low, as it was also in Kingston-St. Andrew, where diphtheria deaths occurred. Several projects without diphtheria deaths had low percentages also. Vaccination against diphtheria is usually given with vaccination against whooping cough and tetanus (DPT) and thus the relationships can be evaluated.

Poliomyelitis vaccine had been given to relatively high proportions of the deceased children in five projects. However, the total number of deaths (31) was too small for evaluation in relation to vaccination. The three projects with the highest rates had low proportions of children vaccinated.

The numbers of deaths from measles, whooping cough, tetanus, diphtheria, and poliomyelitis (2,108, 290, 172, 91, and 31, respectively) add to a total of 2,692; this does not include those deaths in which such diseases acted as associated causes. This high total figure compared with the low level of coverage of vaccinations found among the deceased children aged 1–4 years serves to indicate the need for well-con-

FIG. 81. Mortality from Three Diseases in Children Under 5 Years of Age and Percentage of Children 1–4 Years Vaccinated in 15 Projects.



[a] Data were not obtained.

ducted preventive programs in order to save lives. However, evaluation based only on changes in mortality is not sufficient because the prevention of these diseases means also the reduction of frequent and serious complications among the survivors.

Chapter IX

Nutritional Deficiency

The findings of the Investigation are clarifying the role of nutritional deficiency in mortality of children under 5 years of age in Latin America. To measure the impact of this important health problem it is necessary to study the associated as well as the underlying causes of death in this age group. Among the underlying causes, infectious diseases such as measles and diarrheal disease have clearly been shown to be responsible for a large proportion of the deaths of young children. However, the analysis of multiple causes using evidence obtained from clinical and autopsy records and from interviews in the homes of deceased children, combined with the data from medical certificates of death, implicates nutritional deficiency as the most important contributor to excessive mortality in the 13 projects of the Investigation in Latin America.

It is significant to note that the *International Classification of Diseases*, for the first time in the 1965 Revision, includes a group for "Avitaminoses and Other Nutritional Deficiency" (categories 260–269). Whereas in earlier Revisions some of the deaths due to nutritional deficiency were assigned to nutritional maladjustment (category 772) in the section on "diseases of early infancy," the new grouping brings together in one section all deaths from these important causes, and thus facilitates measurement of the size of the problem.

Nutritional deficiency as a cause of death in infants and children aged 1–4 years was discussed briefly in earlier chapters. The present chapter provides a comprehensive account of the findings in relation to this morbid condition, with details by age group and by type of deficiency and with an analysis of synergistic interrelationships with other causes.

CLASSIFICATION AND DIAGNOSTIC EVIDENCE

All the information available from the clinical histories, autopsy findings, and medical interviews in the home was used to assess the nutritional state of the deceased infants and young children and the role of nutritional deficiency as underlying or associated cause (Table 87). Autopsy findings provided valuable supportive evidence of malnutrition in areas where the size of this important health problem had not previously been recognized.

Weights at birth and in successive age periods were also used whenever available on records. For grading the nutritional

TABLE 87. Evidence for Diagnosis of Nutritional Deficiency as Underlying or Associated Cause of Death in Children Under 5 Years of Age in 13 Latin American Projects.

Project	Total deaths	Clinical information and autopsy		Clinical information no autopsy		Autopsy without clinical information		Medical interview only		Death certificate or other record	
		No.	%	No.	%	No.	%	No.	%	No.	%
Total	11,913	1,036	8.7	7,158	60.1	629	5.3	2,735	23.0	355	3.0
ARGENTINA											
Chaco Province	661	48	7.3	374	56.6	41	6.2	168	25.4	30	4.5
San Juan Province	607	65	10.7	475	78.3	7	1.2	37	6.1	23	3.8
BOLIVIA project	1,532	15	1.0	1,048	68.4	5	0.3	438	28.6	26	1.7
BRAZIL											
Recife	1,679	230	13.7	590	35.1	376	22.4	455	27.1	28	1.7
Ribeirão Prêto	405	79	19.5	258	63.7	43	10.6	15	3.7	10	2.5
São Paulo	1,313	126	9.6	1,054	80.3	84	6.4	42	3.2	7	0.5
CHILE project	669	87	13.0	504	75.3	11	1.6	43	6.4	24	3.6
COLOMBIA											
Cali	593	32	5.4	411	69.3	4	0.7	105	17.7	41	6.9
Cartagena	561	131	23.4	326	58.1	21	3.7	73	13.0	10	1.8
Medellín	570	28	4.9	347	60.9	—	—	139	24.4	56	9.8
EL SALVADOR project	1,525	25	1.6	675	44.3	6	0.4	810	53.1	9	0.6
JAMAICA											
Kingston-St. Andrew	370	117	31.6	149	40.3	25	6.8	67	18.1	12	3.2
MEXICO											
Monterrey	1,428	53	3.7	947	66.3	6	0.4	343	24.0	79	5.5

state of the deceased child, the Gómez classification and scale (Gómez *et al.*, 1955, and Ramos-Galván *et al.*, 1958), based on the weight/age relationship, was applied to the weight standards developed at the Harvard School of Public Health (Nelson *et al.*, 1969). Since these standards are utilized widely and others differed only slightly from them, they appeared to be the most satisfactory for use in the Investigation.

When a child was classed as having had Grade I malnutrition according to the Gómez scale (i.e., when its weight was 75–89 per cent of the standard) the nutritional deficiency was not considered a cause of death. When clinical or autopsy data provided a diagnosis of nutritional deficiency and the child's weight was 60–74 per cent of the standard, the deficiency was classed as Grade II, while deficits below 60 per cent placed it in Grade III. Grades II and III deficiency or their equivalents (moderate and severe, from clinical or autopsy findings) were considered as causes of death, but only Grade III (severe) forms were accepted as underlying causes.

For coding and classification purposes, category 267 (protein malnutrition) of the *International Classification* was assigned for deaths in which the clinical history of illness due to nutritional deficiency or the clinical or pathologic examination clearly revealed the so-called "pluricarential syndrome" or "kwashiorkor," characterized by low weight and the presence of edema, among other signs. This form (even when weight was not available) was always graded as severe.

Nutritional marasmus (category 268) was assigned when the clinical history specified that the deceased child was marasmatic,

cachectic, or emaciated (with or without gradation by weight). Severe forms of nutritional deficiency in infants under 6 months of age frequently fell in this category. Category 269.9 (other nutritional deficiency, unspecified) was used for all deaths in which Grade II deficiency or equivalent was found, in those for which data were not available for assigning a Grade III deficiency to a more specific type, and in those for which no type or grade was indicated in the records.

In projects where high proportions of deaths occurred in hospitals (as in San Juan Province, Ribeirão Prêto, São Paulo, and Chile) 90 per cent or more of the diagnoses of nutritional deficiency were supported by clinical or autopsy evidence. In Cartagena, 85.2 per cent had such evidence. In several projects (as in El Salvador), the medical interviews conducted in the homes provided the basic data for assignment of nutritional deficiency as underlying or associated cause in many deaths.

In areas where clinical data from hospital records were limited, special caution was exercised in assigning nutritional deficiency as a cause, and thus the rates in those areas may be too low because of the lack of supportive evidence. This appeared to be the case in the Bolivia project.

Only low proportions of the deaths were assigned to nutritional deficiency without satisfactory evidence from autopsy, clinical records, or medical interviews with families —that is, on the basis of death certificate or other record only (last column of Table 87). The percentages, in fact, were usually much lower than for other causes of death, because of the special caution exercised. In the 13 projects combined, the assignment to nutritional deficiency was based solely on the death certificate or other record for only 3.0 per cent of the deaths, while the percentage for all causes was 6.8 (Table 5 in Chapter II). The findings, therefore, should be interpreted with care, as the problem may well be more serious in some areas than can be measured at this time. This confirms once again the need to improve the quality of clinical data and to strengthen education in disciplines such as pediatric pathology in many areas of Latin America.

The group "Avitaminoses and Other Nutritional Deficiency" (260–269) of the *International Classification* provides categories for specific avitaminoses (vitamin A deficiency 260, thiamine deficiency 261, etc.) and for the multiple deficiency syndromes (protein malnutrition 267, nutritional marasmus 268, and other nutritional deficiency states 269). In the Investigation only 15 deaths were found to be due to a single vitamin deficiency within categories 260–266, and these categories are therefore grouped in this report under the general heading of vitamin deficiency within the overall section 260–269, which in this report has been more properly named "nutritional deficiency," because of the relative unimportance of the avitaminoses. For future revisions of the *Classification* the group should be renamed "nutritional deficiency" to give more weight to the multiple deficiency syndromes, which are of major importance in many countries.

As for categories 267–269, whenever diagnostic evidence was sufficient the assignment was made to specific conditions (protein malnutrition, nutritional marasmus), though in many areas high proportions of the deaths had to be classified in the miscellaneous group (269). The methods for diagnosing nutritional deficiency syndromes have improved considerably since the description of kwashiorkor (in Spanish *sín-*

drome pluricarencial infantil) was clarified by Autret and Béhar (1954), but wider application of this knowledge and better recording of diagnostic data are required if these deficiency states are to be properly identified and studied.

ROLE OF NUTRITIONAL DEFICIENCY AND IMMATURITY

Analysis of the interrelationships of nutritional deficiency and immaturity—both of which reflect deficits in the growth and development of the child—is essential to an understanding of the impact of these two important causes of death.

Of the 35,095 deaths under 5 years of age in the 15 projects, 19,994 or 57.0 per cent were due to these two conditions as underlying or associated causes (Table 88). In several areas two-thirds of the deceased children had such evidence of increased vulnerability to disease and high risk of death.

Immaturity and low birth weight, which indicate deficient growth and development at the time of birth, were found to be unusually frequent in infants dying in the neonatal period in several areas. These conditions are believed to be attributable at least in part to the poor nutritional state of the mother, though immaturity may be due to other hazards in pregnancy as well.

The assignment of immaturity (category 777) as associated cause was made when the clinical diagnosis showed immaturity and the birth weight was 2,500 grams or less for infants dying in the neonatal period. As was pointed out in Chapter VI (Neonatal Mortality), birth weights were not available for infants born at home or in several hospitals; therefore in these cases (17.9 per cent of the total) the classification of immaturity was made on the basis of clinical information alone.

Immaturity was assigned as underlying cause only when other clinical information was limited or lacking and no cause other than immaturity was stated. Immaturity was assigned for very few deaths occurring after the first month of life.

If both the birth weight and weights at subsequent periods were available, the infant's growth was evaluated and the assignment was made to nutritional deficiency if both the clinical evidence and the weight indicated a serious deficiency state. Only one assignment, either immaturity (777) or a nutritional deficiency (one of the categories 260–269) was made, and thus the total number of infants and young children with either one of these conditions was obtained.

The seriousness of these two conditions as contributors to mortality is clearly evident in Figure 82, which shows first the death rates from all causes in 24 areas, in descending order, and then the rates for immaturity and nutritional deficiency.

In nearly all the Latin American areas mortality from nutritional deficiency was higher than that from immaturity. In Recife, for example, the rate of 1,355.0 per 100,000 population for this deficiency was over twice the rate of 592.4 for immaturity. Since immaturity is assigned principally as a cause of neonatal deaths, these high rates for nutritional deficiency indicate that the impact of the lack of growth and development was even greater after the neonatal period.

In a few areas, however, the reverse was

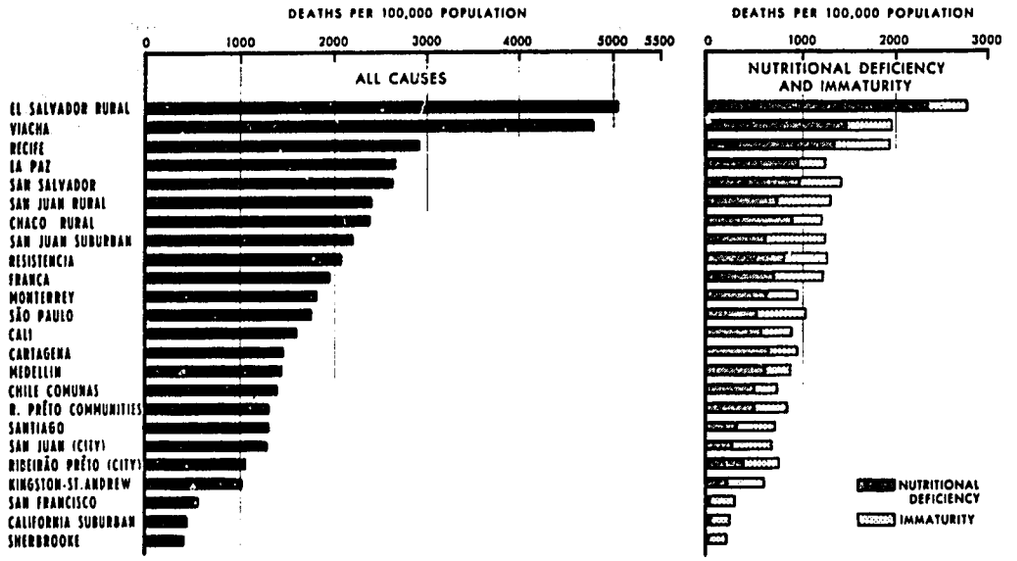
TABLE 88. Mortality[a] from Nutritional Deficiency and Immaturity as Underlying or Associated Cause in Children Under 5 Years of Age in 24 Areas of 15 Projects.

Project and area	Total deaths		Nutritional deficiency and immaturity		Nutritional deficiency		Immaturity		% of total deaths		
	No.	Rate	No.	Rate	No.	Rate	No.	Rate	Both	Nutritional deficiency	Immaturity
Total	35,095	1,672.1	19,994	952.6	11,969	570.3	8,025	382.3	57.0	34.1	22.9
ARGENTINA											
Chaco Province											
Resistencia	864	2,070.0	537	1,286.5	346	828.9	191	457.6	62.2	40.0	22.1
Rural departments	837	2,387.3	429	1,223.6	315	898.5	114	325.2	51.3	37.6	13.6
San Juan Province											
San Juan (city)	326	1,291.6	174	689.4	66	261.5	108	427.9	53.4	20.2	33.1
Suburban departments	780	2,194.7	451	1,269.0	214	602.1	237	666.9	57.8	27.4	30.4
Rural departments	1,050	2,403.8	576	1,318.7	327	748.6	249	570.1	54.9	31.1	23.7
BOLIVIA											
La Paz	4,115	2,660.0	1,958	1,265.7	1,483	958.6	475	307.0	47.6	36.0	11.5
Viacha	161	4,806.0	66	1,970.1	49	1,462.7	17	507.5	41.0	30.4	10.6
BRAZIL											
Recife	3,635	2,933.6	2,413	1,947.4	1,679	1,355.0	734	592.4	66.4	46 2	20.2
Ribeirão Prêto											
Ribeirão Prêto (city)	464	1,088.4	324	760.0	160	375.3	164	384.7	69.8	34.5	35.3
Franca	434	1,942.7	278	1,244.4	158	707.3	120	537.2	64.1	36.4	27.6
Communities	228	1,300.6	152	867.1	87	496.3	65	370.8	66.7	38.2	28.5
São Paulo	4,312	1,769.3	2,537	1,041.0	1,313	538.8	1,224	502.2	58.8	30.4	28.4
CANADA											
Sherbrooke	371	407.4	179	196.6	12	13.2	167	183.4	48.2	3.2	45.0
CHILE											
Santiago	2,489	1,298.7	1,381	720.6	589	307.3	792	413.3	55.5	23.7	31.8
Comunas	225	1,395 3	120	744.4	80	496.3	40	248.1	53.3	35.6	17.8
COLOMBIA											
Cali	1,627	1,607.7	914	903.2	593	586.0	321	317.2	56.2	36.4	19.7
Cartagena	1,255	1,459.3	815	947.7	561	652.3	254	295.3	64.9	44.7	20.2
Medellín	1,348	1,444.8	835	895.0	570	610.9	265	284.0	61.9	42.3	19.7
EL SALVADOR											
San Salvador	2,738	2,636.2	1,487	1,431.7	1,018	980.2	469	451.6	54.3	37.2	17.1
Rural *municipios*	1,082	5,049.0	593	2,767.1	507	2,365.8	86	401.3	54.8	46.9	7.9
JAMAICA											
Kingston-St. Andrew	1,903	1,038.5	1,125	613.9	370	201.9	755	412.0	59.1	19.4	39.7
MEXICO											
Monterrey	3,953	1,813.8	2,153	987.9	1,428	655.2	725	332.7	54.5	36.1	18.3
UNITED STATES											
San Francisco	234	543.6	125	290.4	10	23.2	115	267.1	53.4	4.3	49.1
California, suburban	664	413.4	372	231.6	34	21.2	338	210.4	56.0	5.1	50.9

[a] Rates per 100,000 population.

true, as in the city of San Juan where the death rate of 427.9 for immaturity was much higher than that for nutritional deficiency (261.5 per 100,000 population). On the other hand, within this same project in San Juan Province the rural departments had a much higher rate for nutritional deficiency (748.6), thereby indicating the marked difference in these problems of child growth and development in geographic areas of one project. The deficiency in the rural area probably began at birth, as is suggested by the higher rate for immaturity (Figure 47 of Chapter VI) and thus the health and nutritional state of the mother may be involved.

FIG. 82. Mortality in Children Under 5 Years of Age from All Causes and from Nutritional Deficiency and Immaturity in 24 Areas of 15 Projects.



In the Sherbrooke project in Canada and in the two areas of the California project immaturity was an underlying or associated cause of 45.0, 49.1, and 50.9 per cent respectively of the deaths of children under 5 years of age. Nutritional deficiency was rarely assigned in these areas, which had very low rates from all causes. In these two projects more than 60 per cent of the deaths were in the neonatal period (61.7 per cent in Sherbrooke and 63.5 in California). The situation was thus distinctly different from that found in the Latin American projects.

As can be seen in Figure 82, in areas where the overall death rates for children under 5 years of age were high, the rates were high also for nutritional deficiency. In areas with low death rates, nutritional deficiency was less important and immaturity was assigned in a high proportion of the deaths. Thus reduction of mortality in childhood is dependent on measures to prevent both of these serious conditions.

The data for the Latin American projects suggest that the problem of nutritional deficiency begins with the future mother. There is clearly a need for measures to prevent low birth weights as well as for nutrition programs aimed at promoting normal growth and development.

Since the role of immaturity was discussed in detail in Chapter VI (Neonatal Mortality) the present chapter will deal principally with nutritional deficiency, as the outstanding and most serious health problem of children in many areas of Latin America.

AGE AT DEATH

In this section a full account is given of mortality from nutritional deficiency by age at death. This is the first time that such data for specific geographic areas have become available to permit an epidemiologic description of this important health problem. The study of deaths with this deficiency as an underlying or as an associated cause provides an excellent measure of the impact of this condition on mortality.

In the two projects in Northern America nutritional deficiency was underlying or associated cause of only 56 deaths (4.4 per cent) and the following analysis is therefore confined to the 13 Latin American projects. Table 89 shows, by age group, the conversion from 35,095 deaths in all 15 projects to 33,826 in the 13 Latin American projects which are analyzed in the remainder of this chapter.

Of the 33,826 deaths of children under 5 years of age in the 13 projects, 11,913 or 35.2 per cent had nutritional deficiency as underlying or associated cause. This represents an overall rate of 660.3 per 100,000 population. If neonatal deaths are excluded, 11,512 deaths out of 21,951, or 52.4 per cent, had this deficiency state as a cause.

Table 89 reveals clearly the seriousness of the problem among infants under one year of age. Infant deaths with nutritional deficiency as underlying or associated cause numbered 1,867.6 per 100,000 live births—or by the standard unit for infant mortality, 18.7 per 1,000 live births—a rate higher than the total infant death rate in several countries of the world.

The problem is particularly severe in the postneonatal period (28 days–11 months of age) and during the second year of life. The onset of severe forms of malnutrition early in the first year of age in several projects, as reflected by this exceedingly high death rate in the postneonatal period, has very serious implications. There is in fact evidence (Winick and Rosso, 1969) to suggest that nutritional deficiency occurring in early stages of rapid growth may have more

TABLE 89. Deaths Under 5 Years from All Causes in 15 Projects, by Age Group, and Deaths from Nutritional Deficiency as Underlying or Associated Cause in 13 Latin American Projects Combined.

Age group	Total 15 projects	Northern America, 2 projects	Latin American projects		
			Total	With nutritional deficiency	
				No.	Rate[a]
Total under 5 years	35,095	1,269	33,826	11,913	660.3
Infant	27,602	1,094	26,508	7,701	1,867.6
Neonatal (−28 days)	12,674	799	11,875	401	97.2
Postneonatal (28 days-11 mos.)	14,928	295	14,633	7,300	1,770.4
1 year	4,361	53	4,308	2,589	687.5
2–4 years	3,132	122	3,010	1,623	155.8

[a] Rates under 1 year of age per 100,000 live births; others per 100,000 population.

permanent effects on the child than that occurring during periods of slower growth.

In Table 90 and Figure 83 mortality from nutritional deficiency is shown for three age groups (under 1 year, 1 year, and 2–4 years) for 21 areas of the 13 projects. The rates for infants (as underlying or associated cause) exceeded 2,000 per 100,000 live births in 10 areas. In nine others they were in excess of 1,000. Only in the city of San Juan and in Kingston-St. Andrew were the rates less than 1,000 per 100,000 live births.

Although in all areas mortality from nutritional deficiency was higher in the first year of life than in the age groups 1–4 years, rates were nearly as high in the second year in the rural areas of Bolivia and El Salvador. High rates in the second year were also found in the cities of Recife, La Paz, and San Salvador, in the three cities in Colombia, and in rural Chaco Province. Rates in the group aged 2–4 years were much lower and thus further subdivision is not shown for that age group.

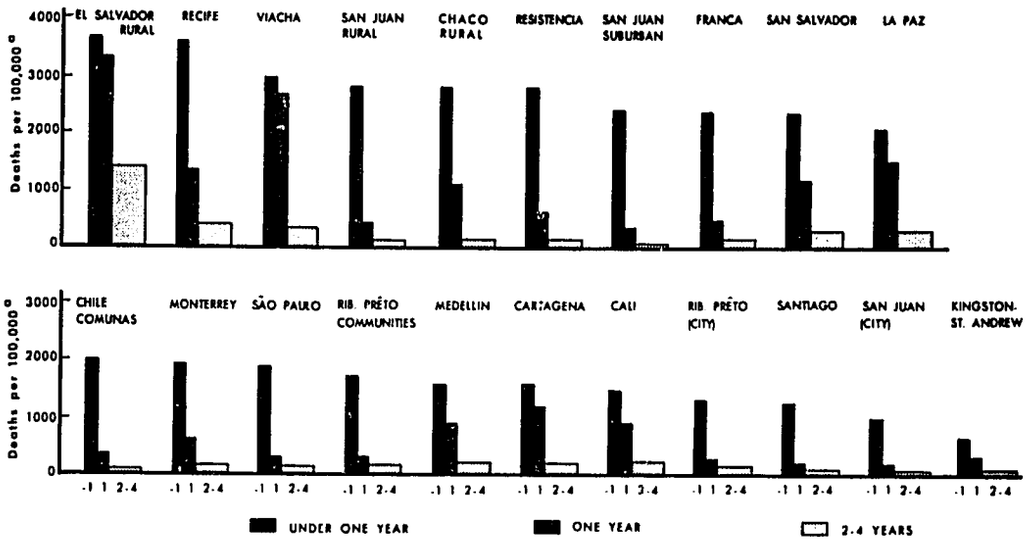
A comparison within projects shows that mortality was much higher in rural areas

TABLE 90. Mortality[a] from Nutritional Deficiency as Underlying or Associated Cause, by Age Group, in 21 Areas of 13 Latin American Projects.

Project and area	Under 5 years		Under 1 year		1 year		2-4 years	
	No.	Rate	No.	Rate	No.	Rate	No.	Rate
Total 13 projects	11,913	660.3	7,701	1,867.6	2,589	687.5	1,623	155.8
ARGENTINA								
Chaco Province								
Resistencia	346	828.9	270	2,755.1	52	581.7	24	101.7
Rural departments	315	898.5	215	2,756.4	75	1,071.4	25	120.3
San Juan Province								
San Juan (city)	66	261.5	55	945.0	8	158.1	3	19.8
Suburban departments	214	602.1	187	2,361.1	20	279.3	7	32.6
Rural departments	327	748.6	269	2,796.3	35	396.8	23	86.7
BOLIVIA								
La Paz	1,483	958.6	746	2,029.4	489	1,477.3	248	285.1
Viacha	49	1,462.7	25	2,941.2	19	2,676.1	5	267.4
BRAZIL								
Recife	1,679	1,355.0	1,080	3,552.6	354	1,319.9	245	355.1
Ribeirão Prêto								
Ribeirão Prêto (city)	160	375.3	116	1,246.0	20	227.0	24	96.5
Franca	158	707.3	119	2,337.9	21	451.6	18	139.5
Communities	87	496.3	64	1,666.7	9	249.3	14	136.7
São Paulo	1,313	538.8	1,062	1,826.0	146	269.7	105	78.2
CHILE								
Santiago	589	307.3	494	1,229.5	66	177.8	29	24.7
Comunas	80	496.3	66	1,941.2	9	288.5	5	50.6
COLOMBIA								
Cali	593	586.0	306	1,450.2	169	836.6	118	194.4
Cartagena	561	652.3	278	1,553.1	197	1,145.3	86	166.7
Medellín	570	610.9	308	1,587.6	154	828.0	108	192.9
EL SALVADOR								
San Salvador	1,018	980.2	597	2,330.2	262	1,146.6	159	278.0
Rural *municipios*	507	2,365.8	198	3,666.7	147	3,259.4	162	1,345.5
JAMAICA								
Kingston-St. Andrew	370	201.9	243	593.3	90	230.1	37	35.4
MEXICO								
Monterrey	1,428	655.2	1,003	1,892.1	247	548.6	178	142.6

[a] Rates under 1 year of age per 100,000 live births; others per 100,000 population.

FIG. 83. Mortality from Nutritional Deficiency in Children Under 5 Years for Three Age Groups in 21 Areas of 13 Latin American Projects.



a Under 1 year per 100,000 live births; other rates per 100,000 population.

than in cities. For example, the rural *municipios* of El Salvador had the highest death rate in infancy and appear in first place in Figure 83, while the city of San Salvador (appearing ninth) had much lower rates. The very low rates in the city of San Juan (shown second from the last) are in distinct contrast to those in rural and suburban San Juan (appearing in fourth and seventh place). In the Bolivia project, the rates for the rural community of Viacha for the first two years of life were much higher than those for La Paz. This evidence of higher rates in rural areas than in the neighboring cities is of key importance for health planning and for further research. Health problems such as this in rural areas must be brought fully to light so that solutions may be sought.

To give a clearer picture of mortality by age, Table 91 shows the numbers of deaths by month for the first two years of life and for six-month periods thereafter. Nutritional deficiency caused excessive mortality principally in the first year of life in six projects: San Juan Province, Monterrey, São Paulo, Ribeirão Prêto, Chile, and Kingston-St. Andrew (Figure 84). The rates continued to be relatively high in the first two years of life in six other projects: Recife, Chaco Province, Bolivia, Medellín, Cartagena, and Cali (Figure 85). In the rural *municipios* of El Salvador the rates continued to be relatively high throughout the first five years of life, as can be seen in Figure 86, which shows both the rural rates and those for the city of San Salvador.

The patterns of mortality from nutritional deficiency varied widely among the areas. In San Juan Province, São Paulo, Monterrey, and Ribeirão Prêto (Figure 84) mortality was excessive principally in very

TABLE 91. Mortality* from Nutritional Deficiency by Month of Age Under 2 Years and by Six-Month Age Groups from 2–4 Years in 19 Areas of 13 Latin American Projects.

Age in months	ARGENTINA Chaco Province				ARGENTINA, San Juan Province						BOLIVIA project		BRAZIL Recife		BRAZIL, Ribeirão Prêto					
	Resistencia		Rural		San Juan (city)		Suburban		Rural						Rib. Prêto (city)		Franca		Communities	
	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate
Total	346	828.9	315	898.5	66	261.5	214	602.1	327	748.6	1,532	969.3	1,679	1,355.0	160	375.3	158	707.3	87	496.3
-1	9	91.8	5	64.1	5	85.9	15	189.4	18	187.1	73	194.1	46	151.3	2	21.5	5	98.2	1	26.0
1	24	244.9	14	179.5	13	232.4	19	239.9	31	322.2	76	202.1	143	470.4	18	193.3	13	255.4	4	104.2
2	40	408.2	29	371.8	12	206.2	32	401.0	47	488.6	75	199.4	146	480.3	21	225.6	19	373.3	14	364.6
3	56	571.4	28	359.0	7	120.3	25	315.7	35	363.8	85	226.0	127	417.8	18	193.3	19	373.3	11	286.5
4	28	285.7	31	397.4	5	85.9	22	277.8	39	405.4	64	170.2	103	338.8	14	150.4	17	334.0	12	312.5
5	30	306.1	20	256.4	4	68.7	21	265.2	32	332.6	46	122.3	95	312.5	8	85.9	9	176.8	4	104.2
6	23	234.7	19	243.6	5	85.9	15	189.4	20	207.9	66	175.5	88	289.5	13	139.6	9	176.8	4	104.2
7	14	142.9	14	179.5	1	17.2	12	151.5	15	155.9	50	132.9	63	207.2	7	75.2	10	196.5	5	130.2
8	12	122.4	19	243.6	1	17.2	12	151.5	11	114.3	49	130.3	82	269.7	2	21.5	7	137.5	—	—
9	15	153.1	10	128.2	—	—	7	88.4	6	62.4	63	167.5	70	230.3	7	75.2	6	117.9	3	78.1
10	10	102.0	15	192.3	2	34.4	2	25.3	6	62.4	59	156.9	60	197.4	2	21.5	4	78.6	2	52.1
11	9	91.8	11	141.0	—	—	5	63.1	9	93.6	65	172.8	57	187.5	4	43.0	1	19.6	4	104.2
12	7	78.3	12	171.4	2	39.5	3	41.9	6	68.0	84	248.4	50	186.4	2	22.7	4	86.0	1	27.7
13	7	78.3	12	171.4	—	—	2	27.9	6	68.0	55	162.7	34	126.8	—	—	2	43.0	—	—
14	7	78.3	8	114.3	—	—	2	27.9	3	34.0	43	127.2	32	119.3	3	34.1	1	21.5	1	27.7
15	5	55.9	5	71.4	1	19.8	4	55.9	2	22.7	44	130.1	39	145.4	2	22.7	1	21.5	1	27.7
16	8	89.5	4	57.1	1	19.8	1	14.0	2	22.7	52	153.8	33	123.0	4	45.4	—	—	—	—
17	4	44.7	6	85.7	2	39.5	1	14.0	6	68.0	45	133.1	39	145.4	6	68.1	—	—	2	55.4
18	3	33.6	4	57.1	1	19.8	1	14.0	3	34.0	56	165.6	33	123.0	1	11.4	3	64.5	1	27.7
19	1	11.2	6	85.7	—	—	2	27.9	1	11.3	28	82.8	30	111.9	—	—	3	64.5	1	27.7
20	2	22.4	5	71.4	1	19.8	2	27.9	2	22.7	28	82.8	18	67.1	—	—	1	21.5	2	55.4
21	4	44.7	4	57.1	—	—	—	—	1	11.3	28	82.8	22	82.0	—	—	2	43.0	—	—
22	3	33.6	5	71.4	—	—	1	14.0	2	22.7	24	71.0	13	48.5	2	22.7	2	43.0	—	—
23	1	11.2	4	57.1	—	—	1	14.0	1	11.3	21	62.1	11	41.0	—	—	2	43.0	—	—
24-29	11	139.9	14	202.0	—	—	5	69.9	6	67.9	100	337.6	83	360.9	5	60.3	4	93.0	2	58.6
30-35	7	89.0	2	28.9	1	19.8	1	14.0	7	79.2	45	151.9	63	274.0	7	84.5	8	186.0	3	87.9
36-41	1	12.7	2	28.9	—	—	—	—	4	45.2	54	182.3	29	126.1	4	48.3	3	69.8	2	58.6
42-47	4	50.9	3	43.3	1	19.8	1	14.0	3	33.9	24	81.0	36	156.5	4	48.3	2	46.5	3	87.9
48-53	—	—	1	14.4	—	—	—	—	1	11.3	19	64.1	26	113.1	3	36.2	—	—	3	87.9
54-59	1	12.7	3	43.3	1	19.8	—	—	2	22.6	11	37.1	8	34.8	1	12.1	1	23.3	1	29.3

Age in months	BRAZIL São Paulo		CHILE project		COLOMBIA Cali		COLOMBIA Cartagena		COLOMBIA Medellín		EL SALVADOR San Salvador		EL SALVADOR Rural		JAMAICA Kingston-St. Andrew		MEXICO Monterrey	
Total	1,313	538.8	669	322.0	593	586.0	561	652.3	570	610.9	1,018	980.2	507	2,365.8	370	201.9	1,428	655.2
-1	119	204.6	28	64.2	6	28.4	11	61.5	5	25.8	22	85.9	8	148.1	7	17.1	54	101.9
1	192	330.1	78	179.0	28	132.7	30	167.6	22	113.4	49	191.3	12	222.2	22	53.7	116	218.8
2	183	314.6	94	215.7	25	118.5	18	100.6	28	144.3	75	292.7	20	370.4	27	65.9	181	341.4
3	152	261.3	89	204.2	37	175.4	20	111.7	31	159.8	68	265.4	20	370.4	13	31.7	128	241.5
4	110	189.1	79	181.3	26	123.2	26	145.3	38	195.9	68	265.4	14	259.3	17	41.5	108	203.7
5	69	118.6	51	117.0	35	165.9	21	117.3	32	164.9	61	238.1	27	500.0	22	53.7	83	156.6
6	56	96.3	43	98.7	23	109.0	21	117.3	33	170.1	46	179.5	19	351.9	21	51.3	83	156.6
7	55	94.6	35	80.3	32	151.7	31	173.2	27	139.2	40	156.1	17	314.8	22	53.7	60	113.2
8	45	77.4	23	52.8	25	118.5	22	122.9	26	134.0	43	167.8	20	370.4	21	51.3	56	105.6
9	32	55.0	20	45.9	25	118.5	19	106.1	28	144.3	38	148.3	15	277.8	22	53.7	38	71.7
10	24	41.3	8	18.4	23	109.0	30	167.6	22	113.4	44	171.7	11	203.7	22	53.7	47	88.7
11	25	43.0	12	27.5	21	99.5	29	162.0	16	82.5	43	167.8	15	277.8	27	65.9	49	92.4
12	30	55.4	15	37.3	36	178.2	34	197.7	28	150.5	32	140.0	21	465.6	17	43.5	29	64.4
13	15	27.7	8	19.9	23	113.9	30	174.4	25	134.4	38	166.3	17	376.9	10	25.6	13	28.9
14	16	29.6	15	37.3	14	69.3	24	139.5	12	64.5	39	170.7	14	310.4	16	40.9	33	73.3
15	9	16.6	10	24.8	18	89.1	21	122.1	9	48.4	23	100.7	14	310.4	12	30.7	17	37.8
16	11	20.3	6	14.9	17	84.2	17	98.8	17	91.4	19	83.2	9	199.6	4	10.2	39	86.6
17	19	35.1	3	7.5	16	79.2	10	58.1	10	53.8	19	83.2	10	221.7	9	23.0	18	40.0
18	5	9.2	6	14.9	13	64.4	12	69.8	14	75.3	22	96.3	15	332.6	5	12.8	20	44.4
19	9	16.6	4	9.9	9	44.6	10	58.1	12	64.5	18	78.8	12	266.1	6	15.3	12	26.7
20	11	20.3	3	7.5	5	24.8	11	64.0	11	59.1	10	43.8	6	133.0	3	7.7	20	44.4
21	7	12.9	2	5.0	9	44.6	9	52.3	4	21.5	17	74.4	8	177.4	2	5.1	16	35.5
22	5	9.2	1	2.5	4	19.8	7	40.7	6	32.3	13	56.9	9	199.6	4	10.2	10	22.2
23	9	16.6	2	5.0	5	24.8	12	69.8	6	32.3	12	52.5	12	266.1	2	5.1	20	44.4
24-29	40	89.4	10	23.6	50	247.1	30	174.4	38	203.6	59	309.5	51	1,270.9	9	25.8	66	158.7
30-35	25	55.9	8	18.9	21	103.8	17	98.8	14	75.0	30	157.4	35	872.2	4	11.5	37	88.9
36-41	19	42.5	5	11.8	18	89.0	16	93.0	20	107.1	21	110.2	23	573.1	6	17.2	24	57.7
42-47	6	13.4	2	4.7	10	49.4	7	40.7	16	85.7	24	125.9	17	423.6	9	25.8	20	48.1
48-53	9	20.1	7	16.5	12	59.3	8	46.5	16	85.7	10	52.5	23	573.1	6	17.2	17	40.9
54-59	6	13.4	2	4.7	7	34.6	8	46.5	4	21.4	15	78.7	13	323.9	3	8.6	14	33.7

* Rates under 1 year of age per 100,000 live births; others per 100,000 population.

FIG. 84. Mortality from Nutritional Deficiency by Month of Age for First 12 Months of Life in Six Projects.

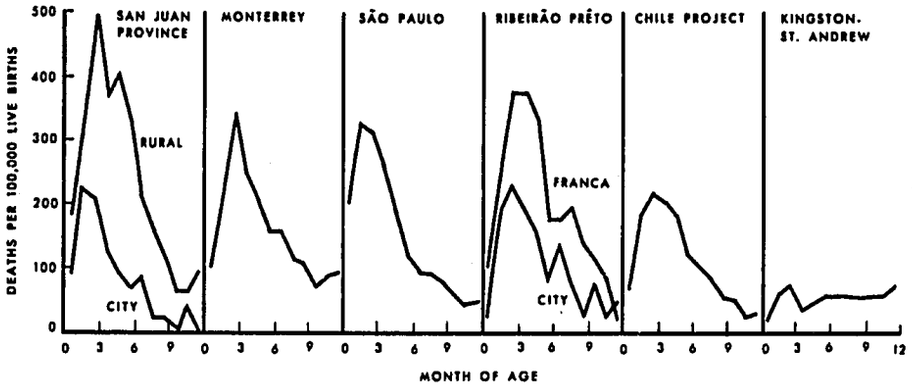
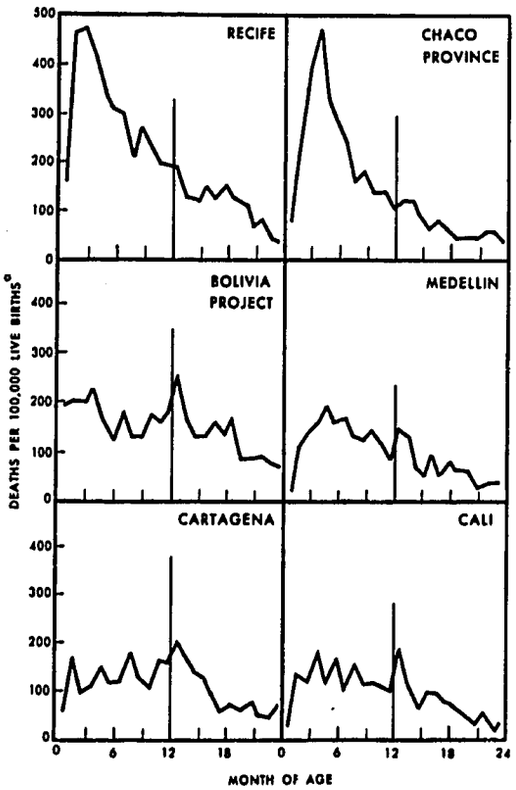


FIG. 85. Mortality from Nutritional Deficiency by Month of Age for First 24 Months of Life in Six Projects.

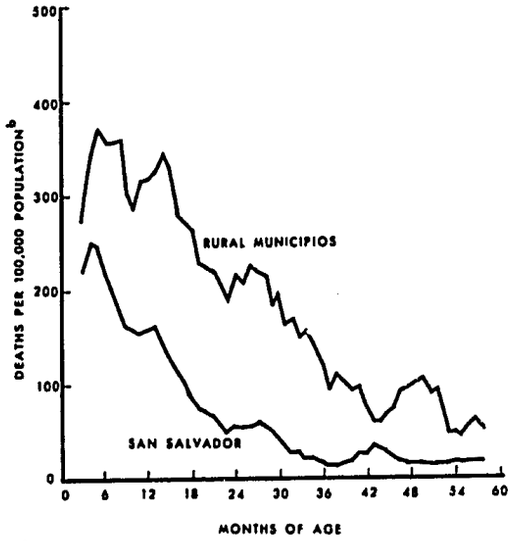


[a]Rates for second year per 100,000 population.

young infants. In San Juan Province, where the rural rates were much higher than those in the city, the highest rates in both areas were in the first six months of life. In the Ribeirão Prêto project, the rates were much higher in the interior city of Franca than in the city of Ribeirão Prêto, and in both the problem affected principally early infancy. Although a similar pattern of high mortality in early life was seen in the Chilean project, the rates were much lower.

In the six projects shown in Figure 85 there appeared to be two different patterns. Recife and Chaco Province had exceedingly high rates in early infancy and mortality continued to be relatively high in the second year of life; the rates per 100,000 live births reached 480.3 for infants 2 months of age in Recife and 477.3 for those aged 3 months in Chaco. On the other hand, in Bolivia, Medellín, Cartagena, and Cali mortality did not appear to be concentrated in early infancy, though rates were between 100 and 200 per 100,000 live births for most of the months of infancy. These rates became lower at the end of the first year of life, but deaths from nutritional deficiency

FIG. 86. Mortality from Nutritional Deficiency by Month[a] of Age for First 5 Years in San Salvador and Rural *Municipios* of El Salvador.



[a]Five-month averages.
[b]Rates for under 1 year per 100,000 live births.

continued to occur in the second year (with variations in rates due to small numbers). It is significant to note that in these four last-mentioned areas breast feeding was practiced much more frequently than in the projects of Brazil.

Although a large proportion of the deceased infants in Chaco Province had been breast fed, as had a relatively large proportion in San Juan Province, the high death rates there in early life were in distinct contrast to the patterns found in the Bolivia and Colombian projects.

Nutritional deficiency was a particularly serious problem in the El Salvador project (Figure 86). In the city of San Salvador, the rates were very high in early infancy and high mortality continued into the second and third years of life. In the rural *municipios* the death rates were exceedingly high in early infancy and approximately twice as high as those in the city of San Salvador for several of the months of age. In the remainder of the first 5 years they continued to be high, and several times higher than those in San Salvador. In the rural *municipios* 49.7 per cent of the deceased infants (excluding those dying in neonatal period) had been breast fed for one month or longer, while in San Salvador only 34.1 per cent had been breast fed. It therefore seems likely that there are other factors (apart from the lack of breast feeding) that are responsible for excessive mortality from nutritional deficiency in these rural areas. The protective value of breast feeding may vary and be diminished by unfavorable factors that produce mortality from nutritional deficiency.

Until complete data become available on the state of health and nutrition of mothers, on the distribution of births by weight, and on feeding practices in rural as well as urban areas, the reasons for such differences will remain obscure. The relationships of nutritional deficiency to diarrheal disease and to breast feeding are discussed later in this chapter and in Chapter XIII.

TYPES OF NUTRITIONAL DEFICIENCY

The data obtained in the Investigation make it possible, for the first time, to analyze mortality from nutritional deficiency according to type of deficiency as well as age at death. The specific types assigned as underlying or associated causes of 11,913

deaths of children under 5 years of age are given for the 13 Latin American projects combined in Table 92, and by individual projects and age groups in Table 93. The division by type is: vitamin deficiency (260–266); protein malnutrition (267); nutritional marasmus (268); and other nutritional deficiency (269).

Protein malnutrition (267), or kwashiorkor, was assigned as a cause in 1,562 deaths, or 13.1 per cent of the total deaths from nutritional deficiency (11,913). This multiple deficiency syndrome is a severe form of generalized deficiency; it develops as the result of deficits in protein-rich foods over a period of several months or longer. For this reason the finding of this type of deficiency in infants less than one year of age indicates lack of sufficient food and damage by disease early in life. In those suffering from this condition, the changes in body composition and function are profound.

Nutritional marasmus (268), which was assigned in 2,544 deaths (21.4 per cent of the total), is the result of an overall deficit in food intake or utilization and is apt to develop very early in life, that is, in the first few months. Infants suffering from this condition may recover partially or completely or they may develop the more serious kwashiorkor type of protein malnutrition and die from some complication.

TABLE 92. Mortality[a] from Nutritional Deficiency, by Type, in Children Under 5 Years of Age in 13 Latin American Projects Combined.

Type of deficiency	Total	Rate
Total	11,913	660.3
Vitamin deficiency (260-266)	15	0.8
Protein malnutrition (267)	1,562	86.6
Nutritional marasmus (268)	2,544	141.0
Other deficiency (269)	7,792	431.9

[a] Rates per 100,000 population.

In the 13 projects, 7,792 deaths (65.4 per cent of the total) were assigned to category 269, *other nutritional deficiency*. Whenever the clinical evidence was not sufficient to permit a specific assignment to category 267 or 268, or when the deficiency was Grade II or equivalent, the assignment was made to category 269.9 (other and unspecified nutritional deficiency).

Only 15 deaths were assigned to a *deficiency of a specific vitamin or to avitaminosis unspecified* (260–266) as underlying or associated cause. Ten of these deaths were due to vitamin D deficiency (265), four to the unspecified group (266.9), and one to ascorbic acid deficiency (264), as can be seen below:

Project	*Age at death*	*Cause*	*Category*
Argentina, rural departments, San Juan Province	8 months	Associated	265.0
Brazil, São Paulo	1 year	Underlying	265.0
	1 year	Underlying	265.0
	8 months	Associated	265.0
Chile, Santiago	4 months	Associated	265.0
	3 months	Associated	265.0
	4 months	Associated	265.0
Colombia, Cali	2 years	Associated	265.9
	5 months	Associated	265.0
Colombia, Medellín	3 years	Associated	266.9
	9 months	Associated	266.9
	27 days	Associated	266.9
	4 months	Associated	266.9
El Salvador, rural *municipios*	6 months	Associated	265.0
Jamaica, St. Andrew, rural	1 year	Underlying	264

The overall rate for all types of nutritional deficiency in children under 5 years of age in the 13 projects combined—660.3 per 100,000 population—is indicative of the seriousness of this health problem (Table 92). The combined rate for protein malnutrition was 86.6 per 100,000. In eight of the

TABLE 93. Mortality[a] from Specific Types of Nutritional Deficiency in Children Under 5 Years, by Age Group, in 13 Projects.

Project	Total		Vitamin deficiency (260–266)		Protein malnutrition (267)		Nutritional marasmus (268)		Other nutritional deficiency (269)		Total		Vitamin deficiency (260–266)		Protein malnutrition (267)		Nutritional marasmus (268)		Other nutritional deficiency (269)	
	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate
	UNDER 5 YEARS										UNDER 1 YEAR									
Total	11,913	660.3	15	0.8	1,562	86.6	2,544	141.0	7,792	431.9	7,701	1,867.6	10	2.4	325	78.8	1,811	439.2	5,555	1,347.2
ARGENTINA																				
Chaco Province	661	860.7	—	—	34	44.3	96	125.0	531	691.4	485	2,755.7	—	—	11	62.5	66	375.0	408	2,318.2
San Juan Province	607	581.1	1	1.0	10	9.6	177	169.4	419	401.1	511	2,187.5	1	4.3	2	8.6	158	676.4	350	1,498.3
BOLIVIA project	1,532	969.3	—	—	116	73.4	176	111.4	1,240	784.6	771	2,050.0	—	—	23	61.2	82	218.0	666	1,770.8
BRAZIL																				
Recife	1,679	1,355.0	—	—	322	259.9	499	402.7	858	692.4	1,080	3,552.6	—	—	79	259.9	340	1,118.4	661	2,174.3
Ribeirão Prêto	405	490.9	—	—	31	37.6	113	137.0	261	316.4	299	1,639.3	—	—	3	16.4	89	487.9	207	1,134.9
São Paulo	1,313	538.8	3	1.2	58	23.8	299	122.7	953	391.0	1,062	1,826.0	1	1.7	14	24.1	255	438.4	792	1,361.8
CHILE project	669	322.0	3	1.4	20	9.6	177	85.2	469	225.7	560	1,285.0	3	6.9	2	4.6	149	341.9	406	931.6
COLOMBIA																				
Cali	593	586.0	2	2.0	130	128.5	138	136.4	323	319.2	306	1,450.2	1	4.7	26	123.2	89	421.8	190	900.5
Cartagena	561	652.3	—	—	201	233.7	99	115.1	261	303.5	278	1,553.1	—	—	58	324.0	64	357.5	156	871.5
Medellín	570	610.9	4	4.3	94	100.8	107	114.7	365	391.2	308	1,587.6	3	15.5	8	41.2	88	453.6	209	1,077.3
EL SALVADOR project	1,525	1,217.2	1	0.8	348	277.8	298	237.8	878	700.8	705	2,562.9	1	3.2	40	128.9	169	544.8	585	1,885.9
JAMICA																				
Kingston-St. Andrew	370	201.9	1	0.5	58	31.7	83	45.3	228	124.4	243	593.3	—	—	25	61.0	59	144.0	159	388.2
MEXICO																				
Monterrey	1,428	655.2	—	—	140	64.2	282	129.4	1,006	461.6	1,003	1,892.1	—	—	34	64.1	203	382.9	766	1,445.0
	1 YEAR										2–4 YEARS									
Total	2,589	687.5	3	0.8	696	184.8	478	126.9	1,412	375.0	1,623	155.8	2	0.2	541	51.9	255	24.5	825	79.2
ARGENTINA																				
Chaco Province	127	796.7	—	—	22	138.0	21	131.7	84	527.0	49	110.4	—	—	1	2.3	9	20.3	39	87.9
San Juan Province	63	299.4	—	—	4	19.0	12	57.0	47	233.4	33	52.3	—	—	4	6.3	7	11.1	22	34.8
BOLIVIA project	508	1,502.5	—	—	66	195.2	60	177.5	382	1,129.8	253	284.7	—	—	27	30.4	34	38.3	192	216.0
BRAZIL																				
Recife	354	1,319.9	—	—	130	484.7	103	384.0	121	451.2	245	355.1	—	—	113	163.8	56	81.2	76	110.2
Ribeirão Prêto	50	292.9	—	—	14	82.0	10	58.6	26	152.3	56	116.7	—	—	14	29.2	14	29.2	28	58.3
São Paulo	146	269.7	2	3.7	27	49.9	26	48.0	91	168.1	105	78.2	—	—	17	12.7	18	13.4	70	52.1
CHILE project	75	186.3	—	—	12	29.8	18	44.7	45	111.8	34	26.7	—	—	6	4.7	10	7.9	18	14.1
COLOMBIA																				
Cali	169	836.6	—	—	51	252.5	34	168.3	84	415.8	118	194.4	1	1.6	53	87.3	15	24.7	49	80.7
Cartagena	197	1,145.3	—	—	106	616.3	25	145.3	66	383.7	86	166.7	—	—	37	71.7	10	19.4	39	75.6
Medellín	154	828.0	—	—	41	220.4	15	80.6	98	526.9	108	192.9	1	1.8	45	80.4	4	7.1	58	103.6
EL SALVADOR project	409	1,494.9	—	—	134	489.8	96	350.9	179	654.2	321	463.7	—	—	174	251.3	33	47.7	114	164.7
JAMAICA																				
Kingston-St. Andrew	90	230.1	1	2.6	26	66.5	18	46.0	45	115.1	37	35.4	—	—	7	6.7	6	5.7	24	23.0
MEXICO																				
Monterrey	247	548.6	—	—	63	139.9	40	88.8	144	319.9	178	142.6	—	—	43	34.5	39	31.2	96	76.9

[a] Rate per 100,000 live births; others per 100,000 population.

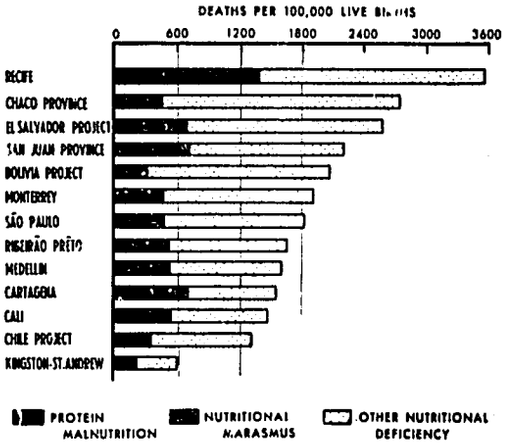
projects very few deaths were assigned to this category, and the rates there were under 100 per 100,000, but in the other five projects they ranged from 100.8 up to 277.8 (Table 93). The overall rate for nutritional marasmus was 141.0. In all projects except Cartagena more than half the nutritional deficiency deaths were assigned to the un-

specified group (269), for which the overall rate was 431.9 per 100,000 population.

With regard to infant mortality (under one year) for the 13 projects (Figure 87), nutritional marasmus and unspecified nutritional deficiency states accounted for most of these deaths. Only in the two projects of Recife and Cartagena were the rates for protein malnutrition in this age group relatively high—259.9 and 324.0 per 100,000 live births, respectively.

The rates for children aged one year and 2–4 years (Figure 88) were lower. In five projects (El Salvador, Recife, Cartagena, Cali, and Medellín) protein malnutrition mortality was particularly high in the second year of life, with the rates ranging from 220.4 to 616.3 per 100,000 population. In Cartagena more than half the nutritional deficiency deaths in one-year-olds were due to this type. The clinical information for this latter city was of unusually good quality and this fact may account partially for the more frequent assignment to specific types there.

Fig. 87. Mortality in Infancy from Specific Types of Nutritional Deficiency in 13 Projects.



The detailed breakdown by type of nutritional deficiency is presented in Table 94 for 12 projects by three-month age groups in the first two years of life. Table 95 gives similar data for the El Salvador project in the first 5 years. These are reference tables designed to provide full information on the local situation in each project.

Fig. 88. Mortality from Nutritional Deficiency, by Type, in Children One Year and 2–4 Years of Age in 13 Projects.

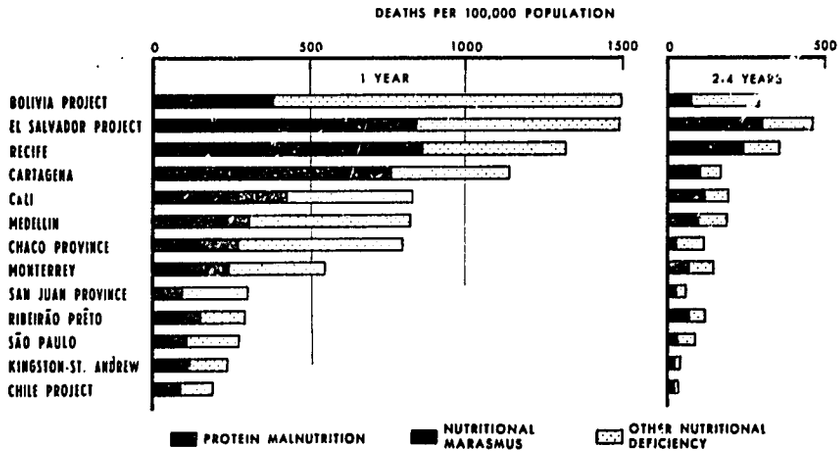


TABLE 94. Mortality[a] from Nutritional Deficiency, by Type, for Three-Month Age Groups Under 2 Years and for 2–4 Years in 12 Projects.

Age group	Total		Protein malnutrition (267)		Nutritional marasmus (268)		Other (269)		Total		Protein malnutrition (267)		Nutritional marasmus (268)		Other (269)	
	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate
	ARGENTINA, Chaco Province								ARGENTINA, San Juan Province							
Total	661	860.7	34	44.3	96	125.0	531	691.4	607[b]	581.1	10	9.6	177	169.4	419	401.1
0–2 months	121	687.5	1	5.7	17	96.6	103	585.2	192	821.9	—	—	47	201.2	145	620.7
3–5 months	193	1,096.6	2	11.4	27	153.4	164	931.8	190	813.4	—	—	67	286.8	123	526.5
6–8 months	101	573.9	2	11.4	16	90.9	83	471.6	92[b]	393.8	1	4.3	31	132.7	59	252.6
9–11 months	70	397.7	6	34.1	6	34.1	58	329.5	37	158.4	1	4.3	13	55.7	23	98.5
12–14 months	53	332.5	10	62.7	11	69.0	32	200.8	24	114.1	2	9.5	7	33.3	15	71.3
15–17 months	32	200.8	3	18.8	7	43.9	22	138.0	20	95.1	2	9.5	2	9.5	16	76.0
18–20 months	21	131.7	5	31.4	2	12.5	14	87.8	13	61.8	—	—	1	4.8	12	57.0
21–23 months	21	131.7	4	25.1	1	6.3	16	100.4	6	28.5	—	—	2	9.5	4	19.0
2–4 years	49	110.4	1	2.3	9	20.3	39	87.9	33	52.3	4	6.3	7	11.1	22	34.8
	BOLIVIA project								BRAZIL, Recife							
Total	1,532	969.3	116	73.4	176	111.4	1,240	784.6	1,679	1,355.0	322	259.9	499	402.7	858	692.4
0–2 months	224	595.6	1	2.7	19	50.5	204	542.4	335	1,102.0	—	—	65	213.8	270	888.2
3–5 months	195	518.5	5	13.3	17	45.2	173	460.0	325	1,069.1	1	3.3	109	358.6	215	707.2
6–8 months	165	438.7	4	10.6	22	58.5	139	369.6	233	766.4	31	102.0	102	335.5	100	328.9
9–11 months	187	497.2	13	34.6	24	63.8	150	398.8	187	615.1	47	154.6	64	210.5	76	250.0
12–14 months	182	538.3	23	68.0	24	71.0	135	399.3	116	432.5	40	149.1	37	138.0	39	145.4
15–17 months	141	417.0	24	71.0	14	41.4	103	304.6	111	413.9	39	145.4	35	130.5	37	138.0
18–20 months	112	331.3	8	23.7	15	44.4	89	263.2	81	302.0	28	104.4	22	82.0	31	115.6
21–23 months	73	215.9	11	32.5	7	20.7	55	162.7	46	171.5	23	85.8	9	33.6	14	52.2
2–4 years	253	284.7	27	30.4	34	38.3	192	216.0	245	355.1	113	163.8	56	81.2	76	110.2
	BRAZIL, Ribeirão Prêto								BRAZIL, São Paulo							
Total	405	490.9	31	37.6	113	137.0	261	316.4	1,313[b]	538.8	58	23.8	299	122.7	953	391.0
0–2 months	97	531.8	—	—	24	131.6	73	400.2	494	849.4	—	—	82	141.0	412	708.4
3–5 months	112	614.0	—	—	30	164.5	82	449.6	331	569.1	2	3.4	102	175.4	227	390.3
6–8 months	57	312.5	1	5.5	23	126.1	33	180.9	156[b]	268.2	6	10.3	51	87.7	98	168.5
9–11 months	33	180.9	2	11.0	12	65.8	19	104.2	81	139.3	6	10.3	20	34.4	55	94.6
12–14 months	14	82.0	2	11.7	4	23.4	8	46.9	61[b]	112.7	10	18.5	13	24.0	36	66.5
15–17 months	16	93.7	6	35.1	5	29.3	5	29.3	39	72.0	4	7.4	11	20.3	24	44.3
18–20 months	12	70.3	3	17.6	1	5.9	8	46.9	25	46.2	8	14.8	1	1.8	16	29.6
21–23 months	8	46.9	3	17.6	—	—	5	29.3	21	38.8	5	9.2	1	1.8	15	27.7
2–4 years	56	116.7	14	29.2	14	29.2	28	58.3	105	78.2	17	12.7	18	13.4	70	52.1
	CHILE project								COLOMBIA, Cali							
Total	669[b]	322.0	20	9.6	177	85.2	469	225.7	593[b]	586.0	130	128.5	138	136.4	323	319.2
0–2 months	200	458.9	—	—	30	68.8	170	390.1	59	279.6	—	—	14	66.4	45	213.3
3–5 months	219[b]	502.5	1	2.3	73	167.5	142	325.8	98[b]	464.5	—	—	35	165.9	62	293.8
6–8 months	101	231.8	1	2.3	39	89.5	61	140.0	80	379.1	10	47.4	22	104.3	48	227.5
9–11 months	40	91.8	—	—	7	16.1	33	75.7	69	327.0	16	75.8	18	85.3	35	165.9
12–14 months	38	94.4	5	12.4	7	17.4	26	64.6	73	361.4	10	49.5	12	59.4	51	252.5
15–17 months	19	47.2	4	9.9	7	17.4	8	19.9	51	252.5	21	104.0	12	59.4	18	89.1
18–20 months	13	32.3	2	5.0	3	7.5	8	19.9	27	133.7	11	54.5	5	24.8	11	54.5
21–23 months	5	12.4	1	2.5	1	2.5	3	7.5	18	89.1	9	44.6	5	24.8	4	19.8
2–4 years	34	26.7	6	4.7	10	7.9	18	14.1	118[b]	194.4	53	87.3	15	24.7	49	80.7
	COLOMBIA, Cartagena								COLOMBIA, Medellín							
Total	561	652.3	201	233.7	99	115.1	261	303.5	570[b]	610.9	94	100.8	107	114.7	365	391.2
0–2 months	59	329.6	—	—	14	78.2	45	251.4	55[b]	283.5	—	—	10	51.5	44	226.8
3–5 months	67	374.3	4	22.3	20	111.7	43	240.2	101[b]	520.6	1	5.2	40	206.2	59	304.1
6–8 months	74	413.4	19	106.1	18	100.6	37	206.7	86	443.3	4	20.6	20	103.1	62	319.6
9–11 months	78	435.8	35	195.5	12	67.0	31	173.2	66[b]	340.2	3	15.5	18	92.8	44	226.8
12–14 months	88	511.6	44	255.8	11	64.0	33	191.9	65	349.5	14	75.3	7	37.6	44	236.6
15–17 months	48	279.1	29	168.6	6	34.9	13	75.6	36	193.5	9	48.4	5	26.9	22	118.3
18–20 months	33	191.9	19	110.5	5	29.1	9	52.3	37	198.9	12	64.5	1	5.4	24	129.0
21–23 months	28	162.8	14	81.4	3	17.4	11	64.0	16	86.0	6	32.3	2	10.8	8	43.0
2–4 years	86	166.7	37	71.7	10	19.4	39	75.6	108[b]	192.9	45	80.4	4	7.1	58	103.6
	JAMAICA, Kingston-St. Andrew								MEXICO, Monterrey							
Total	370[b]	201.9	58	31.7	83	45.3	228	124.4	1,428	655.2	140	64.2	282	129.4	1,006	461.6
0–2 months	56	136.7	—	—	10	24.4	46	112.3	351	662.1	—	—	54	101.9	297	560.3
3–5 months	52	127.0	—	—	15	36.6	37	90.3	319	601.8	4	7.5	67	126.4	248	467.8
6–8 months	64	156.2	12	29.3	13	31.7	39	95.2	199	375.4	11	20.8	52	98.1	136	256.6
9–11 months	71	173.3	13	31.7	21	51.3	37	90.3	134	252.8	19	35.8	30	56.6	85	160.3
12–14 months	43	109.9	14	35.8	10	25.6	19	48.6	75	166.6	16	35.5	10	22.2	49	108.8
15–17 months	25[b]	63.9	7	17.9	6	15.3	11	28.1	74	164.4	20	44.4	15	33.3	39	86.6
18–20 months	14	35.8	4	10.2	2	5.1	8	20.5	52	115.5	15	33.3	8	17.8	29	64.4
21–23 months	8	20.5	1	2.6	—	—	7	17.9	46	102.2	12	26.7	7	15.5	27	60.0
2–4 years	37	35.4	7	6.7	6	5.7	24	23.0	178	142.6	43	34.5	39	31.2	96	76.9

[a] Rates under 1 year of age per 100,000 live births; others per 100,000 population.
[b] Includes death or deaths from 260–266.

TABLE 95. Mortality[a] from Nutritional Deficiency, by Type, for Three-Month Age Groups in San Salvador and Rural *Municipios* of El Salvador.

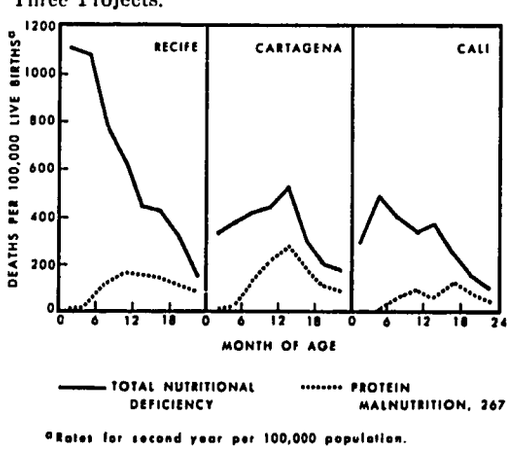
Age group in months	San Salvador								Rural municipios							
	Total		Protein malnutrition (267)		Nutritional marasmus (268)		Other (269)		Total		Protein malnutrition (267)		Nutritional marasmus (268)		Other (269)	
	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate
Total	1,018	980.2	168	161.8	238	229.2	612	589.3	507[b]	2,365.8	180	839.9	60	280.0	266	1,241.3
0-2	146	569.9	—	—	25	97.6	121	472.3	40	740.7	1	18.5	2	37.0	37	685.2
3-5	197	768.9	2	7.8	53	206.9	142	554.3	61	1,129.6	1	18.5	10	185.2	50	925.9
6-8	129	503.5	6	23.4	33	128.8	90	351.3	56[b]	1,037.0	6	111.1	7	129.6	42	777.8
9-11	125	487.9	15	58.5	35	136.6	75	292.7	41	759.3	9	166.7	4	74.1	28	518.5
12-14	109	477.0	24	105.0	32	140.0	53	231.9	52	1,153.0	11	243.9	13	288.2	28	620.8
15-17	61	267.0	19	83.2	14	61.3	28	122.5	33	731.7	16	354.8	5	110.9	12	266.1
18-20	50	218.8	20	87.5	11	48.1	19	83.2	33	731.7	14	310.4	7	155.2	12	266.1
21-23	42	183.8	17	74.4	10	43.8	15	65.6	29	643.0	13	288.2	4	88.7	12	266.1
24-26	32	167.9	20	104.9	2	10.5	10	52.5	23	573.1	16	398.7	—	—	7	174.4
27-29	27	141.6	10	52.5	5	26.2	12	62.9	28	697.7	20	498.4	2	49.8	6	149.5
30-32	19	99.7	3	15.7	5	26.2	11	57.7	17	423.6	10	249.2	1	24.9	6	149.5
33-35	11	57.7	5	26.2	1	5.2	5	26.2	18	448.5	11	274.1	1	24.9	6	149.5
36-38	8	42.0	4	21.0	1	5.2	3	15.7	11	274.1	6	149.5	1	24.9	4	99.7
39-41	13	68.2	4	21.0	3	15.7	6	31.5	12	299.0	10	249.2	—	—	2	49.8
42-44	17	89.2	7	36.7	4	21.0	6	31.5	6	149.5	4	99.7	—	—	2	49.8
45-47	7	36.7	3	15.7	1	5.2	3	15.7	11	274.1	7	174.4	—	—	4	99.7
48-50	6	31.5	1	5.2	1	5.2	4	21.0	13	323.9	11	274.1	1	24.9	1	24.9
51-53	4	21.0	2	10.5	—	—	2	10.5	10	249.2	5	124.6	1	24.9	4	99.7
54-56	7	36.7	3	15.7	1	5.2	3	15.7	7	174.4	5	124.6	1	24.9	1	24.9
57-59	8	42.0	3	15.7	1	5.2	4	21.0	6	149.5	4	99.7	—	—	2	49.8

[a] Rates under 1 year of age per 100,000 live births; others per 100,000 population.
[b] Includes 1 death with rickets (265.0) as associated cause.

Figure 89 shows the rates for protein malnutrition along with the total rates for nutritional deficiency by three-month age groups for three projects (Recife, Cartagena, and Cali). In Cartagena the peak rates for protein malnutrition occurred among children 12–14 months of age, and in Recife the rates were highest for those aged 9–17 months. In Cali the highest rate was for children 15–17 months old. In all three projects, in the last age group of the two-year period (21 to 23 months) essentially half the deaths from nutritional deficiency were due to protein malnutrition.

For El Salvador, where nutritional deficiency was a particularly serious problem,

FIG. 89. Mortality from Nutritional Deficiency and from Protein Malnutrition for Three-Month Age Groups in the First Two Years of Life in Three Projects.



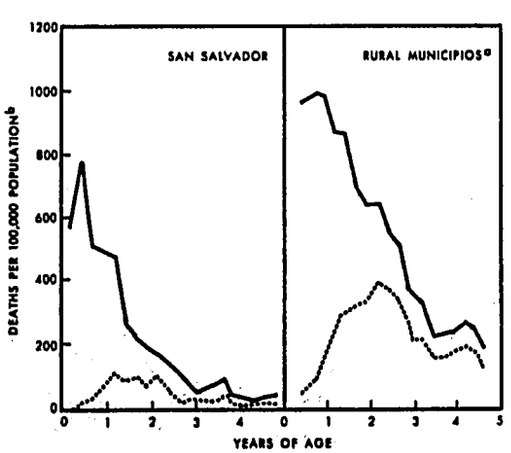
[a] Rates for second year per 100,000 population.

the death rates in both urban and rural areas are shown by three-month intervals for the first 5 years of life (Table 95). In the rural *municipios* protein malnutrition mortality rose to the peak rate of 498.4 in the group aged 27–29 months, and then declined in the older groups. These rates are illustrated in Figure 90. After the second year of life protein malnutrition was the type found in two-thirds of the deaths due to nutritional deficiency (109 out of 162).

For the 13 Latin American projects combined, the role of the various types of nutritional deficiency as underlying or associated cause of death in children under 2 years is shown in Figure 91 and Table 96. The rates for all types combined were highest at 2 and 3 months of age and then declined in the older groups. Protein malnutrition was diagnosed for three infants at 2 months of age, for five at 3 months, and for seven at 4 months; the frequency then increased steadily until the largest numbers were recorded for children aged 12–16 months, and it decreased thereafter during the latter part of the second year of life. Table 97 shows for the 13 projects combined the protein malnutrition death rates for the group under 5 years as a whole as well as for infants and children 1 year and 2–4 years old. The death rate of 184.8 per 100,000 population for one-year-olds indicates that these children suffered the greatest mortality from this type.

This overall picture combining the rates for all projects does not reveal the gravity of the protein malnutrition problem in certain of the projects. Detailed analyses of the kind presented above for the El Salva-

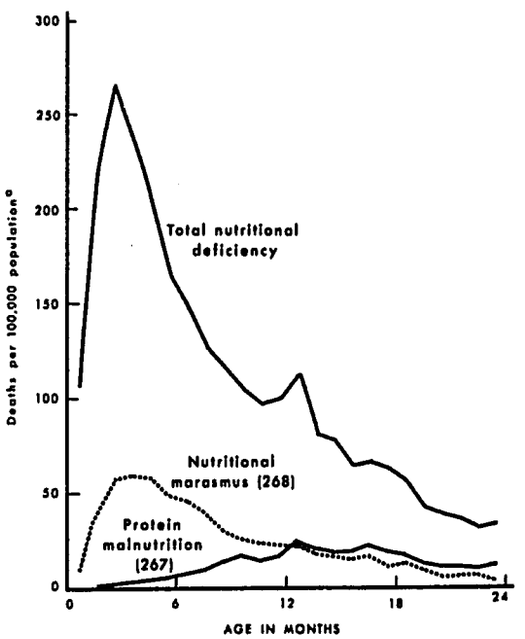
FIG. 90. Mortality from Nutritional Deficiency and from Protein Malnutrition for Three-Month Age Groups Under 5 Years in San Salvador and Rural *Municipios* of El Salvador.



[a]Smoothed averages for rural municipios.

[b]Rates for under 1 year of age per 100,000 live births.

FIG. 91. Mortality from Nutritional Deficiency, Protein Malnutrition, and Nutritional Marasmus by Month of Age in First Two Years of Life in 13 Latin American Projects Combined.



[a]Under 1 year of age per 100,000 live births.

TABLE 96. Mortality[a] from Nutritional Deficiency, by Type and by Month of Age, in First Two Years of Life in 13 Latin American Projects Combined.

Month of age	Total		Avitaminoses (260-266)		Protein malnutrition (267)		Nutritional marasmus (268)		Other deficiency (269)	
	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate
Under 1	439	106.5	1	0.2	—	—	33	8.0	405	98.2
1	904	219.2	—	—	—	—	147	35.7	757	183.6
2	1,086	263.4	—	—	3	0.7	233	56.5	850	206.1
3	969	235.0	1	0.2	5	1.2	237	57.5	726	176.1
4	821	199.1	3	0.7	7	1.7	233	56.5	578	140.2
5	670	162.5	1	0.2	11	2.7	195	47.3	463	112.3
6	607	147.2	1	0.2	25	6.1	182	44.1	399	96.8
7	510	123.7	—	—	35	8.5	153	37.1	322	78.1
8	476	115.4	2	0.5	54	13.1	114	27.6	306	74.2
9	424	102.8	1	0.2	65	15.8	104	25.2	254	61.6
10	393	95.3	—	—	55	13.3	92	22.3	246	59.7
11	402	97.5	—	—	65	15.8	88	21.3	249	60.4
12	413	109.7	—	—	88	23.4	80	21.2	245	65.1
13	297	78.9	—	—	69	18.3	62	16.5	166	44.1
14	283	75.2	2	0.5	68	18.1	56	14.9	157	41.7
15	237	62.9	—	—	67	17.8	50	13.3	120	31.9
16	244	64.8	1	0.3	72	19.1	58	15.4	113	30.0
17	225	59.8	—	—	64	17.0	36	9.6	125	33.2
18	218	57.9	—	—	59	15.7	42	11.2	117	31.1
19	164	43.6	—	—	48	12.7	27	7.2	89	23.6
20	141	37.4	—	—	42	11.2	15	4.0	84	22.3
21	135	35.9	—	—	42	11.2	21	5.6	72	19.1
22	111	29.5	—	—	37	9.8	20	5.3	54	14.3
23	121	32.1	—	—	40	10.6	11	2.9	70	18.6

[a] Rates under 1 year of age per 100,000 live births; others per 100,000 population.

dor project is advisable for other areas; for this purpose it is necessary to have available adequate data for rural areas as well as sufficient clinical evidence to distinguish protein deficiency from the non-specific states when assigning the cause. Protein malnutrition is an indicator of a serious health problem whose impact extends far beyond childhood. Research is needed in order to ascertain the effect of damage by protein-caloric malnutrition on future mothers and determine whether there is a relationship to low birth weights in their offspring.

While mortality from protein malnutrition increased to the highest rates in the second year of life, the rates for nutritional marasmus reached a peak at 2 and 3 months of age and then gradually declined (Table 96). Some of the survivors of nutritional marasmus probably later developed protein malnutrition and thus the damage was laid in this early period of life. It is therefore clear that preventive measures are required very early in life not only to reduce mortality from nutritional deficiency of the intermediate and marasmatic types, but to prevent protein malnutrition in the survivors as well.

Since for all forms of nutritional deficiency combined the highest mortality was in infants 2 and 3 months of age (rates of 263.4 and 235.0, respectively), there is clear evidence of the development of severe forms

TABLE 97. Protein Malnutrition as Underlying or Associated Cause of Death Under 5 Years, by Age Group,[a] in 13 Latin American Projects Combined.

Age group	Total	Rate
Under 5 years	1,562	86.6
Under 1 year	325	78.8
1 year	696	184.8
2–4 years	541	51.9

[a] Rates under 1 year of age per 100,000 live births; others per 100,000 population.

in early life. This is an important finding, for in the past emphasis has been placed on deficiencies in the second year of life. The full significance of the finding is apparent from the fact that a high incidence of protein-calorie malnutrition at an early age, when the need for rapid growth and development is greatest, can result in irreparable damage to the survivors.

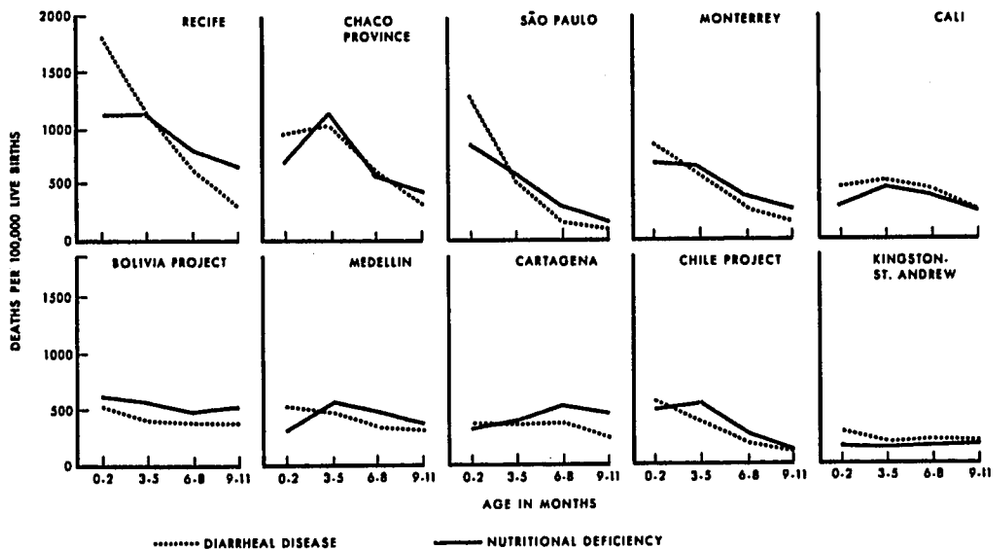
The use of the 1965 Revision of the *International Classification of Diseases,* which brought together in one section the various forms of nutritional deficiencies, and the adoption of the multiple-cause approach to the study of mortality in this Investigation, have made it possible to arrive at these analyses and epidemiologic description of nutritional deficiency by type as well as age at death. Such analyses should lay the foundation for new and effective approaches to the study of measures for prevention of such deficiency.

INTERRELATIONSHIP OF CAUSES

The various patterns of mortality from diarrheal disease as underlying cause in the first year of life were shown in Chapter VIII, while this chapter has presented similar data for nutritional deficiency as underlying or associated cause. The patterns for these two important diseases of childhood are brought together in Figures 92 and 93 and Table 98, by three-month age groups in the first year of life.

Figure 92 presents the rates for 10 projects. In the first four (Recife, Chaco Province, São Paulo, and Monterrey) diarrheal disease mortality was very high in the first three months of life and decreased sharply in infants 6–8 months and 9–11 months of age. A somewhat different pattern is observed for nutritional deficiency. In Recife and São Paulo the rates were lower than those for diarrheal disease in the first three months but were higher in infants aged 6–8 months and 9–11 months, thereby showing a delayed effect of the nutritional deficiency. Actually, in Recife the total number of infant deaths from nutritional deficiency as underlying or associated cause (1,080) was only slightly less than the number from diarrheal disease (1,141). The same was noted in São Paulo (with 1,062 and 1,149 deaths, respectively). The study of clinical records revealed that in many infants the nutritional deficiency resulted from repeated episodes of diarrheal disease; their deleterious effects caused the deficiency weeks or months after such episodes, and the final episode became fatal for the already malnourished infant. It is thus possible to see the interrelationship of these two causes. In other cases the diarrheal disease resulted in the deaths of very young infants whose poor

FIG. 92. Infant Mortality from Diarrheal Disease and Nutritional Deficiency by Three-Month Age Groups in 10 Projects.



nutritional states were probably the result of low birth weight, among other determining factors.

In five of the other projects shown in Figure 92 (Cali, Bolivia, Medellín, Cartagena, and Kingston-St. Andrew), different patterns were found. Excessive rates from diarrheal disease were not noted in the first three months of life. In these projects breast feeding was more commonly practiced and was continued longer than in the Brazilian projects. The pattern for nutritional deficiency was also different in these projects, showing only small variations. In the project in Chile the patterns for both diarrheal disease and nutritional deficiency were similar to those in Recife and São Paulo, though the rates were much lower.

Two projects—El Salvador and San Juan Province—had sufficient data to illustrate

FIG. 93. Infant Mortality from Diarrheal Disease and Nutritional Deficiency by Three-Month Age Groups in Specific Areas of Three Projects.

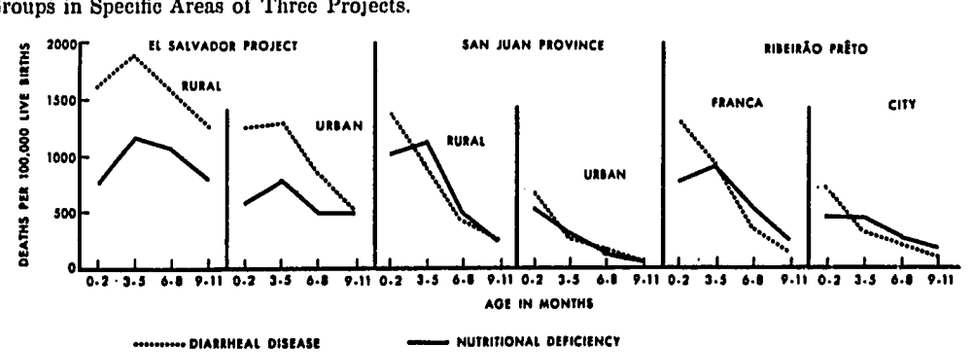


TABLE 98. Infant Mortality from Diarrheal Disease and Nutritional Deficiency by Three-Month Age Groups in 18 Areas of 13 Projects.

Area	Diarrheal disease, underlying cause										Nutritional deficiency*									
	Deaths					Rates per 100,000 live births					Deaths					Rates per 100,000 live births				
	Age in months					Age in months					Age in months					Age in months				
	Total	0-2	3-5	6-8	9-11	Total	0-2	3-5	6-8	9-11	Total	0-2	3-5	6-8	9-11	Total	0-2	3-5	6-8	9-11
ARGENTINA																				
Chaco Province	493	161	175	105	52	2,801.1	914.8	994.3	596.6	295.5	485	121	193	101	70	2,755.7	687.5	1,096.6	573.9	397.7
San Juan Province—Total	510	251	152	74	33	2,183.2	1,074.5	650.7	316.8	141.3	511	192	190	92	37	2,187.5	821.9	813.4	393.8	158.4
San Juan (city)	62	30	15	9	2	1,065.3	618.6	257.7	154.6	34.4	55	30	16	7	2	945.0	515.5	274.9	120.3	34.4
Suburban departments	170	85	51	26	8	2,146.5	1,073.2	643.9	328.3	101.0	187	66	68	39	14	2,361.1	833.3	858.6	492.4	176.8
Rural departments	278	130	86	39	23	2,889.8	1,351.4	894.0	405.4	239.1	269	96	106	46	21	2,796.3	997.9	1,101.9	478.2	218.3
BOLIVIA project	610	192	148	140	130	1,621.9	510.5	393.5	372.2	345.7	771	224	195	165	187	2,050.0	595.6	518.5	438.7	497.2
BRAZIL																				
Recife	1,141	540	335	179	87	3,753.3	1,776.3	1,102.0	588.8	286.2	1,080	335	325	233	187	3,552.6	1,102.0	1,069.1	766.4	615.1
Ribeirão Prêto—Total	308	156	98	41	13	1,688.6	855.3	537.3	224.8	71.3	299	97	112	57	33	1,639.3	531.8	614.0	312.5	180.9
Ribeirão Prêto (city)	115	66	28	18	3	1,235.2	708.9	300.8	193.3	32.2	116	41	40	22	13	1,246.0	440.4	429.6	236.3	139.6
Franca	134	66	45	16	7	2,632.6	1,296.7	884.1	314.3	137.5	119	37	45	26	11	2,337.9	726.9	884.1	510.8	216.1
Communities	59	24	25	7	3	1,536.5	625.0	651.0	182.3	78.1	64	19	27	9	9	1,666.7	494.8	703.1	234.4	234.4
São Paulo	1,149	742	287	83	37	1,975.6	1,275.8	493.5	142.7	63.6	1,062	494	331	156	81	1,826.0	849.4	569.1	268.2	139.3
CHILE project	498	236	154	75	33	1,142.7	541.5	353.4	172.1	75.7	560	200	219	101	40	1,285.0	458.9	502.5	231.8	91.8
COLOMBIA																				
Cali	362	91	108	94	69	1,715.6	431.3	511.8	445.5	327.0	306	59	98	80	69	1,450.2	279.6	464.5	379.1	327.0
Cartagena	222	63	59	62	38	1,240.2	352.0	329.6	346.4	212.3	278	59	67	74	78	1,553.1	329.6	374.3	413.4	435.8
Medellín	289	95	80	62	52	1,489.7	489.7	412.4	319.6	268.0	308	55	101	86	66	1,587.6	283.5	520.6	443.3	340.2
EL SALVADOR project—Total	1,298	401	424	288	185	4,184.4	1,292.7	1,366.9	928.4	596.4	795	186	258	185	166	2,562.9	599.6	831.7	596.4	535.1
San Salvador	961	315	324	204	118	3,751.0	1,229.5	1,264.6	796.3	460.6	597	146	197	129	125	2,330.2	569.9	768.9	503.5	487.9
Rural *municipios*	337	86	100	84	67	6,240.7	1,592.6	1,851.9	1,555.6	1,240.7	198	40	61	56	41	3,666.7	740.7	1,129.6	1,037.0	759.3
JAMAICA																				
Kingston-St. Andrew	334	104	76	81	73	815.4	253.9	185.5	197.8	178.2	243	56	52	64	71	593.3	136.7	127.0	156.2	173.3
MEXICO																				
Monterrey	950	430	204	140	77	1,792.1	828.1	554.6	264.1	145.3	1,003	351	310	199	134	1,892.1	662.1	601.8	375.4	252.8

* Underlying or associated cause.

the differences in rates in urban and rural areas, and in Ribeirão Prêto the differences between an interior city (Franca) and the city of Ribeirão Prêto (which had more medical facilities and better environmental conditions) can be shown (Figure 93). Diarrheal disease rates were found to be much higher in rural areas than in the cities, the rural rates being about twice as high in the case of San Juan Province.

Mortality from nutritional deficiency was also greater in rural areas but in general followed a different pattern, the rates being highest among infants 3–5 months of age. The delayed deleterious effect of diarrheal disease was thus clearly evident in this age period. As in the projects shown in Fig. 92, the numbers of infant deaths from the two causes (diarrheal disease as underlying and nutritional deficiency as underlying or associated) were practically the same. These data of the Investigation thus indicate the seriousness of this complex of diarrheal disease-nutritional deficiency in rural areas of Latin America and probably in interior cities as well.

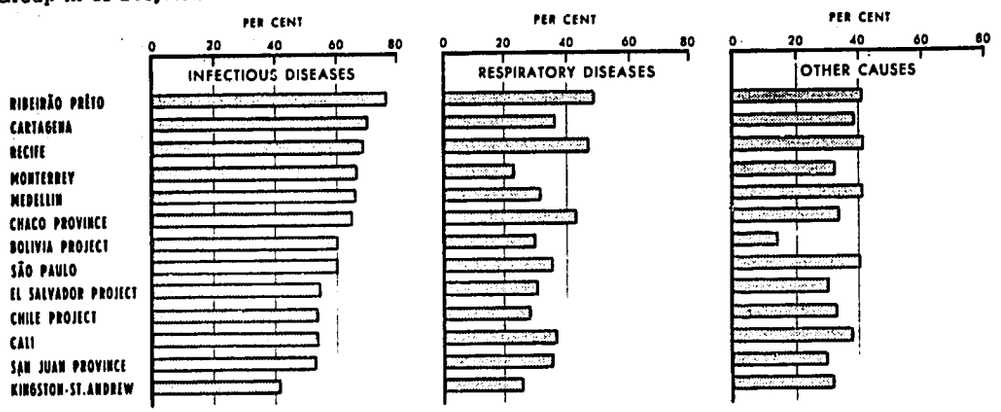
The relationship of nutritional deficiency as associated cause of death to three broad groups of underlying causes in the 13 Latin American projects can be seen in Table 99; these groups are infective and parasitic diseases (divided into diarrheal disease, measles, and other), respiratory diseases, and all other causes (excluding nutritional deficiency as underlying). Neonatal deaths have been excluded since they have a distinct pattern principally involving immaturity and other conditions present at birth (perinatal causes) and thus do not contribute to this analysis of interrelationships of nutritional deficiency and other causes. As is illustrated clearly in Figure 94, nutritional

TABLE 99. Nutritional Deficiency as Associated Cause of Death in Children Under 5 Years of Age (Excluding Neonatal Deaths) by Underlying Cause Group in 13 Projects.

Cause group	Total deaths	With nutritional deficiency		Total deaths	With nutritional deficiency		Total deaths	With nutritional deficiency		Total deaths	With nutritional deficiency		Total deaths	With nutritional deficiency	
		No.	%		No.	%		No.	%		No.	%		No.	%
	ARGENTINA Chaco Province			ARGENTINA San Juan Province			BOLIVIA project			BRAZIL Recife			BRAZIL Ribeirão Prêto		
All causes	1,133	601	53.0	1,250	500	40.0	3,185	1,395	43.8	2,562	1,490	58.2	611	372	60.9
Infective and parasitic diseases	677	443	65.4	579	305	52.7	1,713	1,039	60.7	1,731	1,188	68.6	362	276	76.2
Diarrheal disease	548	365	66.6	410	238	58.0	964	657	68.2	1,122	766	68.3	278	217	78.1
Measles	53	32	60.4	96	34	35.4	578	288	49.8	390	294	74.2	46	31	67.4
Other	76	46	60.5	73	33	45.2	171	94	55.0	213	128	60.1	38	28	73.7
Nutritional deficiency	48			70			69			147			27		
Disease of respiratory system	225	96	42.7	343	119	34.7	1,061	311	29.3	383	177	46.2	91	43	47.3
Other causes	183	62	33.9	258	76	29.5	342	45	13.2	301	125	41.5	131	53	40.5
	BRAZIL São Paulo			CHILE project			COLOMBIA Cali			COLOMBIA Cartagena			COLOMBIA Medellín		
All causes	2,354	1,108	47.1	1,554	592	38.1	1,091	458	42.0	854	438	51.3	965	493	51.1
Infective and parasitic diseases	1,191	710	59.6	593	317	53.5	644	340	52.8	496	346	69.8	555	366	65.9
Diarrheal disease	844	529	62.7	473	252	53.3	486	249	51.2	300	190	63.3	394	249	63.2
Measles	156	74	47.4	21	11	52.4	80	51	63.8	105	91	86.7	89	69	77.5
Other	191	107	56.0	99	54	54.5	78	40	51.3	91	65	71.4	72	48	66.7
Nutritional deficiency	97			55			129			113			72		
Diseases of respiratory system	525	181	34.5	452	125	27.7	149	54	36.2	98	35	35.7	134	41	30.6
Other causes	541	217	40.1	454	150	33.0	169	64	37.9	147	57	38.8	204	86	42.2
	EL SALVADOR project			JAMAICA Kingston-St. Andrew			MEXICO Monterrey								
All causes	2,003	1,317	45.4	913	297	32.5	2,576	1,288	50.0						
Infective and parasitic diseases	2,073	1,123	54.2	420	172	41.0	1,564	1,042	66.6						
Diarrheal disease	1,667	876	52.5	351	148	42.2	933	595	63.8						
Measles	177	126	71.2	9	3	#	297	207	69.7						
Other	229	121	52.8	60	21	35.0	334	240	71.9						
Nutritional deficiency	179			67			90								
Diseases of respiratory system	375	111	29.6	130	32	24.6	503	110	21.9						
Other causes	276	83	30.1	296	93	31.4	419	136	32.5						

Percentage is not calculated when the base is less than 10.

FIG. 94. Frequency of Nutritional Deficiency as Associated Cause of Death[a] by Underlying Cause Group in 13 Projects.



[a]Deaths under 5 years of age excluding neonatal deaths.

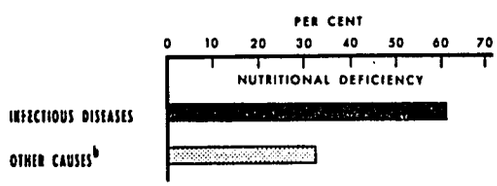
deficiency was an associated cause of higher proportions of deaths from infectious diseases than of deaths from either of the other groups of causes.

When data from all 13 Latin American projects are combined, the synergistic action of infectious diseases and nutritional deficiency becomes evident (Table 100 and Figure 95). Nutritional deficiency was associated cause in 60.9 per cent of the deaths from infectious diseases, as compared with only 32.7 per cent of deaths from all other causes. These findings are in accord with previous research indicating the importance of the nutritional state of the host in the development of disease. For example, Schneider (1946, 1949) found that under certain conditions dietary factors were capable of influencing resistance to infectious disease in mice. Recently Scrimshaw, Taylor, and Gordon (1968) provided a comprehensive review of the interaction of nutrition and infection. The Investigation provides the

TABLE 100. Nutritional Deficiency as Associated Cause of Death Under 5 Years of Age (Excluding Neonatal Deaths) by Underlying Cause Group in 13 Latin American Projects Combined.

Underlying cause group	Total deaths	Nutritional deficiency as associated cause	
		No.	%
All causes	21,951	10,349	47.1
Infective and parasitic diseases	12,598	7,667	60.9
Diarrheal disease	8,770	5,331	60.8
Measles	2,103	1,311	62.3
Other	1,725	1,025	59.4
Nutritional deficiency	1,163		
Diseases of respiratory system	4,469	1,435	32.1
Other causes	3,721	1,247	33.5

FIG. 95. Nutritional Deficiency as Associated Cause of Deaths Due to Infectious Diseases and Other Causes in Children Under 5 Years of Age[a] in 13 Latin American Projects Combined.



[a]Excluding neonatal deaths.

[b]Respiratory diseases and other causes combined.

first extensive series of data on deceased children, based on the study of multiple causes, which show the frequent and serious involvement of nutritional deficiency with infectious diseases and its synergistic effects on those morbid conditions. The role of increased host susceptibility to such diseases can be measured by the degree in which nutritional deficiency is involved as an associated cause of death. As was pointed out in Chapter VI, immaturity constitutes a state of high vulnerability particularly during the neonatal period. After this period, nutritional deficiency is an indicator of increased susceptibility to disease, as was shown in Chapter VIII in regard to measles. Infants and young children with evidence of immaturity or nutritional deficiency are more susceptible to infection, and thus health programs must center on prevention of both infectious diseases and nutritional deficiency. Since immaturity and nutritional deficiency in infants may be at least partially due to deficient nutrition in the mother, particular emphasis should be placed also on the health of women in the reproductive period, especially during pregnancy. Infants of healthy mothers have better chances to be born with normal weight and with more resistance to infection.

What is now known about nutritional deficiency as well as about low birth weight and immaturity would seem to indicate that the deficient nutritional state of populations is perhaps the most important cause of excessive mortality in developing areas. A kind of vicious cycle is established whereby mothers who have been handicapped since early life by nutritional deficiency and other environmental factors give birth to low-weight infants. Many of these infants die from infectious diseases because of their increased vulnerability, and those who survive continue being at greater risk of the hazards of the environment and of nutritional deficiency than those born with satisfactory weight. Measured in terms of mortality and reproductive wastage, the effects of inadequate nutrition on communities are exceedingly grave, especially in women who have numerous pregnancies. The consequences of this complex cycle are much more serious when the impact on the child's intelligence and adaptive capacity is taken into account. Evidence of this impact is accumulating (Winick and Rosso, 1969). A review of current knowledge about malnutrition and its effects on brain and behavior was published recently by the Pan American Health Organization (1972-a) in a volume incorporating the research papers presented and discussions conducted at a seminar held in Jamaica in January 1972.

Measures to break this vicious cycle through adequate nutrition of future mothers and their offspring and through reduction of biological wastage are mandatory in order to safeguard the health and intelligence of children.

Chapter X

Congenital Anomalies

Knowledge of the geographic distribution and of the frequency of congenital anomalies is an important first step in the search for causes of these serious and often fatal abnormalities found at birth. Causes of a few of them have been discovered—such as rubella in the mother (Gregg, 1941) which leads to congenital heart disease, cataract, microcephaly, and deafness in the child, and the drug thalidomide taken in early pregnancy which has caused severe malformations of the extremities (Taussig, 1962, and Leck and Miller, 1962). Genetic factors, chromosomal abnormalities, and a number of environmental intrauterine factors such as infection are among the groups of causes to be suspected on discovery of a congenital anomaly (Warkany and Kalter, 1961). Nevertheless, the relationship between an anomaly and a specific cause is nearly always impossible to establish, a fact that makes prevention rarely feasible.

Although it has been recommended that the term "anomaly" embrace congenital abnormal molecular structure, that is, inborn errors of metabolism (Warkany and Kalter, 1961), congenital anomaly as used in this Investigation refers to macroscopic structural abnormality, as manifested by a deviation from normal development at birth. This definition used in the Investigation embraces all the conditions appearing in the section on congenital anomalies in the *International Classification of Diseases* and permits the inclusion of a few other abnormalities appearing in other sections.

One of the important considerations that led to the undertaking of this Investigation was the need for clarification of the situation in the Americas in regard to frequency of congenital anomalies. The Pan American Health Organization (1963) held a planning conference in 1963 designed to stimulate interest in research in this important field of health. Fortunately this Investigation has provided the geographic distributions of serious anomalies resulting in deaths of children under 5 years of age as well as of minor anomalies diagnosed in deceased children.

In 1959, the World Health Organization requested Dr. Alan C. Stevenson to organize and conduct a prospective study of congenital malformations* in accordance with recommendations made by a meeting of specialists held in April 1959. Facilities and staff of the Population Genetics Research Unit of the Medical Research Council of Great Britain were available for the collection and analysis of the data that were to be assembled. In that research program uniform information was recorded for con-

* In the 1965 Revision of the *International Classification of Diseases* the term anomaly was introduced, replacing malformation.

secutive births occurring in 24 hospitals in 16 countries in the years 1961–1964. The report on the frequency of congenital malformations found in the outcomes of 421,781 consecutive pregnancies (live births and fetal deaths) was publised by WHO (Stevenson *et al.*, 1966). Fortunately seven hospitals in six cities in Latin America were included in that research program, thereby providing data on the occurrence of anomalies diagnosed at birth in four of the countries in which the present Investigation was carried out. Since the Stevenson study was a prospective one in which obstetricians and pediatricians participated in recording the findings, the results can be expected to differ from those obtained retrospectively in the Investigation covering deceased children.

The frequency of congenital anomalies among the 35,095 deceased children under 5 years of age included in the Investigation was obtained from hospital and autopsy records or from interviews in the children's homes. This chapter presents first the numbers of infants and children 1–4 years of age with congenital anomalies, and then an analysis of the specific types diagnosed. The data on these anomalies among the 35,095 deceased children relate to: 27,602 infants from a base of 474,050 live births in the 15 projects, and 7,493 children 1–4 years of age from a base of 1,653,540 population in that age group.

CONGENITAL ANOMALIES IN DECEASED CHILDREN

Presentation of the data on congenital anomalies is complicated because of the frequency with which several anomalies are found in different organic systems in a child and even within the same system. The anomalies diagnosed as associated and as underlying causes are given for each area of the Investigation in the Appendix tables. In order to arrive at clear comparisons of the findings in the various projects and with other studies that have been made, the data have been classified according to whether the anomaly was an underlying or an associated cause of death or a minor anomaly only. In this way, duplication in the data has been eliminated.

Of the 27,602 deceased infants, 2,873 or 10.4 per cent were found to have had at least one anomaly, which gave a rate of 606.1 per 100,000 live births (Table 101). Considering only those with anomalies as underlying or associated causes of death, the number was 2,286, or a rate of 482.2 per 100,000 live births. Only 587 or 20.4 per cent of the 2,873 infants were classed as having minor anomalies, that is, conditions that were present but did not contribute to the sequence of events leading to death. Although such minor anomalies were not involved in the fatal outcome, knowledge of their frequency in a population is important, as they may handicap a surviving child physically and mentally. Also, the finding of minor anomalies indicates the need for a search for serious hidden anomalies. For this reason, epidemiologic studies of causation should include the minor as well as the serious and fatal anomalies.

The variation in mortality in these infants with anomalies was much less than

TABLE 101. Number of Deceased Infants and Children 1–4 Years of Age[a] with Congenital Anomalies as Underlying or Associated Causes of Death or with Minor Anomalies in 15 Projects.

Project	Under 1 year					1–4 years				
	Total infants	Cause of death			Minor anomaly	Total children	Cause of death			Minor anomaly
		Total	Underlying	Associated			Total	Underlying	Associated	
	No. Rate	No. Rate	No. Rate	No. Rate	No. Rate	No. Rate	No. Rate	No. Rate	No. Rate	No. Rate
Total	2,873 606.1	2,286 482.2	1,697 358.0	589 124.2	587 123.8	444 26.9	347 21.0	251 15.2	96 5.8	97 5.9
ARGENTINA										
Chaco Province	74 420.5	62 352.3	50 284.1	12 68.2	12 68.2	14 23.2	11 18.2	10 16.6	1 1.7	3 5.0
San Juan Province	176 753.4	127 543.7	91 389.6	36 154.1	49 209.8	22 26.1	17 20.2	12 14.3	5 5.9	5 5.9
BOLIVIA project	92 244.6	69 183.5	50 132.9	19 50.5	23 61.2	14 11.4	9 7.3	4 3.3	5 4.1	5 4.1
BRAZIL										
Recife	206 677.6	174 572.4	116 381.6	58 190.8	32 105.3	18 18.8	14 14.6	10 10.4	4 4.2	4 4.2
Ribeirão Prêto	101 553.7	91 498.9	71 389.3	20 109.6	10 51.8	13 20.0	9 13.8	8 12.3	1 1.5	4 6.1
São Paulo	458 787.5	316 543.3	223 383.4	93 159.9	142 244.2	46 24.4	38 20.2	26 13.8	12 6.4	8 4.2
CANADA										
Sherbrooke	124 730.7	115 677.7	101 595.2	14 82.5	9 53.0	14 18.8	9 12.1	7 9.4	2 2.7	5 6.7
CHILE project	307 704.5	235 539.2	176 403.9	59 135.4	72 165.2	41 24.5	39 23.3	30 17.9	9 5.4	2 1.2
COLOMBIA										
Cali	107 507.1	90 426.5	59 279.6	31 146.9	17 80.6	25 30.9	17 21.0	12 14.8	5 6.2	8 9.9
Cartagena	110 614.5	87 486.0	59 329.6	28 156.4	23 128.5	28 40.7	23 33.4	14 20.3	9 13.1	5 7.3
Medellín	126 649.5	96 494.8	69 355.7	27 139.2	30 154.6	46 61.7	32 42.9	21 28.2	11 14.7	14 18.8
EL SALVADOR project	216 696.3	164 528.7	119 383.6	45 145.1	52 167.6	41 42.4	27 28.0	18 18.6	9 9.3	14 14.5
JAMAICA										
Kingston-St. Andrew	201 490.7	166 405.3	134 327.1	32 78.1	35 85.4	45 31.3	40 27.9	31 21.6	9 6.3	5 3.5
MEXICO										
Monterrey	353 665.9	306 577.2	229 432.0	77 145.3	47 88.7	43 25.3	36 21.2	26 15.3	10 5.9	7 4.1
UNITED STATES										
California project	222 496.2	188 420.2	150 335.3	38 84.9	34 76.0	34 21 1	26 16.2	22 13.7	4 2.5	8 5.0

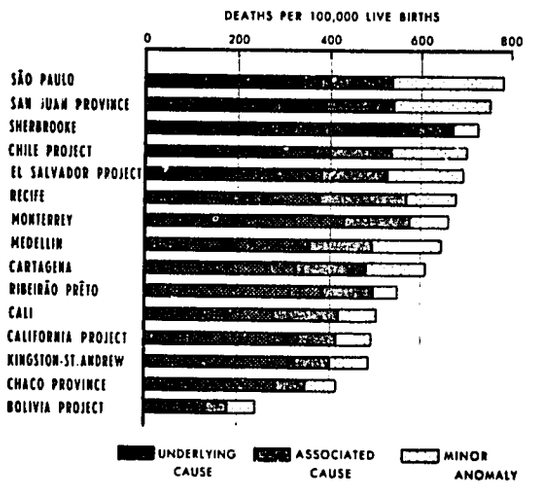
[a] Rates under 1 year of age per 100,000 live births; others per 100,000 population.

that found for many causes (Figure 96). Excluding the Bolivia project, the rates ranged from 420.5 to 787.5 per 100,000 live births. Those for anomalies as underlying causes varied from 279.6 to 432.0 in 13 of the projects. The Sherbrooke project had the very high rate of 595.2. In fact, of the 310 infant deaths in that project, 124 or 40.0 per cent were of infants with anomalies, and (as will be reported later in this chapter) the serious anomaly anencephalus was found more frequently in Sherbrooke than in the other projects. The situation in Bolivia is puzzling; the very low rate (244.6 per 100,000 live births) could be attributed to failure to find some of the families of deceased infants, to the lack of medical attention for diagnosis of anomalies, or perhaps to an actual lower frequency of anomalies. Certain serious anomalies that are clearly visible are usually reported even when medical facilities for diagnosis are limited. This was the case in the rural *municipios* of El Salvador. The results in Bolivia certainly indicate the need for further research into the many unique findings of this Investigation in high-altitude areas.

Infants with anomalies as minor conditions only were reported frequently in São Paulo and in San Juan Province (244.2 and 209.8 per 100,000 live births, respectively).

For six of the countries in which the In-

FIG. 96. Mortality of Infants with Congenital Anomalies as Underlying or Associated Causes or as Minor Anomalies in 15 Projects.



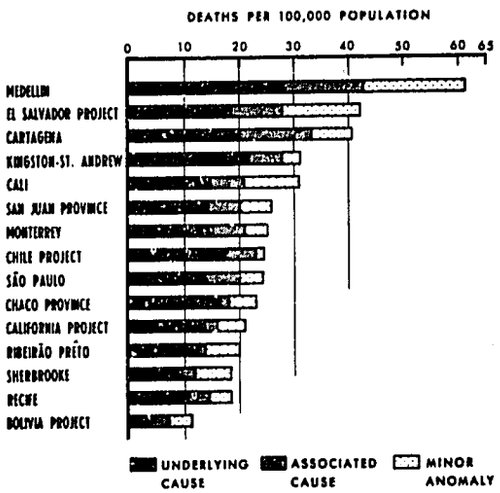
vestigation was conducted, a publication of WHO (1971) provided the numbers of deaths in 1967 due to congenital anomalies as underlying causes in infants, on the basis of the categories of the 1955 Revision of the *International Classification of Diseases*. The death rates per 100,000 live births for those six countries, along with the corresponding rates as underlying causes found in eight projects of the Investigation, are as follows:

WHO data (1967)		*Investigation*	
Canada	403.3	Sherbrooke	595.2
Chile	356.9	Chile project	403.9
Colombia	200.9	Cali	279.6
		Cartagena	329.6
		Medellín	355.7
El Salvador	78.6	El Salvador project	383.6
Mexico	160.6	Monterrey	432.0
United States	330.4	California project	335.3

With the exception of the California project, the death rates in the project of the Investigation were higher and in several cases much higher than those in the countries in which they were situated. This is to be expected since incompleteness of registration, which is probably even greater in rural areas than in populations studied in the Investigation, would affect the quality of such data for the country. In such areas products of pregnancy affected by serious anomalies, even when they are born alive and live a short time, may often be reported as fetal deaths. In the United States reporting of anomalies as underlying causes is probably quite complete, as was indicated by the finding in the California project (335.3 deaths per 100,000 live births) which was practically the same as the rate for the country (330.4).

In the 1955 Revision of the *International Classification of Diseases* (WHO, 1957) the Section on Congenital Malformations did not include certain conditions that were later added to Section XIV (Congenital Anomalies) in the 1965 Revision. One example is Down's disease, which was formerly included in the section on mental disorders. Also in the Investigation, the con-

FIG. 97. Mortality of Children 1–4 Years of Age with Congenital Anomalies as Underlying or Associated Causes or as Minor Anomalies in 15 Projects.



genital hernias as well as a few other anomalies have been added to those in Section XIV. However, these additions are not sufficient to explain the differences between the data for the countries as a whole and those for the projects. The findings of the Investigation are probably more complete than the information hitherto available.

Of the 7,493 deceased children 1–4 years of age, 444 or 5.9 per cent were found to have at least one anomaly, which gave a rate of 26.9 per 100,000 population in that age group. The variation was from 18.8 to 61.7 per 100,000 (Figure 97) in 14 of the projects. As in the case of infants, the death rate in Bolivia was very low (11.4). The comparison of the 1967 rates as underlying causes for five countries (WHO, 1971) and for the seven projects of the Investigation is as follows:

WHO data, 1967		*Investigation*	
Canada	12.5	Sherbrooke	9.4
Chile	5.9	Chile project	17.9
Colombia	5.4	Cali	14.8
		Cartagena	20.3
		Medellín	28.2
Mexico	4.1	Monterrey	15.3
United States	9.7	California project	13.7

The rates obtained in the Investigation in this age period were higher in all projects except that in Sherbrooke. (The experience in that project was small, and variations would be expected to occur from year to year; there were only seven deaths of children 1–4 years of age with an anomaly as underlying cause.) The findings of the Investigation are providing more complete and reliable information regarding the important problem of congenital anomalies than that available from the official reports of countries.

DIAGNOSTIC EVIDENCE

The completeness of the information on congenital anomalies depends in part on the diagnostic evidence available. Table 102 shows the type of evidence obtained for the anomalies assigned as underlying causes of death in 1,948 infants and children 1–4 years of age. Out of this number, autopsies had been performed on 544 or 27.9 per cent, a proportion that was much higher than that for deaths from all causes (16.9 per cent). Clinical information only was available for 64.7 per cent. Relatively few anomalies were included as underlying causes on the basis of medical interviews only (80

TABLE 102. Evidence for Diagnosis of Congenital Anomalies as Underlying Causes of Death in Children Under 5 Years of Age in 15 Projects.

Project	Total	Clinical and autopsy		Clinical only		Autopsy only		Medical interview only		Death certificate or other record	
		No.	%	No.	%	No.	%	No.	%	No.	%
Total	1,948	404	20.7	1,260	64.7	140	7.2	80	4.1	64	3.3
ARGENTINA											
Chaco Province	60	5	8.3	43	71.7	3	5.0	3	5.0	6	10.0
San Juan Province	103	21	20.4	72	69.9	7	6.8	3	2.9	—	—
BOLIVIA project	54	3	5.6	39	72.2	2	3.7	5	9.3	5	9.3
BRAZIL											
Recife	126	9	7.1	73	57.9	24	19.0	11	8.7	9	7.1
Ribeirão Prêto	79	16	20.3	59	74.7	2	2.5	2	2.5	—	—
São Paulo	249	30	12.0	201	80.7	18	7.2	—	—	—	—
CANADA											
Sherbrooke	108	45	41.7	58	53.7	5	4.6	—	—	—	—
CHILE project	206	34	16.5	153	74.3	10	4.9	3	1.5	6	2.9
COLOMBIA											
Cali	71	10	14.1	53	74.6	3	4.2	2	2.8	3	4.2
Cartagena	73	17	23.3	43	58.9	8	11.0	1	1.4	4	5.5
Medellín	90	5	5.6	79	87.8	—	—	4	4.4	2	2.2
EL SALVADOR project	137	18	13.1	97	70.8	3	2.2	18	13.1	1	0.7
JAMAICA											
Kingston-St. Andrew	165	64	38.8	57	34.5	21	12.7	15	9.1	8	4.8
MEXICO											
Monterrey	255	15	5.9	206	80.8	1	0.4	13	5.1	20	7.8
UNITED STATES											
California project	172	112	65.1	27	15.7	33	19.2	—	—	—	—

deaths or 4.1 per cent) and even fewer on the basis of death certificates or other limited record (64 deaths or 3.3 per cent).

The frequency of the diagnoses depends in part on the seriousness of the anomalies and also on visible signs; for example, it is probable that nearly all the deaths due to anencephalus or other serious anomalies of the nervous system were diagnosed (except those for non-registered deaths of infants born at home). Also, nearly all those with definite manifestations of Down's disease were detected, while certain congenital defects of the heart and circulatory system might have been missed or not clearly specified in the absence of postmortem examination.

In assigning associated causes, frequently more than one anomaly of the circulatory system was classified, this being especially true in the California project.

The total numbers of anomalies classified as underlying or associated causes (categories 740–759 of the *International Classification*) are given in the Appendix tables. In this chapter the analysis of these data is in terms of deceased children with specific types of anomalies. In addition to anomalies classified in categories 740–759, other congenital abnormalities in categories 550, 551 (congenital hernias), in 524 (congenital dento-facial anomalies), as well as in 605 (congenital redundant prepuce and phimosis) have been included in tables of this chapter. Such additions have been recommended for inclusion in the section on congenital anomalies in the 1975 Revision of the *International Classification.*

TABLE 103. Number of Deceased Infants[a] with Specific Congenital Anomalies as Cause of Death or as Minor Anomaly in 15 Projects.

Project	Anencephalus[b] (740)				Spina bifida[b] (741)				Others of nervous system (742,743)				Eye (744)				Ear, face, and neck (745)			
	Total		Cause of death	Minor anomaly	Total		Cause of death	Minor anomaly	Total		Cause of death	Minor anomaly	Total		Cause of death	Minor anomaly	Total		Cause of death	Minor anomaly
	No.	Rate	No.	No.	No.	Rate	No.	No.	No.	Rate	No.	No.	No.	Rate	No.	No.	No.	Rate	No.	No.
Total	95	20.0	95	—	208	43.9	203	5	231	48.7	213	18	50	10.5	2	48	91	19.2	3	88
ARGENTINA, Chaco Province	1	5.7	1	—	5	28.4	5	—	8	45.5	6	2	—	—	—	—	1	5.7	—	1
San Juan Province	3	12.8	3	—	11	47.1	10	1	9	38.5	8	1	4	17.1	—	4	4	17.1	—	4
BOLIVIA project	1	2.7	1	—	5	13.3	5	—	1	2.7	1	—	1	2.7	—	1	5	13.3	—	5
BRAZIL, Recife	5	16.4	5	—	9	29.6	9	—	22	72.4	22	—	3	9.9	—	3	2	6.6	—	2
Ribeirão Prêto	2	11.0	2	—	3	16.4	3	—	10	54.8	8	2	5	27.4	—	5	2	11.0	—	2
São Paulo	9	15.5	9	—	22	37.8	21	1	39	67.1	36	3	8	13.8	—	8	12	20.6	—	12
CANADA, Sherbrooke	18	106.1	18	—	19	112.0	19	—	5	29.5	5	—	1	5.9	—	1	—	—	—	—
CHILE project	4	9.2	4	—	16	36.7	16	—	28	64.2	26	2	4	9.2	—	4	18	41.3	1	17
COLOMBIA, Cali	2	9.5	2	—	6	28.4	6	—	8	37.9	7	1	6	28.4	1	5	6	28.4	2	4
Cartagena	1	5.6	1	—	3	16.8	3	—	10	55.9	10	—	2	11.2	—	2	3	16.8	—	3
Medellín	1	5.2	1	—	5	25.8	4	1	11	56.7	11	—	3	15.5	1	2	10	51.5	—	10
EL SALVADOR project	8	25.8	8	—	40	128.9	40	—	14	45.1	14	—	1	3.2	—	1	8	25.8	—	8
JAMAICA, Kingston-St. Andrew	3	7.3	3	—	7	17.0	6	1	20	48.8	18	2	3	7.3	—	3	3	7.3	—	3
MEXICO, Monterrey	20	37.7	20	—	49	92.3	48	1	27	50.9	26	1	5	9.4	—	5	12	22.6	—	12
U.S., California project	17	38.0	17	—	8	17.9	8	—	19	42.5	15	4	4	8.9	—	4	5	11.2	—	5

Project	Heart (746)				Others of circulatory system (747)				Respiratory system (748)				Cleft palate and cleft lip (749)				Others upper alimentary tract (524, 750)			
	Total		Cause of death	Minor anomaly	Total		Cause of death	Minor anomaly	Total		Cause of death	Minor anomaly	Total		Cause of death	Minor anomaly	Total		Cause of death	Minor anomaly
	No.	Rate	No.	No.	No.	Rate	No.	No.	No.	Rate	No.	No.	No.	Rate	No.	No.	No.	Rate	No.	No.
Total	863	182.0	841	22	198	11.8	165	33	71	15.0	57	14	167	35.2	138	29	138	29.1	96	42
ARGENTINA, Chaco Province	21	119.3	21	—	1	5.7	1	—	2	11.4	2	—	12	68.2	11	1	3	17.0	3	—
San Juan Province	51	218.3	50	1	3	12.8	3	—	1	4.3	1	—	17	72.8	15	2	4	17.1	3	1
BOLIVIA project	20	53.2	19	1	—	—	—	—	5	13.3	3	2	8	21.3	8	—	5	13.3	5	—
BRAZIL, Recife	64	210.5	62	2	6	19.7	5	1	—	—	—	—	7	23.0	6	1	11	36.2	9	2
Ribeirão Prêto	37	202.9	36	1	6	32.9	5	1	3	16.4	3	—	4	21.9	4	—	10	54.8	9	1
São Paulo	135	232.1	132	3	25	43.0	18	7	7	12.0	4	3	24	41.3	16	8	22	37.8	13	9
CANADA, Sherbrooke	40	235.7	40	—	22	129.6	20	2	8	47.1	8	—	3	17.7	3	—	6	35.4	4	2
CHILE project	88	201.9	88	—	13	29.8	9	4	7	16.1	4	3	18	41.3	15	3	16	36.7	11	5
COLOMBIA, Cali	43	203.8	42	1	9	42.7	8	1	—	—	—	—	4	19.0	4	—	5	23.7	5	—
Cartagena	33	184.4	30	3	9	50.3	8	1	1	5.6	—	1	7	39.1	7	—	3	16.8	1	2
Medellín	35	180.4	35	—	4	20.6	2	2	1	5.2	1	—	14	72.2	14	—	5	25.8	3	2
EL SALVADOR project	50	161.2	49	1	7	22.6	7	—	2	6.4	1	1	14	45.1	11	3	12	38.7	5	7
JAMAICA, Kingston-St. Andrew	68	166.0	64	4	26	63.5	22	4	3	7.3	3	—	4	9.8	3	1	9	22.0	7	2
MEXICO, Monterrey	104	196.2	104	—	3	5.7	2	1	5	9.4	4	1	17	32.1	14	3	17	32.1	12	5
U.S., California project	74	165.4	69	5	64	143.0	55	9	26	58.1	23	3	14	31.3	7	7	10	22.4	6	4

Project	Congenital hernia (550, 551)				Others of digestive system (751)				Genito-urinary system (752, 753)				Redundant prepuce, phimosis (605)				Clubfoot (754)			
	Total		Cause of death	Minor anomaly	Total		Cause of death	Minor anomaly	Total		Cause of death	Minor anomaly	Total		Cause of death	Minor anomaly	Total		Cause of death	Minor anomaly
	No.	Rate	No.	No.	No.	Rate	No.	No.	No.	Rate	No.	No.	No.	Rate	No.	No.	No.	Rate	No.	No.
Total	261	55.1	92	169	300	63.3	263	37	347	73.2	127	220	51	10.8	15	36	178	37.5	3	175
ARGENTINA, Chaco Province	8	45.5	5	3	6	34.1	4	2	3	17.0	2	1	—	—	—	—	3	17.0	—	3
San Juan Province	23	98.5	7	16	21	89.9	19	2	21	89.9	6	15	2	8.6	1	1	17	72.8	—	17
BOLIVIA project	9	23.9	3	6	19	50.5	19	—	16	42.5	3	13	—	—	—	—	3	8.0	—	3
BRAZIL, Recife	21	69.1	13	8	20	65.8	19	1	31	102.0	11	20	6	19.7	4	2	7	23.0	—	7
Ribeirão Prêto	8	43.9	6	2	13	71.3	12	1	8	43.9	3	5	—	—	—	—	5	27.4	—	5
São Paulo	63	108.3	15	48	35	60.2	30	5	54	92.8	9	45	26	44.7	5	21	19	32.7	1	18
CANADA, Sherbrooke	5	29.5	4	1	13	76.6	10	3	15	88.4	10	5	1	5.9	—	1	10	58.9	—	10
CHILE project	35	80.3	9	26	33	75.7	27	6	13	29.8	3	10	—	—	—	—	27	62.0	—	27
COLOMBIA, Cali	12	56.9	8	4	8	37.9	8	—	8	37.9	2	6	2	9.5	2	—	6	28.4	—	6
Cartagena	10	55.9	2	8	12	67.0	11	1	11	61.5	5	6	3	16.8	1	2	9	50.3	—	9
Medellín	9	46.4	—	9	17	87.6	16	1	11	56.7	—	11	—	—	—	—	8	41.2	—	8
EL SALVADOR project	21	67.7	5	16	15	48.4	13	2	28	90.3	6	22	2	6.4	—	2	15	48.4	1	14
JAMAICA, Kingston-St. Andrew	7	17.1	4	3	24	58.6	23	1	31	75.7	19	12	—	—	—	—	9	22.0	—	9
MEXICO, Monterrey	17	32.1	5	12	37	69.8	34	3	46	86.8	10	36	8	15.1	2	6	25	47.2	—	25
U.S., California project	13	29.1	6	7	27	60.3	18	9	51	114.0	38	13	1	2.2	—	1	15	33.5	1	14

Project	Others of musculoskeletal system (755, 756)				Skin, hair, and nails (757)				Others and unspecified (758)				Down's disease (759.3)				Others of multiple systems (rest of 759)			
	Total		Cause of death	Minor anomaly	Total		Cause of death	Minor anomaly	Total		Cause of death	Minor anomaly	Total		Cause of death	Minor anomaly	Total		Cause of death	Minor anomaly
	No.	Rate	No.	No.	No.	Rate	No.	No.	No.	Rate	No.	No.	No.	Rate	No.	No.	No.	Rate	No.	No.
Total	370	78.1	109	261	17	3.6	6	11	61	12.9	24	37	300	64.6	306	--	70	14.8	65	5
ARGENTINA, Chaco Province	4	22.7	—	4	—	—	—	—	—	—	—	—	8	45.5	8	—	—	—	—	—
San Juan Province	23	98.5	7	16	1	4.3	—	1	1	4.3	—	1	11	59.9	14	—	2	8.6	2	—
BOLIVIA project	5	13.3	2	3	1	2.7	—	1	3	8.0	—	3	7	18.6	7	—	—	—	—	—
BRAZIL, Recife	21	69.1	9	12	3	9.9	—	3	8	26.3	6	2	19	62.5	19	—	5	16.4	5	—
Ribeirão Prêto	14	76.8	8	6	—	—	—	—	1	5.5	—	1	14	76.8	14	—	1	5.5	—	1
São Paulo	46	79.1	9	37	5	8.6	1	4	4	6.9	1	3	34	58.5	34	—	5	8.6	4	1
CANADA, Sherbrooke	15	88.4	6	9	—	—	—	—	4	23.6	3	1	8	47.1	8	—	2	11.8	2	—
CHILE project	50	114.7	14	36	3	6.9	2	1	3	6.9	1	2	42	96.4	42	—	12	27.5	12	—
COLOMBIA, Cali	11	52.1	1	10	—	—	—	—	1	4.7	—	1	10	47.4	10	—	1	4.7	1	—
Cartagena	11	61.3	1	10	1	5.6	1	—	—	—	—	—	20	111.7	20	—	1	5.6	1	—
Medellín	20	103.1	4	16	—	—	—	—	1	5.2	1	—	19	97.9	19	—	5	25.8	4	1
EL SALVADOR project	32	103.2	9	23	1	3.2	—	1	2	6.4	—	2	22	70.9	22	—	2	6.4	2	—
JAMAICA, Kingston-St. Andrew	35	85.4	9	26	1	2.4	1	—	2	4.9	1	1	27	65.9	27	—	13	31.7	11	2
MEXICO, Monterrey	37	69.8	11	26	—	—	—	—	3	5.7	2	1	47	88.7	47	—	14	26.4	14	—
U.S., California project	46	102.8	19	27	1	2.2	1	—	28	62.6	9	19	15	33.5	15	—	7	15.6	7	—

[a] Rates per 100,000 live births.
[b] Sherbrooke project had 4 deaths and Medellín, El Salvador, and California projects had one each with 740 as underlying cause and also 741 as associated cause.

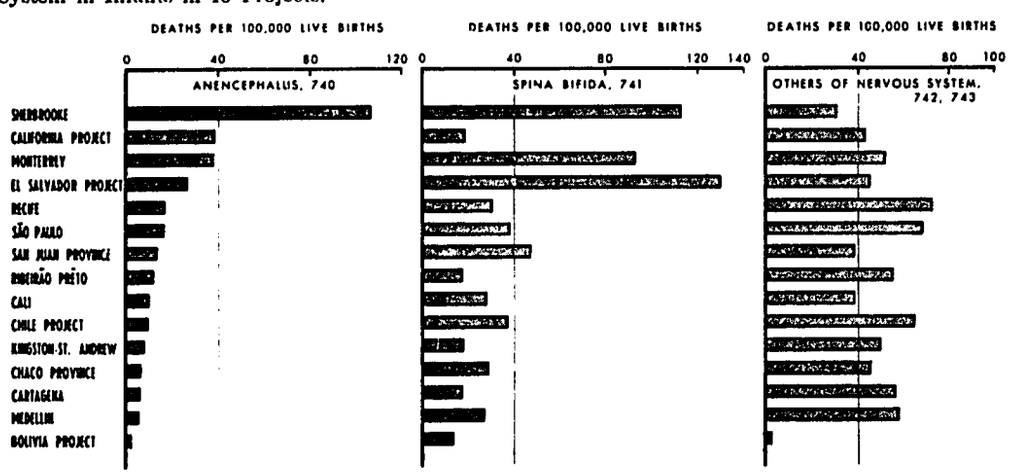
SPECIFIC CONGENITAL ANOMALIES

The numbers of deaths in which 20 specific anomalies or groups of anomalies were diagnosed are given in Table 103. Duplication within these 20 groups has been eliminated for this presentation. Even though two or more distinct anomalies within one system may have been diagnosed and coded —e.g., in the heart (categories 746.2 and 746.3, etc.) or in the musculoskeletal system (categories 755, 756)—only one was used in order that the data may be compared with those published by other authors. Publications such as the WHO study (Stevenson *et al.*, 1966) usually refer to infants with anomalies or deaths due to anomalies even though there are multiple anomalies. The distinction is made here between an anomaly assigned as an underlying or associated cause or as a minor anomaly only. For example, anencephalus (740) is incompatible with survival and thus was always an underlying cause, and Down's disease was always either an underlying or an associated cause. However, the reverse was noted for anomalies of the eye (744), ear, face and neck (745), and many of the digestive, genital and musculoskeletal systems, which were frequently found as minor anomalies.

ANOMALIES OF THE NERVOUS SYSTEM

Unexpected high frequencies of anomalies of the nervous system were found in deceased infants in three projects: Sherbrooke in Canada, Monterrey in Mexico, and El Salvador. The death rates from anencephalus (740), spina bifida (741), and other anomalies of the nervous system (742, 743) are shown in Figure 98.

FIG. 98. Mortality from Anencephalus, Spina Bifida, and Other Congenital Anomalies of Nervous System in Infants in 15 Projects.



The rate for anencephalus in Sherbrooke was 106.1 per 100,000 live births, which was almost three times the rate in the California project (38.0) and in Monterrey (37.7). The rate in El Salvador was 25.8, while for all others it was less than 20 per 100,000 live births.

For spina bifida three projects had high rates, the highest being that of 128.9 per 100,000 live births in El Salvador, followed by 112.0 in Sherbrooke and 92.4 in Monterrey. These rates were significantly higher than those in all other projects.

In Sherbrooke four infants with anencephalus had spina bifida as an associated cause. Also there was one such death in each of the projects in El Salvador, Medellín, and California.

Anomalies of the nervous system are usually serious, and of the 511 deceased infants with such conditions, in 419 or 82.0 per cent they were underlying causes and in 70 (13.7 per cent) associated causes (Table 104). In only 22 deceased infants (4.3 per cent) were such anomalies considered minor. In the Sherbrooke and El Salvador projects (as well as in three others) all of these anomalies were classed as underlying or associated causes.

In the rural *municipios* of El Salvador there were 18 infants with anomalies of the nervous system, which gave a rate of 333.3 per 100,000 live births (Table 105). The rate for the city of San Salvador was less than half as high—156.1—and the difference is significant. Though the numbers are

TABLE 104. Deaths[a] of Infants with Congenital Anomalies of Nervous System as Underlying or Associated Causes or as Minor Anomalies in 15 Projects.

Project	Total[b]		Underlying cause		Associated cause		Minor anomaly	
	No.	Rate	No.	Rate	No.	Rate	No.	Rate
Total	511	107.8	419	88.4	70	14.8	22	4.6
ARGENTINA								
Chaco Province	14	79.5	9	51.1	3	17.0	2	11.4
San Juan Province	23	98.5	19	81.3	2	8.6	2	8.6
BOLIVIA project	7	18.6	7	18.6	—	—	—	—
BRAZIL								
Recife	36	118.4	31	102.0	5	16.4	—	—
Ribeirão Prêto	15	82.2	12	65.8	1	5.5	2	11.0
São Paulo	68	116.9	52	89.4	12	20.6	4	6.9
CANADA								
Sherbrooke	38	223.9	36	212.1	2	11.8	—	—
CHILE project	47	107.8	37	84.9	8	18.4	2	4.6
COLOMBIA								
Cali	16	75.8	12	56.9	3	14.2	1	4.7
Cartagena	14	78.2	11	61.5	3	16.8	—	—
Medellín	14	72.2	10	51.5	3	15.5	1	5.2
EL SALVADOR project	58	187.0	47	151.5	11	35.5	—	—
JAMAICA								
Kingston-St. Andrew	30	73.2	24	58.6	3	7.3	3	7.3
MEXICO								
Monterrey	91	171.7	80	150.9	9	17.0	2	3.8
UNITED STATES								
California project	40	89.4	32	71.5	5	11.2	3	6.7

[a] Rates per 100,000 live births.
[b] Several infants had more than one type of anomaly of the nervous system and the totals in this table are smaller than the totals for the three types of anomalies of the nervous system shown in Table 103.

TABLE 105. Deaths of Infants[a] with Congenital Anomalies of Nervous System in Urban and Rural Areas of El Salvador Project.

Area	Infants with anomalies[b]		Anencephalus (740)		Spina bifida (741)		Other of nervous system (742, 743)	
	No.	Rate	No.	Rate	No.	Rate	No.	Rate
San Salvador	40	156.1	6	23.4	29	113.2	8	31.2
Rural *municipios*	18	333.3	2	37.0	11	203.7	6	111.1

[a] Rates per 100,000 live births.
[b] Four infants had two anomalies.

small, this is a valuable clue for research into the causation of these serious anomalies. It may be, for example, that there is something lacking in the diet in the rural *municipios* and that the deficiency of that element is greater than in the city. The Investigation was very well conducted in El Salvador even though the diagnostic facilities were limited in the rural *municipios*. Therefore, this may represent the most complete data collected in an area known to have an unusually high frequency of serious nutritional deficiency. It has been known for some time that certain antimetabolites produce teratogenic effects through nutritional or toxic mechanisms. Such is the case of Aminopterin (4-amino-pteroylglutamic acid), an antimetabolite of folic acid used in the treatment of leukemia, which has been known to produce cleft lip and cleft palate, hydrocephalus, anencephalus, and encephalocele as observed in embryos and fetuses of women who have used that drug as an abortive (Thiersch, 1956; Warkany *et al.*, 1959). The question remains whether there is a possibility that chronic deficiency of nutrients such as folic acid, operating perhaps through various generations, could be responsible for increased frequency of these serious anomalies. If the health status of the mother was altered by nutritional deficiency, such damage might be transmitted to her children. Excessive death rates for protein malnutrition in deceased children were found in the El Salvador project, as was shown in Chapter IX (Nutritional Deficiency). The data surely indicate the need for further research in this field.

Because of the probable importance of age of the mother at birth of child as a determining factor, data on maternal age are presented for infant deaths from congenital anomalies of the nervous system (Table 106).

For seven projects the distributions of live births were available for use in calculation of death rates by age of mother (Table 107). Fortunately, three of these projects are the ones with unusual frequencies of anomalies of the nervous system.

The death rates for these anomalies in Sherbrooke were high in infants of young mothers and declined in the older mothers. In El Salvador the rate was high for young mothers but even higher for mothers aged 35 years and over (Figure 99). Thus the patterns of mortality in these two projects appear to differ. In the El Salvador project the rate was high due to spina bifida, while in Sherbrooke the rate was high for that condition as well as for anencephalus. It is possible that the causative agents of anencephalus and spina bifida differ also. The pattern in Monterrey is similar to that

TABLE 106. Deaths of Infants with Congenital Anomalies of Nervous System by Age of Mother in 15 Projects.

Project	Total	Under 20 years	20–24 years	25–29 years	30–34 years	35 years and over	Unknown
Total	511	68	154	108	77	73	31
ARGENTINA							
Chaco Province	14	5	4	4	1	—	—
San Juan Province	23	1	8	3	8	3	—
BOLIVIA project	7	—	1	2	2	1	1
BRAZIL							
Recife	36	6	10	8	—	8	4
Ribeirão Prêto	15	—	8	3	2	1	1
São Paulo	68	7	24	15	11	9	2
CANADA							
Sherbrooke	38	3	18	10	5	2	—
CHILE project	47	6	14	10	8	8	1
COLOMBIA							
Cali	16	4	4	3	1	2	2
Cartagena	14	—	4	1	—	4	5
Medellín	14	2	3	2	1	3	3
EL SALVADOR project	58	12	16	9	9	12	—
JAMAICA							
Kingston-St. Andrew	30	4	10	6	4	4	2
MEXICO							
Monterrey	91	10	18	20	20	14	9
UNITED STATES							
California project	40	8	12	12	5	2	1

in El Salvador; here the death rate was high for mothers aged 30–34 years, and there was a slight decline in the oldest age group. The differences in patterns in the four projects with relatively low rates may be due to the small numbers.

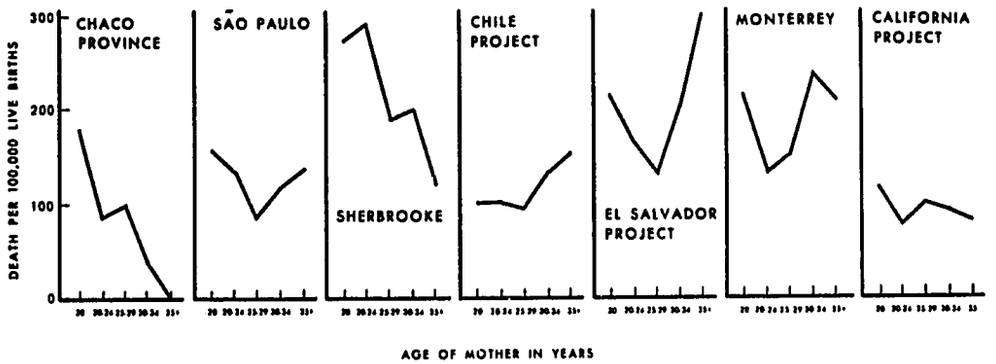
Data were also available for analysis of mortality from anomalies of the nervous system by infant's birth order in four projects (Table 108). Though the numbers of deaths were small in three of these projects, in one—Monterrey—there were 91 deaths. In this project the death rate increased from 94.3 per 100,000 live births for first births to a rate of 258.4, or more than two and one half times greater, for births of

TABLE 107. Mortality[a] of Infants with Congenital Anomalies of Nervous System by Age of Mother in Seven Projects.

Age of mother	ARGENTINA Chaco Province	BRAZIL São Paulo	CANADA Sherbrooke	CHILE project	EL SALVADOR project	MEXICO Monterrey	UNITED STATES California project
Total	79.5	110.9	223.9	107.8	187.0	171.7	89.4
Under 20 years	177.1	153.6	267.7	98.0	211.3	210.9	115.7
20–24 years	84.7	132.7	287.4	99.9	163.6	131.7	74.7
25–29 years	95.6	86.9	186.0	91.0	128.5	145.5	96.4
30–34 years	37.0	111.9	197.3	128.7	199.4	229.6	90.3
35 years and over	—	133.9	119.3	150.4	297.0	202.8	74.9

[a] Rates per 100,000 live births.

FIG. 99. Mortality of Infants with Congenital Anomalies of Nervous System by Age of Mother in Seven Projects.



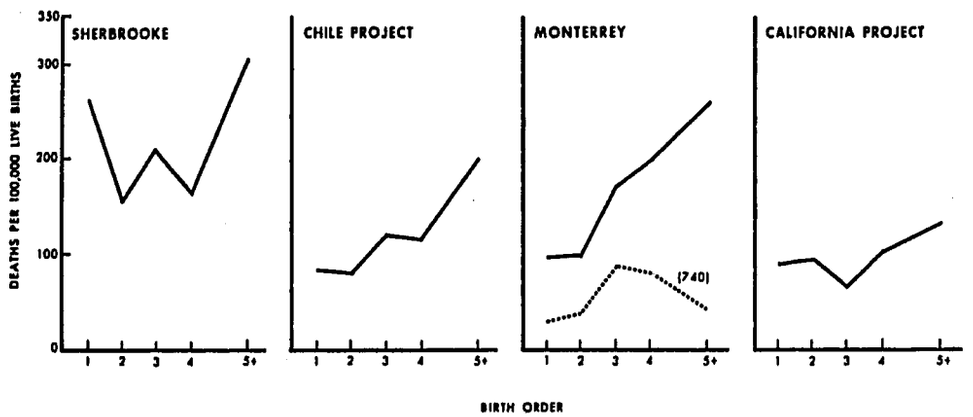
fifth or higher orders (Figure 100). In Sherbrooke the rates were high both for first births and for fifth or later births, though in the latter group there were only six deaths. In this project 18 of the 38 deaths from congenital anomalies of the nervous system as underlying or associated causes were due to anencephalus.

According to McKeown (1961) in his comments on anencephalus in Birmingham, England, an increased incidence in first-born children and a slight increase with maternal age were found. In Monterrey, where the death rate for congenital anomalies of the nervous system increased with birth order, only 20 deaths were due to anencephalus, the rest being due to spina bifida and other anomalies. There is a pos-

TABLE 108. Mortality of Infants with Congenital Anomalies of Nervous System by Birth Order in Four Projects.

Birth order	CANADA Sherbrooke	CHILE project	MEXICO Monterrey	UNITED STATES California project
	Number			
Total	38	47	91	40
1	18	12	10	17
2	7	8	8	12
3	5	7	12	4
4	2	4	11	3
5 and over	6	14	40	4
Unknown	—	2	10	—
	Rates per 100,000 live births			
Total	223.9	107.8	171.7	89.4
1	262.6	81.4	94.3	88.0
2	154.8	77.1	95.2	92.5
3	208.0	116.7	169.2	63.1
4	164.4	114.2	196.2	99.5
5 and over	304.1	197.3	258.4	129.7

FIG. 100. Mortality of Infants with Congenital Anomalies of Nervous System[a] by Birth Order in Four Projects.



[a] Monterrey rates shown also for anencephalus.

sibility that the death rates by birth order are different for these two types of anomalies of the nervous system. In Figure 100 the rate for anencephalus (category 740) is shown for Monterrey, although it is based only on small numbers; this rate did not increase for fifth and later births.

For El Salvador, the numbers of deaths from anencephalus and other anomalies of the nervous system by birth order are given in Table 109 (even though the base for rates, live births by birth order, is not available). Seventeen of the 58 deaths were of first-born infants and 16 others were of fifth or higher birth orders. Both El Salvador and Monterrey have high birth rates and thus many births are of high birth order. While the cause of these anomalies is not known, the data are sufficient to show that many of these deceased infants were of high birth orders. In Monterrey, 15 of the deaths (16.5 per cent) were of infants of the ninth or

TABLE 109. Number of Deaths from Congenital Anomalies of Nervous System by Type and by Birth Order in Monterrey and El Salvador Projects.

Birth order	Monterrey			El Salvador project		
	Total	Anencephalus	Others of nervous system	Total	Anencephalus	Others of nervous system
Total	91	20	71	58	8	50
1	10	2	8	17	3	14
2	8	2	6	9	2	7
3	12	4	8	8	—	8
4	11	3	8	8	1	7
5	4	—	4	3	—	3
6	8	1	7	3	2	1
7	9	1	8	3	—	3
8	4	1	3	4	—	4
9 and over	15	1	14	3	—	3
Unknown	10	5	5	—	—	—

higher order, which is indicative of an unusual frequency in such orders.

The unusually high death rates for anencephalus in Belfast, Ireland (Stevenson and Warnock, 1959) have been known for many years, and Stevenson *et al.* (1966) also found evidence of high frequency in Alexandria, Egypt, as well as many cases in Bombay, India, and in one of the hospitals in Mexico City. In their study (1966) stillbirths and live births were combined in the analyses. From the tabulation of their cases it is possible to obtain the number of anomalies of the nervous system in those born alive and to calculate rates. In the Belfast series of 27,138 live births there were 145 infants with anomalies of the nervous system, or a rate of 534.3 per 100,000 live births, which is much higher than that found in any of the projects in the Investigation. However, in Belfast the number of stillbirths with anomalies of the nervous system, principally anencephalus, was practically the same as the number of those born alive with such anomalies (146 stillbirths and 145 live births). In the series in Egypt the number of live-born infants with such anomalies was 12, or 136.2 per 100,000 live births, which is lower than the rates in three projects of the Investigation. However, there were in addition 64 fetal deaths with those conditions, which indicated a high total frequency of anomalies of the nervous system. The same unequal distribution of these anomalies of the nervous system (64 fetal deaths to 12 live births) may be occurring in other areas. Thus measurement of this serious problem requires thorough investigation of both fetal deaths and live births.

The data on those born alive with anomalies of the nervous system in six cities in the Americas, presented in Table 110, were obtained from basic tabulations in the WHO study (Stevenson *et al.*, 1966). Three cities—São Paulo, Mexico City, and Panama—appeared to have similar rates, and

TABLE 110. Mortality[a] from Congenital Malformations[b] Diagnosed in Single Live Births in Hospitals in Latin America in WHO Study Conducted in 1961–1964.

City	Single live births	Total malformed		Central nervous system								Down's disease A		Heart and great vessels D	
				Total		Anencephalus B1 and B2		Spina bifida B4, 5, 6		Other B3, 7, C					
		No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate
BRAZIL															
São Paulo	13,910	198	1,423.4	20	143.8	2	14.4	14	100.6	4	28.8	7	50.3	9	64.7
CHILE															
Santiago	23,085	213	922.7	23	99.6	4	17.3	12	52.0	7	30.3	37	160.3	3	13.0
COLOMBIA															
Bogotá	18,408	308	1,673.2	19	103.2	—	—	2	10.9	17	92.4	10	54.3	9	48.9
Medellín	20,191	217	1,074.7	11	54.5	4	19.8	4	19.8	3	14.9	18	89.1	17	84.2
MEXICO															
Mexico City[c]	38,390	488	1,271.2	60	156.3	16	41.7	29	75.5	15	39.1	68	177.1	30	78.1
PANAMA															
Panama City	15,574	306	1,964.8	24	154.1	5	32.1	10	64.2	9	57.8	15	96.3	2	12.8

[a] Rates per 100,000 live births.
[b] The Codes A–D used in the Basic Tabulations are given.
[c] Two hospitals of Mexican Institute of Social Security.
Source: Stevenson *et al.* (1966). Basic Tabulations of Comparative Study of Congenital Malformations of WHO.

they were slightly lower than the total rates obtained in the Investigation in the projects in El Salvador and Monterrey. Since in the WHO prospective study a record was made for each birth and the data were restricted to hospital births, and as some of the infants with anomalies of the nervous system were living, the rates would be expected to be higher than those for deceased infants in the general population, as in the case of the Investigation.

The Investigation findings for Sherbrooke, Monterrey, and El Salvador certainly indicate an important field for further research into specific cause or causes. Moreover, the results of the WHO study indicate the value of a prospective study in which each product of conception is examined and the findings are analyzed in terms of fetal deaths as well as live births, since these anomalies of the nervous system may be found frequently in those dying before delivery. At the same time the value of differentiating the findings in those born alive is stressed, since such data should be more complete and comparable. Knowledge of the frequency of these anomalies in both fetal deaths and live births is essential for studies of causation and hence for preventive measures.

In the California project, in two-thirds of the deceased infants with anomalies of the central nervous system, anomalies of other systems were diagnosed also (Table

TABLE 111. Additional Congenital Anomalies in Association with Those of Central Nervous System in Deceased Infants in 15 Projects.

Project	Total with anomalies of nervous system	Number with additional anomalies		Additional anomalies									
				Musculo-skeletal system (754–756)		Digestive system[a,b]		Genito-urinary system (752, 753)		Circulatory system (746, 747)		Other[b]	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Total	511	178	34.8	110	21.5	61	11.9	33	6.5	27	5.3	48	9.4
ARGENTINA													
Chaco Province	14	3	21.4	2	14.3	—	—	—	—	1	7.1	—	—
San Juan Province	23	7	30.4	5	21.7	2	8.7	—	—	2	8.7	—	—
BOLIVIA project	7	2	#	2	#	—	—	—	—	—	—	1	#
BRAZIL													
Recife	36	11	30.6	6	16.7	3	8.3	1	2.8	3	8.3	1	2.8
Ribeirão Prêto	15	3	20.0	1	6.7	1	6.7	—	—	1	6.7	1	6.7
São Paulo	68	20	29.4	13	19.1	7	10.3	1	1.5	2	2.9	3	4.4
CANADA													
Sherbrooke	38	16	42.1	13	34.2	4	10.5	2	5.3	2	5.3	3	7.9
CHILE project	47	21	44.7	10	21.3	7	14.9	2	4.3	2	4.3	10	21.3
COLOMBIA													
Cali	16	4	25.0	3	18.8	—	—	1	6.2	1	6.2	2	12.5
Cartagena	14	5	35.7	3	21.4	2	14.3	1	7.1	—	—	1	7.1
Medellín	14	7	50.0	4	28.6	2	14.3	—	—	1	7.1	1	7.1
EL SALVADOR project	58	12	20.7	11	19.0	2	3.4	4	6.9	1	1.7	2	3.4
JAMAICA													
Kingston-St. Andrew	30	9	30.0	6	20.0	4	13.3	3	10.0	1	3.3	3	10.0
MEXICO													
Monterrey	91	31	34.1	20	22.0	11	12.1	11	12.1	2	2.2	6	6.6
UNITED STATES													
California project	40	27	67.5	11	27.5	16	40.0	7	17.5	8	20.0	14	35.0

[a] Categories 550, 551, 524, 749–751.
[b] More than one anomaly of the digestive system and in the group termed "other" may be included.
Per cent not calculated for base less than 10.

111). An explanation for this high proportion may be the completeness of the information recorded. In five other projects at least one-third of the deceased infants with anomalies of the nervous system had additional anomalies of other systems. Those most frequently found were in the musculoskeletal system: a total of 110, or 21.5 per 100 deaths of infants with anomalies of the nervous system.

DOWN'S DISEASE

Down's disease (trisomy 21) is a severe developmental disease affecting various systems and characterized by the presence of an extra, small chromosome conventionally termed No. 21. This congenital anomaly for which methods of prevention are currently being recommended is of special interest at this time.

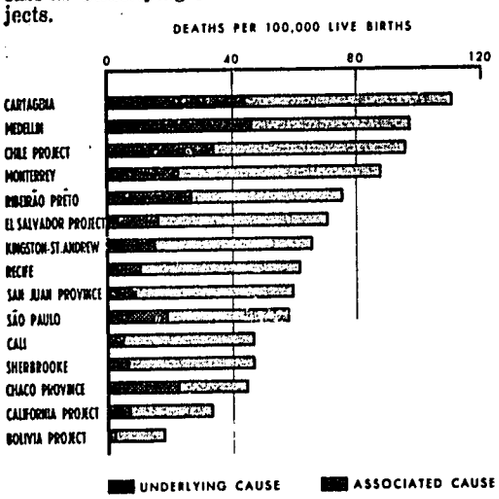
In the 15 projects there were 306 infant deaths due to this disease; in 86 it was underlying cause and in 220 associated cause (Table 112). As can be seen, use of the underlying cause alone would provide information on only 28.1 per cent of these deaths. The total rates in infancy varied from a low of 18.6 per 100,000 live births in the Bolivia project to 111.7 in Cartagena (Figure 101). The rates as underlying cause were highest in the two projects with the highest total rates (Cartagena and Medellín).

TABLE 112. Down's Disease as Underlying or Associated Cause of Death[a] in Children Under 5 Years, in Two Age Groups, in 15 Projects.

Project	Total		Underlying		Associated		Total		Underlying		Associated	
	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate
	Under 1 year						1–4 years					
Total	306	64.6	86	18.1	220	46.4	89	5.4	35	2.1	54	3.3
ARGENTINA												
Chaco Province	8	45.5	4	22.7	4	22.7	4	6.6	4	6.6	—	—
San Juan Province	14	59.9	2	8.6	12	51.4	4	4.8	—	—	4	4.8
BOLIVIA project	7	18.6	1	2.7	6	16.0	2	1.6	—	—	2	1.6
BRAZIL												
Recife	19	62.5	3	9.9	16	52.6	3	3.1	1	1.0	2	2.1
Ribeirão Prêto	14	76.8	5	27.4	9	49.3	4	6.1	2	3.1	2	3.1
São Paulo	34	58.5	11	18.9	23	39.5	9	4.8	2	1.1	7	3.7
CANADA												
Sherbrooke	8	47.1	1	5.9	7	41.2	4	5.4	4	5.4	—	—
CHILE project	42	96.4	15	34.4	27	62.0	11	6.6	5	3.0	6	3.6
COLOMBIA												
Cali	10	47.4	1	4.7	9	42.7	5	6.2	—	—	5	6.2
Cartagena	20	111.7	8	44.7	12	67.0	5	7.3	2	2.9	3	4.4
Medellín	19	97.9	9	46.4	10	51.5	9	12.1	3	4.0	6	8.0
EL SALVADOR project	22	70.9	5	16.1	17	54.8	5	5.2	3	3.1	2	2.1
JAMAICA												
Kingston-St. Andrew	27	65.9	6	14.6	21	51.3	13	9.1	6	4.2	7	4.9
MEXICO												
Monterrey	47	88.7	12	22.6	35	66.0	6	3.5	1	0.6	5	2.9
UNITED STATES												
California project	15	33.5	3	6.7	12	26.8	5	3.1	2	1.2	3	1.9

[a] Rates under 1 year of age per 100,000 live births; others per 100,000 population.

FIG. 101. Mortality of Infants with Down's Disease as Underlying or Associated Cause in 15 Projects.



Medellín and São Paulo had rates similar in size to those found in the WHO study (Stevenson *et al.*, 1966) (Table 110). However, the rates in that study for Santiago and Mexico City (160.3 and 177.1 per 100,000 live births) were higher than those of the Chile and Monterrey projects in the Investigation (96.4 and 88.7, respectively). Since many children with Down's disease do not die in infancy, the findings in the WHO study could be expected to be higher than those for deceased infants in the Investigation.

In the age group 1–4 years 89 deaths were due to Down's disease as underlying or associated cause. This represents 20.0 per cent of the deaths with congenital anomalies in this age group. Medellín, which had one of the highest rates for this disease in infancy, had the highest in this age group.

It is well known that older mothers are more frequently the ones who have a child with Down's disease. This was the case in the projects in the Investigation, as can be seen in Tables 113 and 114. Of the mothers with ages known, 138 out of 289 (or 47.8 per

TABLE 113. Deaths of Infants with Down's Disease as Underlying or Associated Cause by Age of Mother in 15 Projects.

Project	Total	Under 20 years	20–24 years	25–29 years	30–34 years	35 years and over	Unknown
Total	306	20	39	40	52	138	17
ARGENTINA							
Chaco Province	8	—	—	—	1	6	1
San Juan Province	14	—	2	3	1	8	—
BOLIVIA project	7	—	3	1	2	1	—
BRAZIL							
Recife	19	1	1	2	2	12	1
Ribeirão Prêto	14	—	1	2	3	6	2
São Paulo	34	2	6	5	8	12	1
CANADA							
Sherbrooke	8	—	1	—	1	6	—
CHILE project	42	2	4	7	8	21	—
COLOMBIA							
Cali	10	—	1	2	2	4	1
Cartagena	20	2	3	2	2	6	5
Medellín	19	3	1	1	4	10	—
EL SALVADOR project	22	—	3	3	5	11	—
JAMAICA							
Kingston-St. Andrew	27	2	4	5	5	10	1
MEXICO							
Monterrey	47	6	8	4	5	20	4
UNITED STATES							
California project	15	2	1	3	3	5	1

TABLE 114. Mortality[a] of Infants with Down's Disease as Underlying or Associated Cause by Age of Mother in Seven Projects.

Age of mother	ARGENTINA Chaco Province	BRAZIL São Paulo	CANADA Sherbrooke	CHILE project	EL SALVADOR project	MEXICO Monterrey	UNITED STATES California project
Total	45.5	58.5	47.1	96.4	70.9	88.7	33.5
Under 20 years	—	43.9	—	32.0	—	124.6	30.2
20–24 years	—	32.5	16.0	27.9	30.7	57.6	6.5
25–29 years	—	29.0	—	62.4	42.8	28.7	25.2
30–34 years	42.3	81.4	39.5	126.0	110.8	56.5	56.6
35 years and over	216.2	178.6	358.0	386.4	272.2	285.3	195.7

[a] Rates per 100,000 live births.

cent) were 35 years and over at birth of the child, and nearly two-thirds (63.8 per cent) were at least 30 years of age.

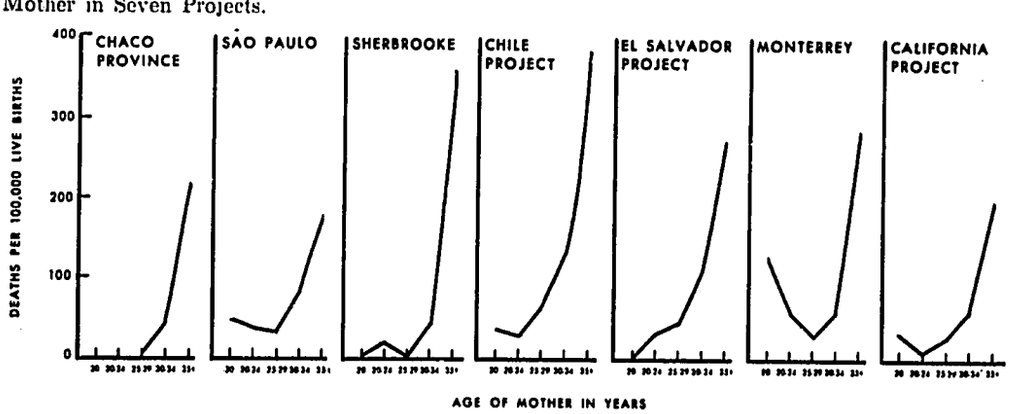
For infants of mothers aged 35 years and over, the death rates for Down's disease in seven projects (Figure 102) were very high, especially those in Sherbrooke and Chile, which were about two times those in São Paulo and California. Variations in patterns in the projects appear to be due in part to small numbers, as in Chaco Province and Sherbrooke. Monterrey, on the other hand, had a distinct pattern, with high rates in infants of young mothers and low rates for those of mothers 25–29 years of age.

When the data were combined for seven projects for which the distributions of live births by age of mother were available (the projects in Table 114) the following rates per 100,000 live births were obtained:

Under 20 years	38.8
20–24 years	28.1
25–29 years	30.9
30–34 years	77.1
35 years and over	266.6

The very high rate for infants of mothers aged 35 years and over reveals the great risk in that age group of having a child with Down's disease who dies in infancy—2.7 per 1,000 live births.

FIG. 102. Mortality of Infants with Down's Disease as Underlying or Associated Cause by Age of Mother in Seven Projects.



In the WHO study (Stevenson *et al.*, 1966) one half of infants with Down's disease (176 of 347) were born to mothers 35 years of age and over. In that study the rates were very low for infants of mothers aged 20–29 years, after which they increased rapidly, reaching extremely high levels for mothers aged 40 years and over. These rates per 1,000 total single births (fetal deaths and live births) were as follows:

Less than 15 years	*15–19 years*	*20–24 years*	*25–29 years*	*30–34 years*	*35–39 years*	*40–44 years*	*45 years and over*
0.30	0.50	0.32	0.38	1.63	2.11	6.34	16.65

Thus, the risk becomes very great for older mothers; in fact, as high as 1 in 60 for mothers 45 years of age and over, according to this study.

The selection of the underlying cause in deaths of children with Down's disease was at times difficult, particularly in those in which other anomalies such as ostium primum, interventricular septal defect, or duodenal atresia were also present. The underlying cause was assigned to the congenital anomaly most closely related to the terminal or direct cause of death. The association between Down's disease and other anomalies was frequently found. Such anomalies were not considered as components of the chromosomal abnormality of Down's disease.

TABLE 115. Additional Anomalies in Association with Down's Disease in Deceased Infants in 15 Projects.

Project	Total with Down's disease	Number with additional anomalies		Additional anomalies							
				Circulatory system (746, 747)		Digestive system[a,b]		Musculo-skeletal system (754–756)		Other[b]	
		No.	%	No.	%	No.	%	No.	%	No.	%
Total	306	148	48.4	99	32.4	44	14.4	19	6.2	30	9.8
ARGENTINA											
Chaco Province	8	—	—	—	—	—	—	—	—	—	—
San Juan Province	14	9	64.3	7	50.0	3	21.4	—	—	2	14.3
BOLIVIA project	7	2	#	—	—	2	#	—	—	2	#
BRAZIL											
Recife	19	11	57.9	8	42.1	1	5.3	1	5.3	3	15.8
Ribeirão Prêto	14	8	57.1	7	50.0	1	7.1	—	—	—	—
São Paulo	34	14	41.2	7	20.6	3	8.8	3	8.8	4	11.8
CANADA											
Sherbrooke	8	5	#	4	#	2	#	—	—	—	—
CHILE project	42	19	45.2	14	33.3	8	19.0	2	4.8	2	4.8
COLOMBIA											
Cali	10	5	50.0	3	30.0	2	20.0	1	10.0	2	20.0
Cartagena	20	8	40.0	3	15.0	3	15.0	2	10.0	3	15.0
Medellín	19	8	42.1	4	21.1	5	26.3	1	5.3	3	15.8
EL SALVADOR project	22	11	50.0	8	36.4	1	4.5	3	13.6	1	4.5
JAMAICA											
Kingston-St. Andrew	27	16	59.3	15	55.6	3	11.1	1	3.7	—	—
MEXICO											
Monterrey	47	20	42.6	11	23.4	5	10.6	4	8.5	4	8.5
UNITED STATES											
California project	15	12	80.0	8	53.3	5	33.3	1	6.7	4	26.7

[a] Categories 524, 550, 551, 749–751.
[b] More than one anomaly of this system may be included.
Per cent not calculated for base less than 10.

Stein and Susser (1971), in a paper on the preventability of Down's disease, recommended specific preventive measures aimed at reducing the frequency of this serious condition. There are sound bases for education of parents and for genetic counseling to prevent the birth of a child with Down's disease. The well-known relationship of the frequency of this chromosomal abnormality with increase in maternal age has been corroborated by this Investigation. Also the availability of diagnostic tests for those women (Stein and Susser, 1971) at great risk of giving birth to a child with this congenital anomaly should be mentioned among the bases for prevention.

In nearly half of the 306 deaths from Down's disease additional anomalies were found (in 148 or 48.4 per cent). The most frequent were those of the circulatory system; in fact, 99 (32.4 per cent) of the infants dying from this disease had circulatory anomalies as well (Table 115). In four projects half had circulatory anomalies, although other anomalies were also found. Unfortunately it was not always possible to establish the specific type of anomaly of the circulatory system, although the diagnosis of congenital heart disease was made on clinical grounds. For this reason, the anomaly most frequently mentioned was unspecified congenital anomalies of the heart (746.9). Interventricular septal defect (746.3) was next in frequency. Several anomalies of the upper digestive tract (cleft palate and lip) and of the lower digestive system with obstruction of the small intestine were found in association with Down's disease.

ANOMALIES OF CIRCULATORY SYSTEM

Anomalies of the circulatory system were the most common. In fact, 963 or 33.5 per cent of the 2,873 deceased infants with congenital anomalies had at least one anomaly of the circulatory system (Table 116 and Figure 103). Usually these conditions were serious and only 42 of these infants had only a minor anomaly of the circulatory system.

The variation in mortality from these conditions was great. The Bolivia project had a rate of 53.2 per 100,000 live births, or about one-sixth that in Sherbrooke (300.5). Ten projects had rates of at least 200.0 per 100,000 live births, which indicated considerable consistency in the frequency of these serious defects of heart and circulatory system.

The assignment of underlying cause in the presence of various forms of anomalies of heart and great vessels can be extremely difficult and at times impossible. No special rule was followed in the classification and coding of these multiple anomalies, except that the one stated in the record (clinical or autopsy) and thought to be the most serious was selected. Likewise, it was very difficult at times to decide which of the other anomalies of heart and vessels were contributors to death, since it is known that under certain circumstances, an anomaly in this system can serve as compensatory mechanism of another and even be lifesaving.

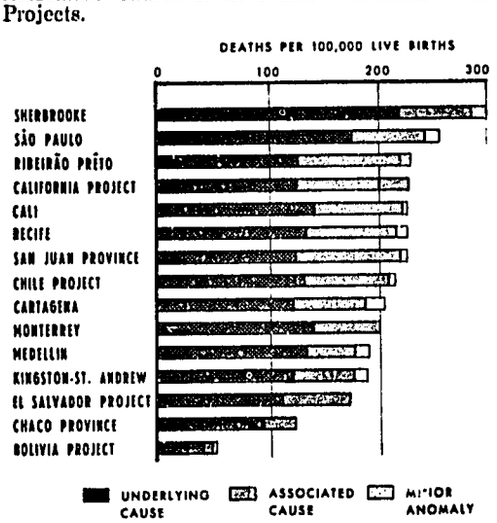
Another difficulty in assigning causative value to an anomaly derives from the concept of anomaly. In fact, some of these

TABLE 116. Deaths[a] of Infants with Congenital Anomalies of Circulatory System as Underlying or Associated Causes or as Minor Anomalies in 15 Projects.

Project	Total		Underlying cause		Associated cause		Minor anomaly	
	No.	Rate	No.	Rate	No.	Rate	No.	Rate
Total	963	203.1	615	129.7	306	64.6	42	8.9
ARGENTINA								
Chaco Province	22	125.0	17	96.6	5	28.4	—	—
San Juan Province	53	226.9	29	124.1	23	98.5	1	4.3
BOLIVIA project	20	53.2	15	39.9	4	10.6	1	2.7
BRAZIL								
Recife	69	227.0	41	134.9	25	82.2	3	9.9
Ribeirão Prêto	42	230.3	23	126.1	17	93.2	2	11.0
São Paulo	150	257.9	101	173.7	41	70.5	8	13.8
CANADA								
Sherbrooke	51	300.5	37	218.0	12	70.7	2	11.8
CHILE project	94	215.7	58	133.1	34	78.0	2	4.6
COLOMBIA								
Cali	48	227.5	30	142.2	17	80.6	1	4.7
Cartagena	37	206.7	22	122.9	12	67.0	3	16.8
Medellín	37	190.7	26	134.0	9	46.4	2	10.3
EL SALVADOR project	54	174.1	35	112.8	19	61.3	—	—
JAMAICA								
Kingston-St. Andrew	78	190.4	51	124.5	23	56.2	4	9.8
MEXICO								
Monterrey	106	200.0	74	139.6	31	58.5	1	1.9
UNITED STATES								
California project	102	228.0	56	125.2	34	76.0	12	26.8

[a] Rates per 100,000 live births.

FIG. 103. Mortality of Infants with Congenital Anomalies of Circulatory System as Underlying or Associated Causes or as Minor Anomalies in 15 Projects.



conditions present at birth in very small babies may be normal for their state of development. If the finding was thought to have been involved in the death of the baby, the assignment was made as a cause irrespective of the stage of development.

Anomalies of the circulatory system were frequently associated with those of other systems and with Down's disease (Table 117). In the California project, of the 102 deceased infants with circulatory anomalies 45 or 44.1 per cent had additional ones of other systems, including 21 with anomalies of the digestive system. Down's disease was the most common associated anomaly in six projects. Congenital anomalies of the digestive system, which include cleft palate and cleft lip, were frequently associated with those of the circulatory system.

TABLE 117. Additional Anomalies in Association with Congenital Anomalies of Circulatory System of Deceased Infants in 15 Projects.

Project	Total with anomalies of circulatory system	Number with additional anomalies		Additional anomalies											
				Digestive system[a,b]		Down's disease (759.3)		Musculo-skeletal system (754-756)		Genito-urinary system[b] (605, 752, 753)		Nervous system (740-743)		Other[b]	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Total	963	296	30.7	106	11.0	99	10.3	71	7.4	58	6.0	27	2.8	78	8.1
ARGENTINA															
Chaco Province	22	4	18.2	2	9.1	—	—	—	—	1	4.5	1	4.5	—	—
San Juan Province	53	15	28.3	6	11.3	7	13.2	5	9.4	2	3.8	2	3.8	3	5.7
BOLIVIA project	20	2	10.0	—	—	—	—	1	5.0	1	5.0	—	—	1	5.0
BRAZIL															
Recife	69	21	30.4	4	5.8	8	11.6	1	1.4	4	5.8	3	4.3	4	5.8
Ribeirão Prêto	42	19	45.2	6	14.3	7	16.7	3	7.1	2	4.8	1	2.4	6	14.3
São Paulo	150	33	22.0	16	10.7	7	4.7	5	3.3	9	6.0	2	1.3	7	4.7
CANADA															
Sherbrooke	51	13	25.5	4	7.8	4	7.8	3	5.9	2	3.9	2	3.9	3	5.9
CHILE project	94	33	35.1	14	14.9	14	14.9	8	8.5	2	2.1	2	2.1	5	5.3
COLOMBIA															
Cali	48	12	25.0	5	10.4	3	6.2	3	6.2	4	8.3	1	2.1	5	10.4
Cartagena	37	9	24.3	4	10.8	3	8.1	1	2.7	4	10.8	—	—	—	—
Medellín	37	10	27.0	4	10.8	4	10.8	1	2.7	1	2.7	1	2.7	4	10.8
EL SALVADOR project	54	21	38.9	6	11.1	8	14.8	6	11.1	5	9.3	1	1.9	3	5.6
JAMAICA															
Kington-St. Andrew	78	31	39.7	9	11.5	15	19.2	7	9.0	3	3.8	1	1.3	7	9.0
MEXICO															
Monterrey	106	28	26.4	5	4.7	11	10.4	9	8.5	4	3.8	2	1.9	4	3.8
UNITED STATES															
California project	102	45	44.1	21	20.6	8	7.8	18	17.6	14	13.7	8	7.8	26	25.5

[a] Categories 524, 550, 551, 749-751.
[b] More than one anomaly of this system may be included.

Table 118 gives the age distribution of mothers of deceased infants with congenital anomalies of the circulatory system. For only 309 or one-third of these infants with age of mother known (897) were the mothers 30 years of age and over. As was shown in the section on Down's disease, there was a definite concentration of deaths in infants of older mothers. Since 10.3 per cent of the deceased infants with anomalies of the circulatory system had Down's disease as well, this may account for some of the deaths from anomalies of this system in infants of older mothers.

For seven projects the infant death rates for anomalies of the circulatory system are given by age of mother (Table 119 and Figure 104). In four of these projects, namely, Sherbrooke, Chile, El Salvador, and Monterrey, definite increases in the rates were noted for infants of older mothers. In two other projects, São Paulo and California, the rates were high for infants of mothers under 20 years of age. Although all rates were low in the seventh project (Chaco Province), they were highest for infants of the younger mothers.

TABLE 118. Deaths of Infants with Congenital Anomalies of Circulatory System by Age of Mother in 15 Projects.

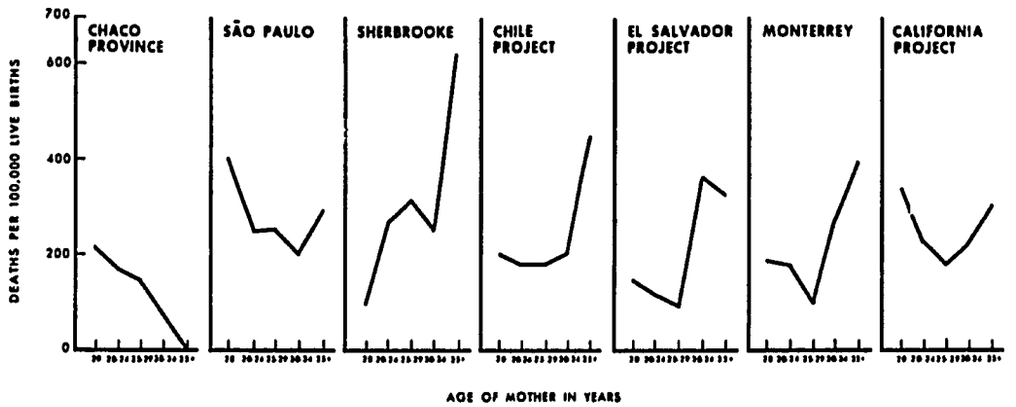
Project	Total	Under 20 years	20-24 years	25-29 years	30-34 years	35 years and over	Unknown
Total	963	132	249	207	139	170	66
ARGENTINA							
Chaco Province	22	6	8	6	2	—	—
San Juan Province	53	8	10	7	10	17	1
BOLIVIA project	20	1	5	4	1	4	5
BRAZIL							
Recife	69	13	15	13	6	13	9
Ribeirão Prêto	42	3	11	10	6	9	3
São Paulo	150	18	44	43	19	19	7
CANADA							
Sherbrooke	51	1	16	16	6	10	2
CHILE project	94	12	24	19	12	23	4
COLOMBIA							
Cali	48	8	12	10	7	5	6
Cartagena	37	4	9	8	3	2	11
Medellin	37	6	9	3	5	9	5
EL SALVADOR project	54	8	11	6	16	13	—
JAMAICA							
Kingston-St. Andrew	78	12	15	27	10	10	4
MEXICO							
Monterrey	106	9	25	13	24	28	7
UNITED STATES							
California project	102	23	35	22	12	8	2

TABLE 119. Mortality[a] of Infants with Congenital Anomalies of Circulatory System by Age of Mother in Seven Projects.

Age of mother	ARGENTINA Chaco Province	BRAZIL São Paulo	CANADA Sherbrooke	CHILE project	EL SALVADOR project	MEXICO Monterrey	UNITED STATES California project
Total	125.0	257.9	300.5	215.7	174.1	200.0	228.0
Under 20 years	212.5	402.2	92.9	200.4	140.8	183.1	330.9
20-24 years	169.4	247.7	265.9	175.1	112.5	176.5	216.8
25-29 years	143.5	253.7	309.7	176.8	85.7	91.3	175.8
30-34 years	74.1	196.7	246.4	197.3	354.5	265.8	215.5
35 years and over	—	287.9	621.1	442.0	321.7	391.3	298.0

[a] Rates per 100,000 live births.

FIG. 104. Mortality of Infants with Congenital Anomalies of Circulatory System by Age of Mother in Seven Projects.



ANOMALIES OF THE DIGESTIVE SYSTEM

The digestive system was the site of anomalies in 809 deceased infants, that is, more than one-fourth of those with congenital anomalies (28.2 per cent). Seventy per cent of those conditions were involved as underlying or associated causes and the rest were considered non-causal or minor (Table 120).

The variation in death rates for anomalies of this type was from 100.1 per 100,000 live births in Kingston-St. Andrew to 265.4 in San Juan Province. The rate in the Bolivia project was similar to that in Kingston-St. Andrew (Figure 105). In the latter project the diagnostic facilities were unusually good (autopsies with or without clinical information were available for 51.5 per cent of deceased children from all types of anomalies) and it is probable that a high proportion of the serious anomalies of the digestive system were discovered. In the California project the death rate was only slightly higher, but that project had the lowest rate for these anomalies as underlying cause (40.2 per 100,000 live births).

Table 103 presented the data on 866 anomalies of the digestive system, in four groups:

	Number
Cleft palate and cleft lip (749)	167
Other anomalies of upper alimentary tract (524, 750)	138
Congenital hernias (550, 551)	261
Other anomalies of digestive system (751)	300

However, several of these conditions were diagnosed in infants with additional anomalies in one of the other groups. For example, of the 261 deceased infants with congenital hernias, 9 had cleft palate or cleft lip and 28 had other anomalies of the digestive system classed as 750 or 751. After elimination of all duplication there were 809 infants with an anomaly of the digestive system.

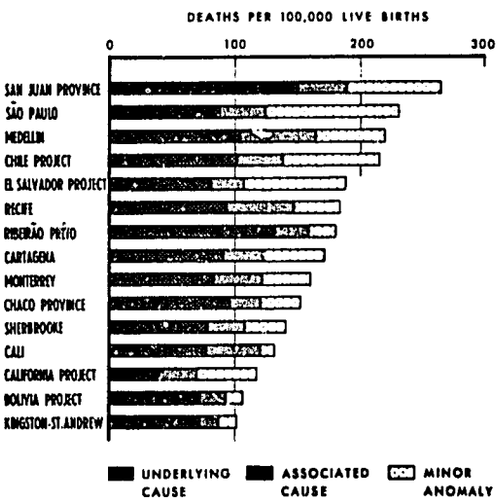
Cleft palate and clept lip (category 749) are anomalies that are easily diagnosed and are a cause of great concern because of the disability they produce in the infant. For this reason, data for this category are shown

TABLE 120. Deaths[a] of Infants with Congenital Anomalies of Digestive System[b] as Underlying or Associated Causes or as Minor Anomalies in 15 Projects.

Project	Total		Underlying cause		Associated cause		Minor anomaly	
	No.	Rate	No.	Rate	No.	Rate	No.	Rate
Total	809	170.7	407	85.9	159	33.5	243	51.3
ARGENTINA								
Chaco Province	27	153.4	17	96.6	4	22.7	6	34.1
San Juan Province	62	265.4	35	149.8	9	38.5	18	77.1
BOLIVIA project	40	106.4	27	71.8	8	21.3	5	13.3
BRAZIL								
Recife	56	184.2	28	92.1	17	55.9	11	36.2
Ribeirão Prêto	33	180.9	24	131.6	5	27.4	4	21.9
São Paulo	135	232.1	50	86.0	22	37.8	63	108.3
CANADA								
Sherbrooke	24	141.4	13	76.6	5	29.5	6	35.4
CHILE project	94	215.7	44	101.0	16	36.7	34	78.0
COLOMBIA								
Cali	28	132.7	16	75.8	9	42.7	3	14.2
Cartagena	31	173.2	16	89.4	6	33.5	9	50.3
Medellín	43	221.6	20	103.1	12	61.9	11	56.7
EL SALVADOR project	59	190.2	25	80.6	8	25.8	26	83.8
JAMAICA								
Kingston-St. Andrew	41	100.1	30	73.2	5	12.2	6	14.6
MEXICO								
Monterrey	85	160.3	44	83.0	20	37.7	21	39.6
UNITED STATES								
California project	51	114.0	18	40.2	13	29.1	20	44.7

[a] Rates per 100,000 live births.
[b] Categories 524, 550, 551, 749–751.

FIG. 105. Mortality of Infants with Congenital Anomalies of Digestive System as Underlying or Associated Causes or as Minor Anomalies in 15 Projects.



separately (Table 121 and Figure 106). Apparently these conditions are rare in Kingston-St. Andrew, as only four infants were found with such anomalies (9.8 deaths per 100,000 live births). The number was small also in the Sherbrooke project (3 infants, or a rate of 17.7). In contrast, three projects had death rates of from 68.2 to 72.8 (Chaco Province, Medellín, and San Juan Province). This wide variation can be seen in Figure 106. In the two projects in Argentina these conditions were serious and were assigned as underlying causes for 8 of the 12 deaths in this category in Chaco Province and for 12 of 17 in San Juan Province.

In all projects these anomalies were considered minor in only 29 (17.4 per cent) of these deceased infants. However, slightly more of them were classed as associated

TABLE 121. Deaths[a] of Infants with Cleft Palate and Cleft Lip as Underlying or Associated Cause or as Minor Anomaly in 15 Projects.

Project	Total		Underlying cause		Associated cause		Minor anomaly	
	No.	Rate	No.	Rate	No.	Rate	No.	Rate
Total	167	35.2	66	13.9	72	15.2	29	6.1
ARGENTINA								
Chaco Province	12	68.2	8	45.5	3	17.0	1	5.7
San Juan Province	17	72.8	12	51.4	3	12.8	2	8.6
BOLIVIA project	8	21.3	4	10.6	4	10.6	—	—
BRAZIL								
Recife	7	23.0	3	9.9	3	9.9	1	3.3
Ribeirão Prêto	4	21.9	2	11.0	2	11.0	—	—
São Paulo	24	41.3	7	12.0	9	15.5	8	13.8
CANADA								
Sherbrooke	3	17.7	1	5.9	2	11.8	—	—
CHILE project	18	41.3	7	16.1	8	18.4	3	6.9
COLOMBIA								
Cali	4	19.0	2	9.5	2	9.5	—	—
Cartagena	7	39.1	2	11.2	5	27.9	—	—
Medellín	14	72.2	4	20.6	10	51.5	—	—
EL SALVADOR project	14	45.1	6	19.3	5	16.1	3	9.7
JAMAICA								
Kingston-St. Andrew	4	9.8	2	4.9	1	2.4	1	2.4
MEXICO								
Monterrey	17	32.1	3	5.7	11	20.8	3	5.7
UNITED STATES								
California project	14	31.3	3	6.7	4	8.9	7	15.6

[a] Rates per 100,000 live births.

causes (72) than as underlying causes (66). This would indicate that although they contributed to the fatal outcome some other disease or condition was more often responsible for the train of events leading to death and therefore was assigned as the underlying cause. In infants in whom these conditions were the underlying or associated causes of death the anomaly frequently caused aspiration of food and lack of adequate intake. Comparisons with reports giving the incidence of cleft palate and cleft lip are not available since these anomalies are rarely fatal.

The distribution of deceased infants with cleft palate and cleft lip by age of mother did not show an excess in older mothers (Table 122). When the data were combined

FIG. 106. Mortality of Infants with Cleft Palate and Cleft Lip as Underlying or Associated Cause or as Minor Anomaly in 15 Projects.

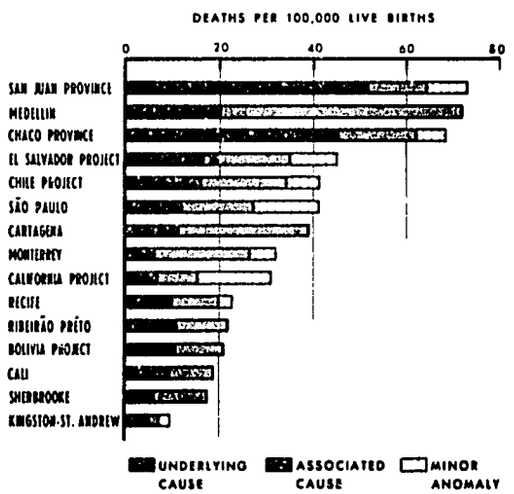


TABLE 122. Deaths of Infants with Cleft Palate and Cleft Lip by Age of Mother in 15 Projects.

Project	Total	Under 20 years	20–24 years	25–29 years	30–34 years	35 years and over	Unknown
Total	107	27	36	42	24	20	9
ARGENTINA							
Chaco Province	12	1	3	4	3	1	—
San Juan Province	17	2	3	6	3	3	—
BOLIVIA project	8	2	2	2	—	—	2
BRAZIL							
Recife	7	2	—	2	—	3	—
Ribeirão Prêto	4	—	2	—	—	1	1
São Paulo	24	4	4	9	4	3	—
CANADA							
Sherbrooke	3	—	—	2	—	1	—
CHILE project	18	4	4	2	4	4	—
COLOMBIA							
Cali	4	—	1	1	1	1	—
Cartagena	7	—	3	—	—	1	3
Medellín	14	4	1	3	2	4	—
EL SALVADOR project	14	2	4	3	2	2	1
JAMAICA							
Kingston-St. Andrew	4	1	1	—	—	1	1
MEXICO							
Monterrey	17	2	5	2	4	3	1
UNITED STATES							
California project	14	3	3	6	1	1	—

for seven projects for which the distributions of live births by age of mother were available, the following rates per 100,000 live births were obtained:

Age of mother	*Rate*
Under 20 years	49.4
20–24 years	27.7
25–29 years	38.5
30–34 years	44.3
35 years and over	48.4

Thus the rates were practically the same for the youngest and the oldest age groups, the lowest rates being those for mothers 20–24 years of age.

Among the other anomalies of the upper digestive tract, congenital pyloric stenosis (750.1) was a cause of death of 31 infants in 15 projects combined (Table 123). Early recognition and treatment could prevent such deaths. Another anomaly in this category of particularly serious prognosis is tracheo-esophageal fistula (750.2), which was responsible for 57 infant deaths in 15 projects combined. Atresia and stenosis of small intestine (751.1), frequently associated with Down's disease, was responsible for 43 deaths, while the subcategory 751.2 (of rectum and anal canal), which includes anomaly of imperforate anus, produced 72 deaths. Only 19 infant deaths in the Investigation were due to Hirschsprung's disease (751.3) as underlying or associated cause, and five of these occurred in Kingston-St. Andrew. Finally, 58 deaths were found to be due to serious congenital anomalies of the gallbladder, bile ducts, and liver (751.6), of which nearly all were atresia of bile ducts.

TABLE 123. Deaths of Infants with Specific Anomalies of Digestive System as Underlying or Associated Causes in 15 Projects.

Project	Pyloric stenosis (750.1)	Tracheo-esophageal fistula, etc. (750.2)	Atresia and stenosis		Hirsch-sprung's disease (751.3)	Gallbladder, bile ducts, and liver (751.6)
			of small intestine (751.1)	of rectum and anal canal (751.2)		
Total	31	57	43	72	19	58
ARGENTINA						
Chaco Province	3	—	1	1	1	—
San Juan Province	1	2	1	6	1	4
BOLIVIA project	1	3	3	11	—	2
BRAZIL						
Recife	4	5	1	5	1	10
Ribeirão Prêto	2	7	2	2	2	4
São Paulo	6	5	8	8	2	3
CANADA						
Sherbrooke	—	3	2	1	—	3
CHILE project	2	8	5	8	1	7
COLOMBIA						
Cali	3	2	1	1	2	4
Cartagena	1	—	2	5	—	5
Medellín	—	1	5	3	1	5
EL SALVADOR project	1	4	3	4	—	2
JAMAICA						
Kingston-St. Andrew	3	4	3	3	5	3
MEXICO						
Monterrey	3	9	4	11	1	6
UNITED STATES						
California project	1	4	2	3	2	—

ANOMALIES OF GENITO-URINARY SYSTEM

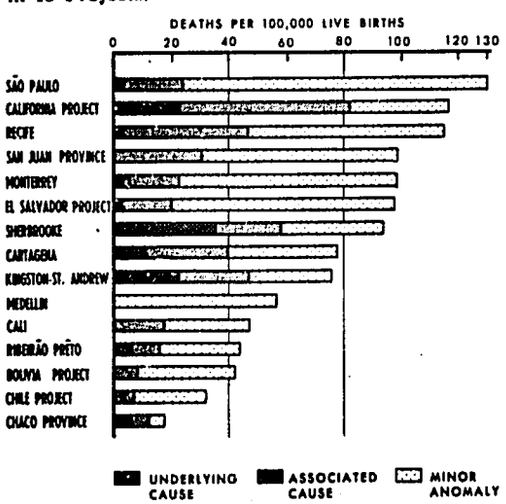
Anomalies of the genito-urinary system were rarely found as the underlying cause of death in the 15 projects; well over half (250 of 391) were classed as minor conditions (Table 124 and Figure 107). Very low rates were noted in the projects in Chaco Province and Chile. In contrast, rates were high (over 100 per 100,000 live births) in the São Paulo, California, and Recife projects. As underlying and associated causes combined these anomalies resulted in higher rates in the California project than in any

TABLE 124. Deaths[a] of Infants with Congenital Anomalies of Genito-Urinary System as Underlying or Associated Causes or as Minor Anomalies in 15 Projects.

Project	Total		Underlying cause		Associated cause		Minor anomaly	
	No.	Rate	No.	Rate	No.	Rate	No.	Rate
Total	391	82.5	36	7.6	105	22.1	250	52.7
ARGENTINA								
Chaco Province	3	17.0	1	5.7	1	5.7	1	5.7
San Juan Province	23	98.5	—	—	7	30.0	16	68.5
BOLIVIA project	16	42.5	—	—	3	8.0	13	34.6
BRAZIL								
Recife	35	115.1	1	3.3	13	42.8	21	69.1
Ribeirão Prêto	8	43.9	1	5.5	2	11.0	5	27.4
São Paulo	76	130.7	2	3.4	12	20.6	62	106.6
CANADA								
Sherbrooke	16	94.3	6	35.4	4	23.6	6	35.4
CHILE project	14	32.1	—	—	3	6.9	11	25.2
COLOMBIA								
Cali	10	47.4	—	—	4	19.0	6	28.4
Cartagena	14	78.2	2	11.2	5	27.9	7	39.1
Medellín	11	56.7	—	—	—	—	11	56.7
EL SALVADOR project	30	96.7	1	3.2	5	16.1	24	77.4
JAMAICA								
Kingston-St. Andrew	31	75.7	9	22.0	10	24.4	12	29.3
MEXICO								
Monterrey	52	98.1	3	5.7	9	17.0	40	75.5
UNITED STATES								
California project	52	116.2	10	22.4	27	60.3	15	33.5

[a] Rates per 100,000 live births.

FIG. 107. Mortality of Infants with Congenital Anomalies of Genito-Urinary System as Underlying or Associated Causes or as Minor Anomalies in 15 Projects.



of the others. Sherbrooke and Kingston-St. Andrew also had relatively high rates as underlying and associated causes combined.

In the California project seven of the 10 deaths from congenital anomalies of the genito-urinary system as underlying causes and 13 of the 27 as associated causes were either renal agenesis (753.0) or polycystic kidney (753.1). The association of these two serious anomalies with pulmonary hypoplasia (748.6) was noted in 8 infant deaths in this project.

The most common minor anomalies of the genito-urinary system were undescended testicle (cryptorchism) (category 752.1), found in 96 deceased infants, and phimosis (category 605), found in 36.

CONGENITAL ANOMALIES OF OTHER SYSTEMS

Anomalies of the respiratory system were found in 71 deceased infants in 15 projects combined (Table 103). In 14 of these deaths the anomalies were unrelated to the process of death. In the California project, in 23 out of the 26 infant deaths due to these conditions they acted as underlying or associated causes, most of the deaths (20) being due to pulmonary hypoplasia (category 748.6).

All eight anomalies of the respiratory system in the Sherbrooke project acted as associated causes, and four of them were contributory to absence of diaphragm (756.8) as underlying cause. Another was associated with anencephalus as underlying cause and also with absence of diaphragm as associated cause. In one death pulmonary hypoplasia was associated with cystic fibrosis (273.0). Another of these anomalies was associated with renal agenesis and the last of the eight was associated with coarctation of aorta (747.1) as underlying cause.

Clubfoot (754) was found in 178 deceased infants and was unrelated to the process of death in 175. In the remaining three infants, a complication of treatment triggered the chain of events leading to death. The highest rates for this anomaly were found in San Juan Province and in the Chilean project, where there were 72.8 and 62.0 deceased infants with clubfoot per 100,000 live births, respectively.

Among the 370 infant deaths in which other anomalies of the musculoskeletal system (755, 756) were found, in only 109 were such conditions involved as underlying or associated causes. In 52 of these 109 deaths they were underlying causes; 50 belonged to category 756 and the other two were assigned to category 755. The other 57 deceased infants had 44 anomalies belonging to category 756 as associated causes and only 13 assigned to category 755, also as associated causes. Therefore, it seems evident that conditions in category 756 are more serious from the standpoint of mortality than those in categories 754 and 755.

MORTALITY BY AGE OF MOTHER

The influence of maternal age on anomalies in the products of gestation is usually an important factor. In this presentation the death rates by maternal age have been shown for Down's disease and for anomalies of the nervous and the circulatory systems. Augmented rates were noted with increased maternal age in Down's disease, which probably raised the rates for anomalies of the circulatory system owing to the frequent association of these two conditions (10.3 per cent of the deceased infants with circulatory anomalies had Down's disease as well).

In Table 125 the distribution of deceased infants with congenital anomalies is given by age of mother at the infant's birth. Of the total, 32.8 per cent were born to mothers aged 30 years and over (excluding those with age unknown). This percentage is

TABLE 125. Deaths of Infants with Congenital Anomalies by Age of Mother in 15 Projects.

Project	Total	Under 20 years	20-24 years	25-29 years	30-34 years	35 years and over	Unknown
Total	2,873	373	788	630	410	465	207
ARGENTINA							
Chaco Province	74	18	15	18	11	11	1
San Juan Province	176	23	52	38	28	29	6
BOLIVIA project	92	5	20	18	13	21	15
BRAZIL							
Recife	206	35	44	52	17	35	23
Ribeirão Prêto	101	5	36	20	11	17	12
São Paulo	458	39	150	124	65	53	27
CANADA							
Sherbrooke	124	7	47	31	16	21	2
CHILE project	307	37	83	69	50	60	8
COLOMBIA							
Cali	107	17	28	19	16	12	15
Cartagena	110	10	21	18	8	13	40
Medellín	126	20	28	19	17	32	10
EL SALVADOR project	216	38	63	35	36	42	2
JAMAICA							
Kingston-St. Andrew	201	38	55	51	23	26	8
MEXICO							
Monterrey	353	36	76	62	68	77	34
UNITED STATES							
California project	222	45	70	56	31	16	4

similar to the percentage of live births among mothers 30 years and over in the Chaco Province and Monterrey projects but higher than that in the other five projects with maternal ages for live births known (Table 148 of Chapter XII).

The death rates in the seven projects for which the distribution of live births by mothers' age were available are given in Table 126 and in Figure 108. In only four projects were the rates for mothers aged 35 years and over higher than for mothers under 20 years (Sherbrooke, Chile, El Salvador, and Monterrey). In Figure 108, the rates with Down's disease excluded are shown by a broken line. Some increase with age remained in all four projects.

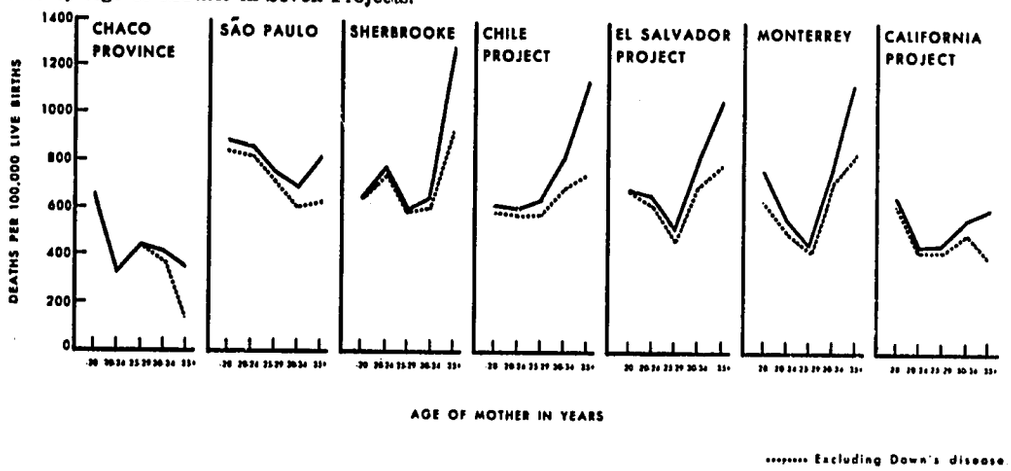
Although differences were noted, similarities also were observed. For example, the death rates for the infants of young mothers

TABLE 126. Mortality[a] of Infants with Congenital Anomalies by Age of Mother in Seven Projects.

Age of mother	ARGENTINA Chaco Province	BRAZIL São Paulo	CANADA Sherbrooke	CHILE project	EL SALVADOR project	MEXICO Monterrey	UNITED STATES California project
Total	420.5	787.5	730.7	704.5	696.3	665.9	496.2
Under 20 years	646.3	882.7	635.0	607.5	675.2	757.1	646.3
20-24 years	321.9	855.5	762.8	595.2	650.2	554.4	432.9
25-29 years	436.4	741.1	586.0	631.3	504.4	449.9	446.8
30-34 years	413.0	681.9	641.7	808.3	805.0	778.4	555.7
35 years and over	351.6	813.5	1,273.7	1,133.5	1,049.1	1,112.1	595.1

[a] Rates per 100,000 live births.

FIG. 108. Mortality of Infants with Congenital Anomalies of All Types and Excluding Down's Disease by Age of Mother in Seven Projects.



under 20 years varied only from 607.5 to 882.7 per 100,000 live births, a relatively narrow range compared with that of the rates for anomalies of specific systems.

The combined data by age of mother for these seven projects for all anomalies and for all excluding Down's disease produced the following rates per 100,000 live births:

Age of mother	*All anomalies*	*Excluding Down's disease*
Under 20 years	695.0	656.2
20–24 years	616.9	588.8
25–29 years	561.8	530.9
30–34 years	699.8	622.7
35 years and over	930.0	663.2

As can be seen, the rates are of similar size in the youngest and oldest mothers when Down's disease is excluded. The rates are lowest for mothers aged 25–29 years at the birth of the child.

* * *

The preceding presentation reveals that the abnormal conditions known as congenital anomalies represent a very important and difficult field of pediatric pathology. These data provide a background of information concerning the geographic distribution of congenital anomalies based on mortality in childhood. The relative significance of these conditions in infancy and childhood becomes greater as other causes of morbidity and mortality are reduced and as diagnostic procedures are improved. These two factors usually go hand in hand. The frequency of certain anomalies, because of their seriousness, can probably be fairly well known through mortality statistics owing to the limited chance of survival. At the other extreme, certain ones may have little or no pathological significance themselves, but they indicate the possibility of more serious hidden anomalies. Between these two extremes various degrees of severity may be attached to the anomalies, and quality of the treatment may be the main factor underlying differences in studies of mortality. The most outstanding findings in this Investigation in regard to congenital anomalies are the differences encountered in connection with those of the central nervous system. These differences point to the existence of causative factors that urgently need investigation.

Chapter XI

Other Diseases and External Causes

The study of mortality from several other important underlying causes contributes to an understanding of the health problems encountered in childhood. Among these are leukemia and other malignant neoplasms, external causes, and sudden death. Though the numbers of deaths from malignant neoplasms and from sudden death were relatively small in the 15 projects (163 and 280), their importance becomes clearly evident as the overall level of infant mortality is reduced. The same relative importance could be attached to the external causes, which were responsible for 847 deaths.

In addition, mortality from several other groups of diseases that are important as associated as well as underlying causes is discussed in this chapter to complete the account of conditions responsible for deaths of infants and young children.

MALIGNANT NEOPLASMS

Data on the geographic distribution of mortality from leukemia and specific malignant neoplasms contribute to the background information needed in the search for causes. Thus, though only few deaths (163) were due to these conditions, a basis is provided for exploring possible causative factors and relationships.

Table 127 shows the mortality for the two major groups, leukemia and other malignant neoplasms (all of which were underlying causes) in children under 5 years of age in the 15 projects. Of the 163 deaths, 80, or practically half, were caused by leukemia, and the remaining 83 by other malignant neoplasms. Seventeen of the deaths occurred in the first year of life, while the numbers were larger in the other age groups:

	Leukemia	*Other malignant neoplasms*
Under 1 year	9	8
1 year	20	10
2 years	16	18
3 years	16	21
4 years	19	26

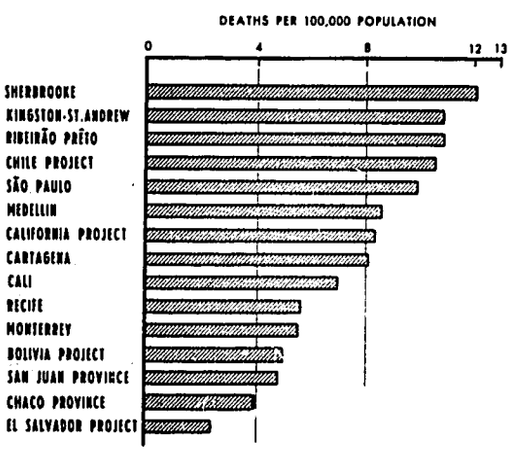
In four projects the death rates for these two groups were at least 10 per 100,000 population: Sherbrooke, Chile, Kingston-St. Andrew, and Ribeirão Prêto (Figure 109). The three projects with large rural areas had the lowest rates: El Salvador, Chaco Province, and San Juan Province. The distributions of these deaths in the rural and suburban areas, combined for six Latin American

TABLE 127. Mortality[a] from Leukemia and Other Malignant Neoplasms in Children Under 5 Years, by Age Group, in 15 Projects.

Project	Total		Leukemia						Other malignant neoplasms					
			Total		Under 1 year		1–4 years		Total		Under 1 year		1–4 years	
	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate
Total	163	7.8	80	3.8	9	1.9	71	4.3	83	4.0	8	1.7	75	4.5
ARGENTINA														
Chaco Province	3	3.9	1	1.3	—	—	1	1.7	2	2.6	—	—	2	3.3
San Juan Province	5	4.8	4	3.8	1	4.3	3	3.6	1	1.0	1	4.3	—	—
BOLIVIA project	8	5.1	3	1.9	—	—	3	2.4	5	3.2	—	—	5	4.1
BRAZIL														
Recife	7	5.6	5	4.0	—	—	5	5.2	2	1.6	1	3.3	1	1.0
Ribeirão Prêto	9	10.9	2	2.4	—	—	2	3.1	7	8.5	—	—	7	10.8
São Paulo	24	9.8	10	4.1	1	1.7	9	4.8	14	5.7	1	1.7	13	6.9
CANADA														
Sherbrooke	11	12.1	7	7.7	1	5.9	6	8.1	4	4.4	—	—	4	5.4
CHILE project	22	10.6	12	5.8	1	2.3	11	6.6	10	4.8	1	2.3	9	5.4
COLOMBIA														
Cali	7	6.9	3	3.0	—	—	3	3.7	4	4.0	1	4.7	3	3.7
Cartagena	7	8.1	2	2.3	—	—	2	2.9	5	5.8	—	—	5	7.3
Medellín	8	8.6	2	2.1	—	—	2	2.7	6	6.4	—	—	6	8.0
EL SALVADOR project	3	2.4	1	0.8	—	—	1	1.0	2	1.6	—	—	2	2.1
JAMAICA														
Kingston-St. Andrew	20	10.9	12	6.5	4	9.8	8	5.6	8	4.4	2	4.9	6	4.2
MEXICO														
Monterrey	12	5.5	6	2.8	—	—	6	3.5	6	2.8	1	1.9	5	2.9
UNITED STATES														
California project	17	8.3	10	4.9	1	2.2	9	5.6	7	3.4	—	—	7	4.3

[a] Rates under 1 year of age per 100,000 live births; others per 100,000 population.

FIG. 109. Mortality from Leukemia and Other Malignant Neoplasms in Children Under 5 Years of Age in 15 Projects.



projects, showed that only eight deaths occurred outside the cities, which gave a rate of 4.7 per 100,000 population, compared with 7.7 for the cities. However, the numbers are too small for significance; very few deaths from these causes occurred in San Juan Province and El Salvador, even though the high-quality medical records and interviewing there uncovered other serious problems, such as congenital anomalies of the nervous system in El Salvador.

The findings in the Investigation are shown below in relation to the official data for 1967 published by WHO (1970-a) for malignant neoplasms of all sites and for leukemia of children under 5 years of age:

Official data, 1967 (WHO)			*Investigation*		
	All forms	*Leukemia*		*All forms*	*Leukemia*
Canada	9.5	4.3	Sherbrooke	12.1	7.7
Chile	6.6	3.3	Chile project	10.6	5.8
Colombia	5.6	2.6	Cali	6.9	3.0
			Cartagena	8.1	2.3
			Medellín	8.6	2.1
El Salvador	1.0	0.3	El Salvador project	2.4	0.8
Mexico	3.1	1.5	Monterrey	5.5	2.8
United States	7.7	3.6	California project	8.3	4.9

Although the numbers of deaths in the Investigation and for the countries (except the United States) were small and variations can be expected from year to year, the rates per 100,000 population were consistently higher in the Investigation for all forms of malignant neoplasms and for leukemia (except in two projects in Colombia). Thus, the Investigation has revealed the size of this serious problem more completely than has been known previously.

Since all but 17 of the deaths from these malignant diseases occurred in the age group 1–4 years, the death rates are shown in Figure 110 only for that age period. The rates for leukemia ranged from a high of 8.1 to a low of 1.0 per 100,000 population, the highest figures being in the projects in Sherbrooke and Chile. The rates for the other malignant neoplasms were around 4 per 100,000 population (from 2.9 to 5.4) in eight projects. Four projects had higher rates: Ribeirão Prêto (10.8), Medellín (8.0), Cartagena (7.3), and São Paulo (6.9); Recife and El Salvador had very low rates (with only one and two deaths) and no deaths occurred in San Juan Province.

The specific sites of the malignant neoplasms are given in Table 128 for the 15 projects.

Evidence was available to support the diagnoses of leukemia and other neoplasms for 159 of the 163 deaths, as is shown in

FIG. 110. Mortality from Leukemia and Other Malignant Neoplasms in Children 1–4 Years of Age in 15 Projects.

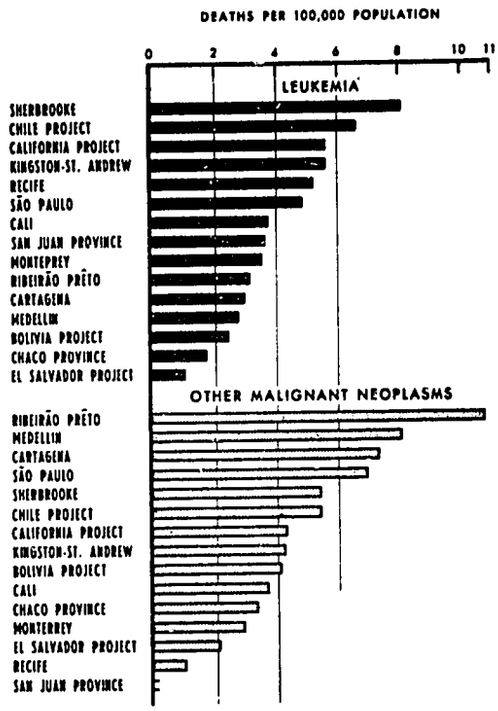


Table 129. The diagnoses were very well documented. Hematologic studies with or without other evidence substantiated 63 of the deaths due to leukemia, and biopsies were performed for 63 of the other malignant neoplasms. Autopsies were performed in 57 of the deaths. Unfortunately, three hospital records were lost and in four instances surgery was performed without mention of histologic examination. In addition to these well-documented deaths it is likely that a few others occurred in which no diagnostic tests were recorded or performed, and therefore these were not included in this series for lack of evidence of malignancies.

TABLE 128. Mortality[a] from Malignant Neoplasms by Specific Site in Children Under 5 Years of Age in 15 Projects.

Project	Total deaths from malignant neoplasms	Leukemia (204–207)		Lymphomas (200–203)		Bone (170, 171)		Kidney (189.0)		Brain (191)		Neuroblastoma (192.5)		Eye (190)		Other[b] (rest of 140–199)	
		No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate
Total	163	80	3.8	22	1.0	5	0.2	13	0.6	8	0.4	13	0.6	11	0.5	11	0.5
ARGENTINA																	
Chaco Province	3	1	1.3	—	—	—	—	—	—	1	1.3	—	—	—	—	1	1.3
San Juan Province	5	4	3.8	—	—	—	—	—	—	—	—	1	1.0	—	—	—	—
BOLIVIA project	8	3	1.9	2	1.3	—	—	—	—	—	—	—	—	3	1.9	—	—
BRAZIL																	
Recife	7	5	4.0	—	—	—	—	1	0.8	—	—	—	—	—	—	1	0.8
Ribeirão Prêto	9	2	2.4	1	1.2	—	—	2	2.4	2	2.4	2	2.4	—	—	—	—
São Paulo	24	10	4.1	5	2.1	—	—	1	0.4	2	0.8	1	0.4	3	1.2	2	0.8
CANADA																	
Sherbrooke	11	7	7.7	—	—	—	—	1	1.1	2	2.2	1	1.1	—	—	—	—
CHILE project	22	12	5.8	6	2.9	1	0.5	1	0.5	—	—	—	—	1	0.5	1	0.5
COLOMBIA																	
Cali	7	3	3.0	2	2.0	—	—	—	—	—	—	1	1.0	—	—	1	1.0
Cartagena	7	2	2.3	2	2.3	—	—	1	1.2	—	—	1	1.2	—	—	1	1.2
Medellín	8	2	2.1	2	2.1	1	1.1	1	1.1	—	—	1	1.1	—	—	1	1.1
EL SALVADOR project	3	1	0.8	—	—	1	0.8	1	0.8	—	—	—	—	—	—	—	—
JAMAICA																	
Kingston-St. Andrew	20	12	6.5	1	0.5	2	1.1	—	—	—	—	3	1.6	1	0.5	1	0.5
MEXICO																	
Monterrey	12	6	2.8	1	0.5	—	—	1	0.5	—	—	2	0.9	2	0.9	—	—
UNITED STATES																	
California project	17	10	4.9	—	—	—	—	3	1.5	1	0.5	—	—	1	0.5	2	1.0

[a] Rates per 100,000 population.
[b] The categories of the *International Classification of Diseases* for these 11 deaths were as follows: 153.8, one in Recife; 155.0, one in São Paulo; 158.0, one in São Paulo; 163, one in Kingston-St. Andrew; 183.0, one in Cartagena; 186, one in Chaco Province and one in Medellín; 192.0, one in California; 195, one in Chile project; 199, one in Cali and one in California project.

TABLE 129. Diagnostic Evidence for Malignant Neoplasms in Deaths of Children Under 5 Years of Age in 15 Projects Combined.

Diagnostic evidence	Total	Leukemia	Other malignant neoplasms
Total	163	80	83
Hematology			
with biopsy	21	19	2
with autopsy	13	13	—
with biopsy and autopsy	9	8	1
hematology only	26	23	3
Biopsy			
with autopsy	20	2	18
biopsy only	51	6	45
Autopsy only	15	6	9
Surgery only	4	1	3
Other[a]	4	2	2

[a] Hospital records were lost in three of these and the other had clinical evidence only.

Of the 80 deaths due to leukemia, the specific types were as follows:

Acute lymphatic leukemia (204.0)	43
Chronic lymphatic leukemia (204.1)	1
Unspecified lymphatic leukemia (204.9)	2
Acute myeloid leukemia (205.0)	13
Acute monocytic leukemia (206.0)	2
Acute leukemia (207.0)	15
Unspecified leukemia (207.9)	4

The lymphomas responsible for 22 deaths in all projects combined were classified as follows:

Reticulum-cell sarcoma (200.0)	2
Lymphosarcoma (200.1)	18
Hodgkin's disease (201)	1

TABLE 130. Nutritional Deficiency as Associated Cause of Deaths from Malignant Neoplasms in Children Under 5 Years of Age in 15 Projects Combined.

Type	Total deaths from malignant neoplasms	Nutritional deficiency as associated cause		
		Total	Consequence	Contributory
Total	163	48	41	7
Leukemia	80	12	7	5
Other neoplasms	83	36	34	2

Other primary malignant neoplasms of lymphoid tissue (202.2) 1

The classifications of the rest of the malignant neoplasms (61 deaths) were:

Retinoblastoma and other malignant neoplasms of the eye (190) 11
Wilms' tumor (189.0) 13
Malignant neoplasms of sympathetic nervous system (neuroblastoma) (192.5) 13
Malignant neoplasms of brain (191) 8
Other malignant neoplasms (rest of 140–209) 16

The relationship to nutritional deficiency (Table 130) was distinctly different from that found for the infectious diseases. In only seven deaths from malignant diseases was nutritional deficiency a contributory cause, but in 41 it was a consequence. Thus, in contrast to a disease like measles, which causes death in the malnourished child, these diseases developed in children without evidence of such deficiency, except in seven (4.3 per cent).

Pneumonia developed as a consequence in 32 children and septicemia in 12. In five deaths, ascariasis or trichuriasis was a contributory cause. In one death of a 3-year-old-child due to leukemia, Down's disease was an associated cause. In eight other deaths a minor congenital anomaly was reported. Of the 146 children aged 1–4 years who died from leukemia and other malignant neoplasms, six had minor anomalies (4.1 per cent). By comparison, of the 7,493 deaths of children in that age group from all causes minor anomalies occurred in only 97 (1.3 per cent). Though the difference in these percentages was small (and may be due to the quality of diagnostic information), it is sufficient to suggest the need for further research into associations of minor anomalies with malignant neoplasms.

In the analysis of mortality by educational level of the mother (Chapter XIV) it is reported that the proportion of deceased children of mothers who had no education or only one or two years of primary schooling was higher in the 1–4 age group than in the neonatal period. Of those whose mothers had secondary or university education, 51.5 per cent died in the neonatal period, compared with 24.3 per cent for those whose mothers had no education. A relationship between education as a socioeconomic indicator and mortality from malignant neoplasms can also be sought. Since the numbers of deaths were small the combined data for the 13 Latin American projects are presented (Table 131). A marked contrast in the percentages is evident; 4.2 per cent of the deceased children whose mothers had secondary or university edu-

TABLE 131. Deaths from All Causes and from Malignant Neoplasms by Educational Level of Mother, in Children 1–4 Years of Age in 13 Latin American Projects Combined.

Educational level of mother[a]	Total deaths	Malignant neoplasms	
		No.	%
Total	5,972	104	1.7
Secondary, university	360	15	4.2
Primary, 3 years and over	2,347	50	2.1
Primary, 1 and 2 years	1,076	20	1.9
None	2,189	19	0.9

[a] In families in which home interviews were conducted and information was provided.

cation died from malignant neoplasms, compared with 0.9 per cent of those whose mothers had no education. Caution should be exercised in interpreting this finding in view of the other factors that may be involved. Smaller proportions of children of mothers with higher level of education died from infectious diseases than did those of mothers with no education. If certain children were at risk of dying from malignancies because of a genetic susceptibility, in certain families they may have died from an infectious disease before the age of development of the malignant neoplasm.

ENDOCRINE AND METABOLIC DISEASES

Endocrine and metabolic diseases were underlying causes of only 64 deaths in 14 of the projects, with rates varying from a low of 0.6 per 100,000 population in Bolivia to 5.5 in Sherbrooke (Table 132). Of the 103 deaths in which these diseases were assigned as associated causes nearly half (50) were found in Recife. In that project the local group frequently found acute adrenal insufficiency resulting from hemorrhage of this gland as a complication of severe dehydration and toxic states. In fact, of the 50 deaths in which these conditions were associated causes, 38 were due to diarrheal disease as underlying cause.

Cystic fibrosis of the pancreas (category 273.0), a hereditary disease of children, adolescents, and young adults characterized by generalized dysfunction of exocrine glands, was found in only 18 deaths, of which 14 occurred in eight Latin American projects, three in Sherbrooke, and one in California. In populations of Caucasian descent an incidence of cystic fibrosis (homozygotes) of about 1 in 2,000 live births

TABLE 132. Mortality[a] from Endocrine and Metabolic Diseases[b] as Underlying or Associated Causes of Death in Children Under 5 Years of Age in 15 Projects.

Project	Underlying		Associated	
	No.	Rate	No.	Rate
Total	64	3.0	103	4.9
ARGENTINA				
Chaco Province	4	5.2	—	—
San Juan Province	5	4.8	7	6.7
BOLIVIA project	1	0.6	2	1.3
BRAZIL				
Recife	4	3.2	50	40.4
Ribeirão Prêto	2	2.4	1	1.2
São Paulo	8	3.3	5	2.1
CANADA				
Sherbrooke	5	5.5	1	1.1
CHILE project	11	5.3	9	4.3
COLOMBIA				
Cali	5	4.9	2	2.0
Cartagena	—	—	4	4.7
Medellín	4	4.3	1	1.1
EL SALVADOR project	4	3.2	3	2.4
JAMAICA				
Kingston-St. Andrew	4	2.2	4	2.2
MEXICO				
Monterrey	3	1.4	5	2.3
UNITED STATES				
California project	4	2.0	9	4.4

[a] Rates per 100,000 population.
[b] Categories 240–258, 270–279.

has been reported (di Sant'Agnese and Talamo, 1967). From 2 to 4 per cent of autopsies carried out in various pediatric hospitals in the United States and abroad revealed cystic fibrosis of pancreas (di Sant'-Agnese, 1969). The small number of deaths from this disease found in several of the projects may be due principally to lack of awareness and unavailability of required diagnostic procedures. Of the 18 deaths caused by cystic fibrosis, nine occurred in the neonatal period and had as principal manifestation a meconium ileus syndrome.

Congenital anomalies were found in three of the deaths from cystic fibrosis. Two of them occurred in Sherbrooke, one in a 5-month-old child with anomaly of the tracheal cartilages (category 748.3) and the other in a newborn infant with three minor anomalies, namely, hypoplasia of the mandible (524.1) and deformities of lower and upper limbs (755). The third death was found in the California project in a 23-month-old child with Down's disease.

DEFICIENCY ANEMIAS AND OTHER DISEASES OF BLOOD AND BLOOD-FORMING ORGANS

This important group of conditions includes the anemias due to deficiency of iron, vitamins and other nutrients, the hereditary and acquired hemolytic anemias (except anemia of newborn), aplastic anemias, coagulation defects, purpuras, and other diseases of blood-forming organs.

Deficiency anemias (categories 280, 281) were assigned only exceptionally as underlying causes (in one death in each of three projects), as can be observed in Table 133. As associated causes, they were assigned in 158 deaths in 14 projects, with rates of from 0.8 to 21.3 per 100,000 population. The reasons for this relatively small involvement are, first, that nutritional anemias are rarely diagnosed with specificity and, second, whenever the presence of anemia was stated or confirmed by laboratory evidence in a child with moderate to severe malnutrition the anemia was considered a component of the general deficiency state.

The other diseases of blood and blood-forming organs (282–289) were mainly unspecified anemias, usually assigned as associated causes. Possibly many of these anemias may have resulted from deficiency of one or more nutrients, but no clarification was found in the records. In the many instances in which a bleeding tendency (purpuric episode) was present as one of the manifestations of conditions such as septicemia, no assignment was made to the hemorrhagic syndrome as an associated cause, but rather it was considered a component of the main disease. The number of deaths from all these conditions as associated causes, compared with those as underlying causes (636 as associated and 55 as underlying), reveals once more the importance of the study of mortality using the multiple-cause approach.

TABLE 133. Mortality[a] from Deficiency Anemias and Other Diseases of Blood and Blood-Forming Organs as Underlying or Associated Causes of Death in Children Under 5 Years of Age in 15 Projects.

Project	Deficiency anemias (280,281)				Other diseases of blood and blood-forming organs (282–289)			
	Underlying		Associated		Underlying		Associated	
	No.	Rate	No.	Rate	No.	Rate	No.	Rate
Total	3	0.1	158	7.5	55	2.6	636	30.3
ARGENTINA								
Chaco Province	—	—	5	6.5	1	1.3	10	13.0
San Juan Province	—	—	22	21.1	3	2.9	55	52.7
BOLIVIA project	—	—	5	3.2	4	2.5	12	7.6
BRAZIL								
Recife	—	—	27	21.8	9	7.3	94	75.9
Ribeirão Prêto	1	1.2	3	3.6	2	2.4	17	20.6
São Paulo	—	—	10	4.1	6	2.5	148	60.7
CANADA								
Sherbrooke	—	—	1	1.1	—	—	3	3.3
CHILE project	—	—	15	7.2	—	—	15	7.2
COLOMBIA								
Cali	—	—	5	4.9	3	3.0	17	16.8
Cartagena	1	1.2	13	15.1	3	3.5	33	38.4
Medellín	—	—	9	9.6	2	2.1	11	11.8
EL SALVADOR project	—	—	1	0.8	3	2.4	105	83.8
JAMAICA								
Kingston-St. Andrew	1	0.5	22	12.0	14	7.6	44	24.0
MEXICO								
Monterrey	—	—	20	9.2	2	0.9	68	31.2
UNITED STATES								
California project	—	—	—	—	3	1.5	4	2.0

[a] Rates per 100,000 population.

DISEASES OF NERVOUS SYSTEM AND SENSE ORGANS

This broad group of causes is composed of inflammatory diseases of the central nervous system and their late effects; hereditary and familial diseases of nervous system; cerebral infantile paralysis; epilepsy; and other diseases of nervous system and sense organs. In the 15 projects these conditions were assigned as underlying causes in 965 deaths of children under 5 years of age, with rates ranging from 7.7 per 100,000 population in Sherbrooke to 89.0 in São Paulo (Table 134). As associated causes they were assigned in 1,428 deaths, with rates of from 14.7 in the California project to 127.5 in Recife.

As can be seen in Table 134 and Figure 111, this group of diseases produce their most serious impact during the first year of life. The death rates as underlying causes in that age period varied from 5.9 per 100,000 live births in Sherbrooke to 304.3 in São Paulo, while those for children aged 1–4 years ranged from 6.2 in California to 40.7 in Recife. Among infants the rates for these

TABLE 134. Mortality[a] from Diseases of Nervous System and Sense Organs[b] as Underlying or Associated Causes in Children Under 5 Years, by Age Group, in 15 Projects.

Project	Underlying cause						Associated cause					
	Under 5 years		Under 1 year		1–4 years		Under 5 years		Under 1 year		1–4 years	
	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate
Total	965	46.0	656	138.4	309	18.7	1,428	68.0	1,010	213.1	418	25.3
ARGENTINA												
Chaco Province	49	63.8	36	204.5	13	21.6	60	78.1	46	261.4	14	23.2
San Juan Province	70	67.0	51	218.3	19	22.6	110	105.3	87	372.4	23	27.3
BOLIVIA project	50	31.6	24	63.8	26	21.2	57	36.1	28	74.4	29	23.6
BRAZIL												
Recife	83	67.0	44	144.7	39	40.7	158	127.5	107	352.0	51	53.2
Ribeirão Prêto	37	44.8	27	148.0	10	15.4	58	70.3	38	208.3	20	30.7
São Paulo	217	89.0	177	304.3	40	21.2	234	96.0	195	335.3	39	20.7
CANADA												
Sherbrooke	7	7.7	1	5.9	6	8.1	14	15.4	10	58.9	4	5.4
CHILE project	116	55.8	84	192.7	32	19.1	126	60.6	103	236.3	23	13.7
COLOMBIA												
Cali	46	45.5	26	123.2	20	24.7	54	53.4	28	132.7	26	32.1
Cartagena	25	29.1	18	100.6	7	10.2	60	69.8	36	201.1	24	34.9
Medellín	39	41.8	25	128.9	14	18.8	63	67.5	29	149.5	34	45.6
EL SALVADOR project	47	37.5	25	80.6	22	22.8	92	73.4	62	199.9	30	31.1
JAMAICA												
Kingston-St. Andrew	57	31.1	29	70.8	28	19.5	76	41.5	54	131.8	22	15.3
MEXICO												
Monterrey	97	44.5	74	139.6	23	13.5	236	108.3	165	311.3	71	41.8
UNITED STATES												
California project	25	12.3	15	33.5	10	6.2	30	14.7	22	49.2	8	5.0

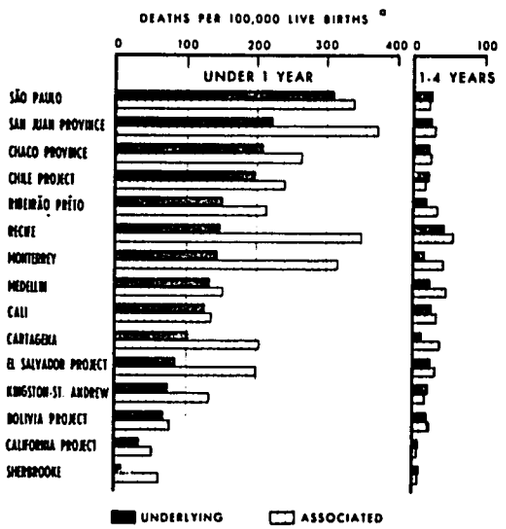
[a] Rates under 1 year of age per 100,000 live births; others per 100,000 population.
[b] Categories 320–389, with the addition of a few associated causes in 310–315.

diseases as associated causes were always higher than those as underlying causes, and in general the same was noted in children 1–4 years of age. The largest number of morbid conditions in the group consisted of inflammatory diseases of the central nervous system (excluding specific diseases with localization in or invasion of that system, such as viral encephalitis, tuberculous meningitis and others, which are coded in the group of infective and parasitic diseases).

Inflammatory diseases of the central nervous system (categories 320–324) alone were responsible for 513 deaths and were assigned as associated causes in 674 in the 15 projects (Table 135). The lowest rates were found in the Sherbrooke and California projects. Rates several times higher in the Latin American projects, where diagnostic procedures may not be as frequently utilized, reflect the size of this problem and the need for improving health care to prevent these serious diseases and their late effects.

Cerebral spastic infantile paralysis (category 343) includes a large number of conditions such as cerebral infantile palsy, spastic diplegia, paralysis due to birth injury and others, and the causes of these conditions are extensive. In the 15 projects 105 deaths were assigned to this category as underlying cause and 63 as associated cause (Table 135). The variation in rates

FIG. 111. Mortality from Diseases of Nervous System and Sense Organs as Underlying or Associated Causes in Children Under 5 Years, by Age Group, in 15 Projects.



[a] For 1-4 years, per 100,000 population.

was great, with those as underlying cause going from 1.1 and 1.2 per 100,000 population in the Sherbrooke and Ribeirão Prêto projects to over 9 in Chile and São Paulo, as is shown in Figure 112. Most of these deaths had the precedent of difficult labor with trauma or asphyxia, or a history of severe asphyxia at birth. No double coding was used when the cerebral palsy was due to complications of labor or delivery. The marked variations in mortality from this morbid state indicate the need to search for causes such as complications of labor and delivery in each of the project areas.

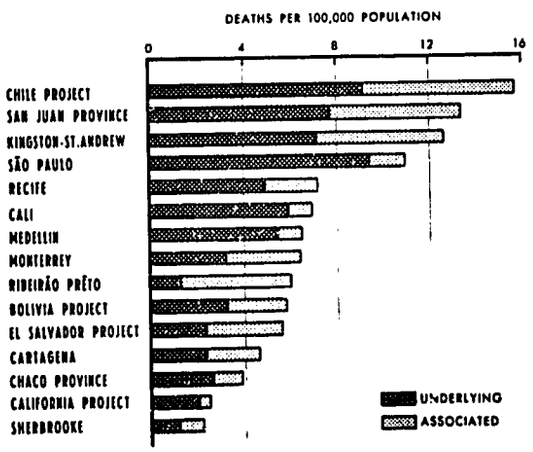
The various forms of disorders included in category 345 (epilepsy) were not found to be significant as underlying or associated causes of death. The forms encountered were of the generalized convulsive type known to be relatively infrequent in small children. Less than 2 per cent of children have an onset under 2 years of age (Livingston, 1954). In the 15 projects only 33 deaths were reported as due to epilepsy as underlying cause and 26 as associated cause. The figures obtained cannot be taken as a measure of the incidence of epilepsy. The need is clear, however, for prompt recognition and supervised treatment to help prevent deaths as well as complications in survivors.

TABLE 135. Mortality[a] from Certain Diseases of Nervous System as Underlying or Associated Causes in Children Under 5 Years of Age in 15 Projects.

Project	Inflammatory diseases (320–324)				Cerebral spastic infantile paralysis (343)				Epilepsy (345)			
	Underlying		Associated		Underlying		Associated		Underlying		Associated	
	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate
Total	513	24.4	674	32.1	105	5.0	63	3.0	33	1.6	26	1.2
ARGENTINA												
Chaco Province	27	35.2	38	49.5	2	2.6	1	1.3	2	2.6	1	1.3
San Juan Province	50	47.9	44	42.1	8	7.7	6	5.7	—	—	2	1.9
BOLIVIA project	35	22.1	33	20.9	5	3.2	4	2.5	2	1.3	2	1.3
BRAZIL												
Recife	42	33.9	50	40.4	6	4.8	3	2.4	4	3.2	3	2.4
Ribeirão Prêto	20	24.2	19	23.0	1	1.2	4	4.8	1	1.2	—	—
São Paulo	73	30.0	84	34.5	23	9.4	4	1.6	3	1.2	2	0.8
CANADA												
Sherbrooke	2	2.2	11	12.1	1	1.1	1	1.1	—	—	—	—
CHILE project	72	34.7	57	27.4	19	9.1	14	6.7	—	—	4	1.9
COLOMBIA												
Cali	31	30.6	35	34.6	6	5.9	1	1.0	1	1.0	1	1.0
Cartagena	12	14.0	45	52.3	2	2.3	2	2.3	—	—	—	—
Medellín	19	20.4	20	21.4	5	5.4	1	1.1	5	5.4	7	7.5
EL SALVADOR project	26	20.8	45	35.9	3	2.4	4	3.2	5	4.0	2	1.6
JAMAICA												
Kingston-St. Andrew	34	18.6	28	15.3	13	7.1	10	5.5	3	1.6	2	1.1
MEXICO												
Monterrey	59	27.1	143	65.6	7	3.2	7	3.2	6	2.8	—	—
UNITED STATES												
California project	11	5.4	22	10.8	4	2.0	1	0.5	1	0.5	—	—

[a] Rates per 100,000 population.

FIG. 112. Mortality from Cerebral Spastic Infantile Paralysis as Underlying or Associated Cause in Children Under 5 Years of Age in 15 Projects.



DISEASES OF RESPIRATORY SYSTEM

This broad group of respiratory diseases (categories 460–519) includes upper respiratory infections, acute bronchitis, influenza, pneumonias, and other diseases of the respiratory system. It does not include specific infections such as tuberculosis and whooping cough, or any other condition coded in the group of infective and parasitic diseases.

These morbid conditions were second to diarrheal disease as underlying cause of death in children under 5 years of age in the 15 projects. They were responsible for 5,741 deaths, with rates going from 35.1 and 40.3 per 100,000 population in the Sherbrooke and California projects up to 866.2 in the Bolivia project (Table 136). In addition, they were assigned as associated causes in 10,298 deaths, with rates ranging from 38.4 and 53.5 in the Northern American projects to the exceedingly high rate of 1,147.6 in Recife.

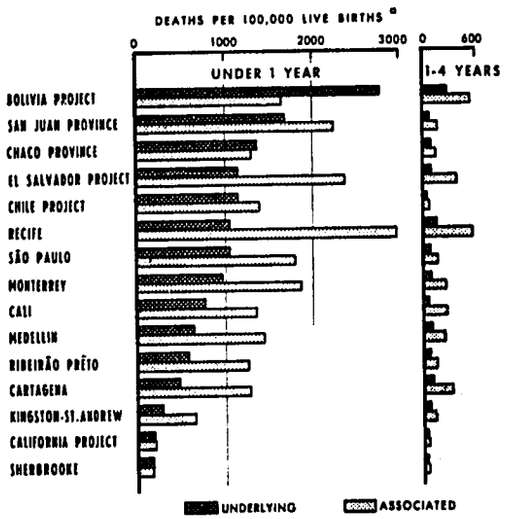
Table 136 and Figure 113 show the rates per 100,000 live births for infant deaths and per 100,000 population for deaths of children aged 1–4 years. In all projects, mortality from respiratory diseases as underlying or associated causes was several times higher in infancy than in early childhood.

TABLE 136. Mortality[a] from Diseases of Respiratory System[b] as Underlying or Associated Causes in Children Under 5 Years, by Age Group, in 15 Projects.

Project	Underlying cause						Associated cause					
	Under 5 years		Under 1 year		1–4 years		Under 5 years		Under 1 year		1–4 years	
	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate
Total	5,741	273.5	4,650	980.9	1,091	66.0	10,298	490.6	7,060	1,489.3	3,238	195.8
ARGENTINA												
Chaco Province	279	363.3	237	1,346.6	42	69.6	309	402.3	229	1,301.1	80	132.6
San Juan Province	431	412.6	394	1,686.6	37	44.0	641	613.6	526	2,251.7	115	136.6
BOLIVIA project	1,369	866.2	1,035	2,751.9	334	272.3	1,243	786.5	618	1,643.2	625	509.5
BRAZIL												
Recife	445	359.1	316	1,039.5	129	134.6	1,422	1,147.6	901	2,963.8	521	543.8
Ribeirão Prêto	120	145.5	98	537.3	22	33.8	309	374.5	228	1,250.0	81	124.5
São Paulo	700	290.9	604	1,038.5	105	55.7	1,317	540.4	1,045	1,796.8	272	144.4
CANADA												
Sherbrooke	32	35.1	27	159.1	5	6.7	35	38.4	25	147.3	10	13.5
CHILE project	541	260.4	494	1,133.5	47	28.1	708	340.8	610	1,399.7	98	58.5
COLOMBIA												
Cali	203	200.6	161	763.0	42	51.9	484	478.3	290	1,374.4	194	239.8
Cartagena	123	143.0	82	458.1	41	59.6	440	511.6	231	1,290.5	209	303.8
Medellín	155	166.1	123	634.0	32	42.9	448	480.2	281	1,448.5	167	223.9
EL SALVADOR project	444	354.4	361	1,163.8	83	85.9	1,090	870.0	738	2,379.1	352	364.4
JAMAICA												
Kingston-St. Andrew	166	90.6	118	288.1	48	33.4	374	204.1	269	656.7	105	73.1
MEXICO												
Monterrey	642	294.6	523	986.6	119	70.1	1,369	628.2	985	1,858.1	384	226.1
UNITED STATES												
California project	82	40.3	77	172.1	5	3.1	109	53.5	84	187.8	25	15.5

[a] Rates under 1 year of age per 100,000 live births; others per 100,000 population.
[b] Categories 460–519.

FIG. 113. Mortality from Diseases of Respiratory System as Underlying or Associated Causes in Children Under 5 Years, by Age Group, in 15 Projects.



[a] For 1-4 years, per 100,000 population.

In fact, the rates as underlying causes in infancy varied from 159.1 in Sherbrooke to 2,751.9 in the Bolivia project, while those in children 1–4 years ranged from 3.1 in the California project to 272.3 in Bolivia. Essentially the same pattern of variation was found for these diseases as associated causes.

With the exception of the projects in Bolivia, Chaco Province, and Sherbrooke, death rates from diseases of the respiratory system in infancy were higher as associated causes than as underlying causes. In six projects they were more than twice as high as associated causes. In the Bolivia project the problem of these diseases as underlying causes seems to be particularly serious, while in Recife the rate as associated causes was exceedingly high, owing mainly to complications of measles and nutritional deficiency.

Of the 5,741 deaths from diseases of the respiratory system, 4,576 were classified in the group pneumonia and influenza (470–486). Although deaths from this latter group are referred to in various parts of this report and are given in the Appendix tables for each area, only 55 deaths or 1.2 per cent were due to influenza (470–474). In regard to this group of diseases, in many instances it was possible to identify one or more bacterial agents, though for many deaths the diagnosis was not confirmed by special bacteriologic studies. The distinction between pneumonia and bronchopneumonia was based sometimes on radiologic studies but more often on clinical and autopsy findings. Differences in terminology made it necessary to consult with the local groups to clarify the classification. For example, in several areas the term acute pneumopathy (in Spanish *neumopatía aguda*) (category 519.2) is commonly used to mean pneumonia unspecified (486). Another problem

was encountered in connection with use of the term grippe, an inclusion term in the group influenza. In several areas "grippe" is used to signify an upper respiratory infection. Thus, some of the 55 deaths assigned to influenza might in fact belong to the group of upper respiratory infections or to pneumonia.

The association of bronchopneumonia with infectious diseases (diarrheal disease, measles, whooping cough, and others) was very common and was observed usually as a terminal condition. In many of those deaths the contribution of nutritional deficiency was very important. It seems apparent, from a review of the records of such deaths, that as diagnostic and recording procedures are improved the role of lower respiratory conditions as underlying causes decreases and they become more significant as associated conditions (consequences) of other causes of death.

DISEASES OF CIRCULATORY SYSTEM

In the 15 projects 59 deaths from diseases of the circulatory system were assigned as underlying causes (Table 137). A few occurred in each of 14 projects; São Paulo, with 20 deaths, had the highest rate (8.2 per 100,000 population) while the Bolivia project, with 9 deaths, had the second highest (5.7). The conditions most commonly assigned as underlying cause were myocarditis (category 422) and cardiac insufficiency of unspecified origin (428). Rheumatic fever, included in this group in the *International Classification of Diseases* (categories 390–392), was found as underlying cause of only five deaths: two in Recife, two in Ribeirão Prêto, and one in Chaco Province.

Diseases in this group were associated causes in 936 deaths, the most frequent among the conditions assigned being congestive heart failure and cardiac insufficiency, pericarditis, and myocarditis. They were usually the consequences of infectious diseases such as diphtheria, and of respiratory disease, congenital anomalies, overhydration during treatment of dehydration accompanying diarrheal disease, severe anemias, and others.

TABLE 137. Mortality[a] from Diseases of Circulatory System[b] as Underlying or Associated Causes in Children Under 5 Years of Age in 15 Projects.

Project	Underlying		Associated	
	No.	Rate	No.	Rate
Total	59	2.8	936	44.6
ARGENTINA				
Chaco Province	3	3.9	12	15.6
San Juan Province	3	2.9	50	47.9
BOLIVIA project	9	5.7	17	10.8
BRAZIL				
Recife	3	2.4	101	81.5
Ribeirão Prêto	3	3.6	31	37.6
São Paulo	20	8.2	153	62.8
CANADA				
Sherbrooke	1	1.1	16	17.6
CHILE project	—	—	79	38.0
COLOMBIA				
Cali	1	1.0	34	33.6
Cartagena	2	2.3	47	54.7
Medellín	3	3.2	53	56.8
EL SALVADOR project	1	0.8	104	83.0
JAMAICA				
Kingston-St. Andrew	4	2.2	98	53.5
MEXICO				
Monterrey	4	1.8	105	48.2
UNITED STATES				
California project	2	1.0	36	17.7

[a] Rates per 100,000 population.
[b] Categories 390–458.

DISEASES OF DIGESTIVE SYSTEM

This group (categories 520–577) includes abnormal conditions of organs and tissues of the mouth, of the salivary glands, esophagus, stomach, intestine, peritoneum, liver, and pancreas. The specific infectious diseases and the congenital anomalies of this system are not included, although the hernias and a few congenital abnormalities of the mandibles have been included.

There were 217 deaths of children under 5 years of age in which these diseases were assigned as underlying causes. The rates varied from 4.9 per 100,000 population in the California project to 18.2 in San Juan Province (Table 138). The conditions most frequently encountered as underlying causes were hernias, intestinal obstructions such as intussusception and volvulus (not congenital), and unspecified diseases of the liver such as acute necrosis (570) and others (573).

Diseases of the digestive system contributed to 1,103 deaths as associated causes, with rates varying from 6.6 in Sherbrooke to 142.9 in the El Salvador project. Intestinal obstruction was the most frequent associated cause in this group.

TABLE 138. Mortality[a] from Diseases of Digestive System[b] as Underlying or Associated Causes in Children Under 5 Years of Age in 15 Projects.

Project	Underlying		Associated	
	No.	Rate	No.	Rate
Total	217	10.3	1,103	52.6
ARGENTINA				
Chaco Province	13	16.9	12	15.6
San Juan Province	19	18.2	140	134.0
BOLIVIA project	28	17.7	32	20.2
BRAZIL				
Recife	17	13.7	105	84.7
Ribeirão Prêto	4	4.8	29	35.2
São Paulo	28	11.5	139	57.0
CANADA				
Sherbrooke	5	5.5	6	6.6
CHILE project	16	7.7	54	26.0
COLOMBIA				
Cali	10	9.9	32	31.6
Cartagena	13	15.1	75	87.2
Medellín	6	6.4	41	43.9
EL SALVADOR project	11	8.8	179	142.9
JAMAICA				
Kingston-St. Andrew	23	12.6	40	21.8
MEXICO				
Monterrey	14	6.4	190	87.2
UNITED STATES				
California project	10	4.9	29	14.2

[a] Rates per 100,000 population.
[b] Categories 520–577.

OTHER DISEASES

The broad group of diseases of the genito-urinary system (categories 580–629) acted as underlying causes of 138 deaths (Table 139). Of these, 48 occurred in São Paulo; on reviewing the master tabulations of this project it was found that most of these deaths were due to pyelonephritis and to urinary tract infection not otherwise specified, only two being due to acute glomerulonephritis.

As associated causes the diseases of the genito-urinary system contributed to 589 deaths in the 15 projects. Infections of the urinary tract were most commonly found

to be associated with congenital anomalies of the urinary system, infections of the intestinal tract, and with severe forms of nutritional deficiency.

Diseases of the skin and subcutaneous tissue (categories 680–709) were responsible for 164 deaths (Table 140). From the viewpoint of mortality, the infections of skin and subcutaneous tissue (680–686) were by far the most important, and of these, boil and carbuncle (680), cellulitis (681–682), impetigo (684), and other localized infections of skin (686) predominated as associated or underlying causes. In many of the deaths in which these conditions were assigned as underlying cause, and particularly in small infants, septicemia was the consequence. In the 15 projects they were associated causes in 460 deaths, with rates per 100,000 population varying from 0.5 in California to 66.2 in Recife. In the former project only one death was due to one of these conditions as associated cause, and none as underlying cause. In Sherbrooke only two deaths were due to these conditions as underlying causes. Low mortality from these infections of the skin in certain projects is an indication of the value of adequate standards of hygiene in the handling of infants.

Diseases of the musculoskeletal system and connective tissue (categories 710–738) were the underlying causes of only 12 deaths in seven of the projects and were assigned as associated causes in another 12 deaths in eight projects.

TABLE 139. Mortality[a] from Diseases of Genito-Urinary System[b] as Underlying or Associated Causes in Children Under 5 Years of Age in 15 Projects.

Project	Underlying		Associated	
	No.	Rate	No.	Rate
Total	138	6.6	589	28.1
ARGENTINA				
Chaco Province	5	6.5	17	22.1
San Juan Province	7	6.7	20	19.1
BOLIVIA project	3	1.9	17	10.8
BRAZIL				
Recife	5	4.0	50	40.4
Ribeirão Prêto	7	8.5	9	10.9
São Paulo	48	19.7	127	52.1
CANADA				
Sherbrooke	—	—	3	3.3
CHILE project	9	4.3	47	22.6
COLOMBIA				
Cali	11	10.9	25	24.7
Cartagena	10	11.6	61	70.9
Medellín	5	5.4	38	40.7
EL SALVADOR project	4	3.2	34	27.1
JAMAICA				
Kingston-St. Andrew	3	1.6	17	9.3
MEXICO				
Monterrey	19	8.7	115	52.8
UNITED STATES				
California project	2	1.0	9	4.4

[a] Rates per 100,000 population.
[b] Categories 580–629.

TABLE 140. Mortality[a] from Diseases of Skin and Subcutaneous Tissue[b] as Underlying or Associated Causes in Children Under 5 Years of Age in 15 Projects.

Project	Underlying		Associated	
	No.	Rate	No.	Rate
Total	164	7.8	460	21.9
ARGENTINA				
Chaco Province	12	15.6	14	18.2
San Juan Province	10	9.6	34	32.5
BOLIVIA project	10	6.3	11	7.0
BRAZIL				
Recife	39	31.5	82	66.2
Ribeirão Prêto	8	9.7	14	17.0
São Paulo	10	4.1	61	25.0
CANADA				
Sherbrooke	2	2.2	—	—
CHILE project	13	6.3	35	16.8
COLOMBIA				
Cali	5	4.9	26	25.7
Cartagena	5	5.8	25	29.1
Medellín	10	10.7	25	26.8
EL SALVADOR project	14	11.2	59	47.1
JAMAICA				
Kingston-St. Andrew	7	3.8	17	9.3
MEXICO				
Monterrey	19	8.7	56	25.7
UNITED STATES				
California project	—	—	1	0.5

[a] Rates per 100,000 population.
[b] Categories 680–709.

MORTALITY FROM EXTERNAL CAUSES

As mortality from infectious diseases and nutritional deficiency is reduced to low levels, external causes of death assume increasing importance in childhood. The growing magnitude of the problems created by accidents and other external causes calls for increased efforts to find solutions and to develop methods for reducing mortality and disability from the preventable causes. Concern over these problems was expressed by the Member Governments of the Pan American Health Organization during the technical discussions on prevention of accidents in childhood held in the course of the XV Pan American Sanitary Conference (PAHO, 1958).

In the 15 projects 847 deaths of children under 5 years of age were due to external causes, which gave a rate of 40.4 per 100,000 population (Table 141). In the projects in Northern America a significant proportion of deaths in early childhood (1–4 years) were due to these causes: 28 out of 61 in Sherbrooke and 47 out of 114 in the California project.

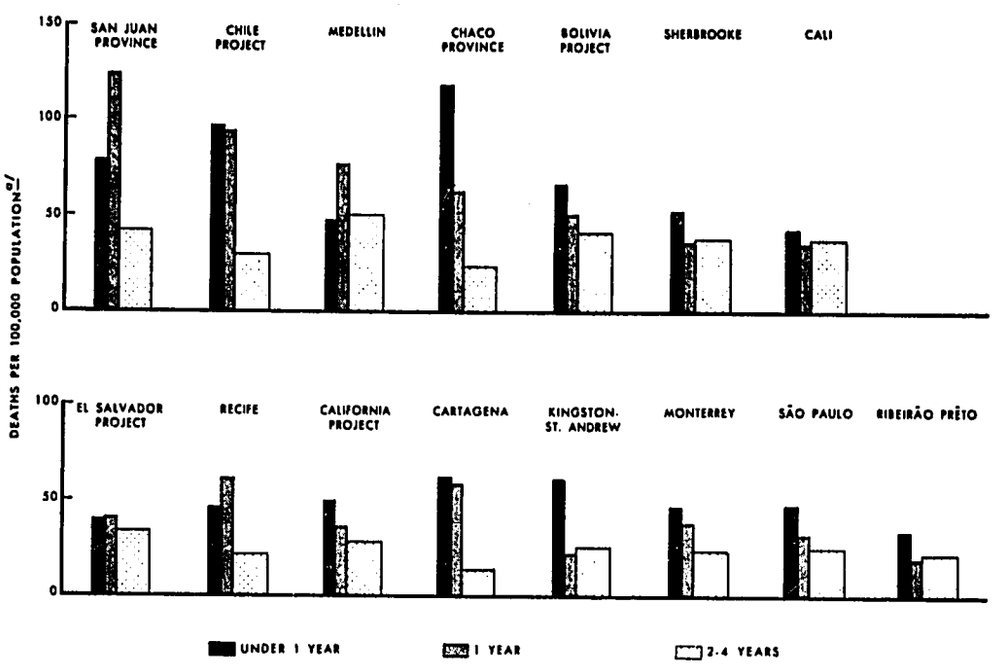
The distribution of mortality from external causes by age group is shown in Figure 114 for the 15 projects, in descending order of the total death rates from these

TABLE 141. Mortality[a] from External Causes[b] in Children Under 5 Years, by Age Group, in 15 Projects.

Project	Under 5 years		Under 1 year		1 year		2–4 years	
	No.	Rate	No.	Rate	No.	Rate	No.	Rate
Total	847	40.4	274	57.8	214	49.4	359	29.4
ARGENTINA								
Chaco Province	41	53.4	21	119.3	10	62.7	10	22.5
San Juan Province	70	67.0	18	77.1	26	123.6	26	41:2
BOLIVIA project	80	50.6	25	66.5	17	50.3	38	42.8
BRAZIL								
Recife	44	35.5	14	46.1	16	59.7	14	20.3
Ribeirão Prêto	19	23.0	6	32.9	3	17.6	10	20.8
São Paulo	77	31.6	27	46.4	17	31.4	33	24.6
CANADA								
Sherbrooke	37	40.6	9	53.0	6	35.3	22	38.4
CHILE project	118	56.8	42	96.4	38	94.4	38	29.9
COLOMBIA								
Cali	39	38.5	9	42.7	7	34.7	23	37.9
Cartagena	28	32.6	11	61.5	10	58.1	7	13.6
Medellín	51	54.7	9	46.4	14	75.3	28	50.0
EL SALVADOR project	46	36.7	12	38.7	11	40.2	23	33.2
JAMAICA								
Kingston-St. Andrew	59	32.2	25	61.0	8	20.5	26	24.9
MEXICO								
Monterrey	69	31.7	24	45.3	17	37.8	28	22.4
UNITED STATES								
California project	69	33.9	22	49.2	14	35.0	33	27.3

[a] Rates under 1 year of age per 100,000 live births; others per 100,000 population.
[b] Categories E800–E989.

FIG. 114. Mortality from External Causes in Children Under 5 Years, by Age Group, in 15 Projects.



a/Under 1 year per 100,000 live births

causes. The highest figure (67.0 per 100,000 population) was in San Juan Province and the lowest (23.0) in Ribeirão Prêto.

Though the proportions of deaths due to external causes were higher in children aged 1–4 years, the rates were highest in infancy in 11 of the projects; in four others they were highest in the second year of life. Thus, very young children must be protected from external causes as well as older ones.

Variations in the rates occurred as the result of differences in frequency of fatal injuries of several different types. Deaths in the 15 projects combined for nine groups of external causes were as follows:

	No. of deaths
Motor vehicle accidents (E810–E823)	191
Accidental poisoning (E850–E877) ..	64
Accidental falls (E880–E887)	70
Accidents caused by fires and flames (E890–E899)	70
Accidental drowning and submersion (E910)	103
Accidental obstruction or suffocation by food or other object, and mechanical suffocation (E911–E913)	124
Accident caused by hot substance, corrosive liquid, and steam (E924) ...	65
Homicide (E960–E969)	36
All other external causes (rest of E800–E989)	124

The data for these nine groups are given by age at death in Tables 142, 143, and 144.

Motor vehicle accidents caused 191 deaths or 22.6 per cent of the total from external causes. The rates varied widely, from the low of 0.8 per 100,000 population due to one death in Recife to the high of 19.8 in the Sherbrooke project due to 18 deaths (Figure 115). In fact, in that project nearly half the deaths from external causes were due to motor vehicle accidents (18 of 37 deaths). The Bolivia project had the second highest rate, 19.0 per 100,000 population due to 30 deaths.

Mortality from motor vehicle accidents was higher in the 1–4-year age group than in infancy for the 15 projects combined; only 18 of the 191 deaths from this cause were of infants. The child aged 1–4 years is at greater risk of such accidents, when walking on streets and highways and also riding as a passenger.

Four other types of accidents caused many deaths in children aged 1–4 years: poisoning, fires, burns by hot substance, and drowning. Deaths from these causes in that age group as well as in all children under 5 years are given in Table 143. In addition to the 70 deaths due to fires, there were 65 in which burns from hot substance were the underlying cause. Only one project had no deaths due to this cause; three projects had one each, but the others had from 2 to 14 deaths.

Drowning caused 103 deaths, of which 32 were in San Juan Province, where the rate was high for children 1–4 years (36.8 per 100,000 population). Many of these accidental deaths were due to falls into canals of the irrigation system.

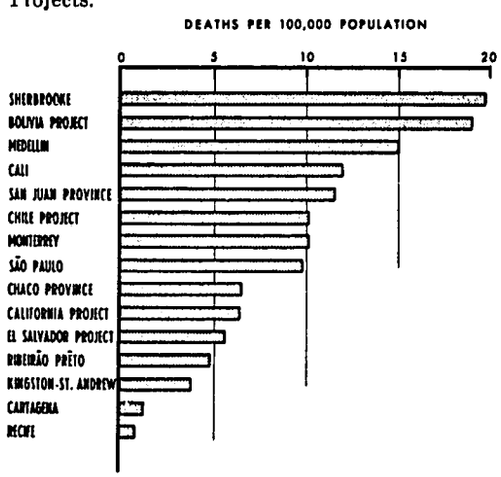
Four other types of external causes were responsible for deaths principally in infancy. These were falls, obstruction and

TABLE 142. Mortality[a] from Motor Vehicle Accidents[b] in Children Under 5 Years, by Age Group, in 15 Projects.

Project	Under 5 years		Under 1 year		1–4 years	
	No.	Rate	No.	Rate	No.	Rate
Total	191	9.1	18	3.8	173	10.5
ARGENTINA						
Chaco Province	5	6.5	1	5.7	4	6.6
San Juan Province	12	11.5	5	21.4	7	8.3
BOLIVIA project	30	19.0	4	10.6	26	21.2
BRAZIL						
Recife	1	0.8	—	—	1	1.0
Ribeirão Prêto	4	4.8	—	—	4	6.1
São Paulo	24	9.8	2	3.4	22	11.7
CANADA						
Sherbrooke	18	19.8	3	17.7	15	20.2
CHILE project	21	10.1	—	—	21	12.5
COLOMBIA						
Cali	12	11.9	—	—	12	14.8
Cartagena	1	1.2	—	—	1	1.5
Medellín	14	15.0	1	5.2	13	17.4
EL SALVADOR project	7	5.6	—	—	7	7.2
JAMAICA						
Kingston-St. Andrew	7	3.8	—	—	7	4.9
MEXICO						
Monterrey	22	10.1	1	1.9	21	12.4
UNITED STATES						
California project	13	6.4	1	2.2	12	7.5

[a] Rates under 1 year of age per 100,000 live births; others per 100,000 population.
[b] Categories E810–E823.

FIG. 115. Mortality from Motor Vehicle Accidents in Children Under 5 Years of Age in 15 Projects.



..., homicide, and a miscellaneous group of other and unspecified external causes (Table 144). Deaths from obstruction and suffocation included a few that occurred in the first few days of life, due to aspiration of milk and also to mechanical suffocation in bed, the latter usually occurring under conditions of overcrowding. This group also included some of the so-called sudden deaths in which the clinical and autopsy evidence indicated that the child suffocated on aspirating regurgitated food. Evidence has been presented (Emery, 1959) to show that a healthy infant does not aspirate sufficient regurgitated material to suffocate. However, deaths were assigned to aspiration of food or vomitus in those infants in whom presence of aspirated food was the only finding on postmortem examination. Likewise, suffocation in bed has been considered unlikely in normal infants (Woolley, 1945), unless overcrowded conditions exist or the persons sharing the sleeping facilities are under the influence of drugs or alcohol. This may have been the case in several deaths assigned to "overlaid in bed" (E913.0).

Thirty-six deaths were due to homicide and at least one such death occurred in 12 of the 15 projects (Table 144); 22 of these

TABLE 143. Mortality[a] from Four Types of Accidents in Children Under 5 Years and 1–4 Years of Age in 15 Projects.

Projects	Under 5 years								1–4 years							
	Poisoning (E850–E877)		Fires (E890–E899)		Hot substance (E924)		Drowning (E910)		Poisoning (E850–E877)		Fires (E890–E899)		Hot substance (E924)		Drowning (E910)	
	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate
Total	64	3.0	70	3.3	65	3.1	103	4.9	52	3.1	50	3.0	52	3.1	97	5.9
ARGENTINA																
Chaco Province	6	7.8	2	2.6	1	1.3	10	13.0	3	5.0	1	1.7	—	—	9	14.9
San Juan Province	7	6.7	1	1.0	2	1.9	32	30.6	6	7.1	1	1.2	1	1.2	31	36.8
BOLIVIA project	6	3.8	5	3.2	6	3.8	2	1.3	2	1.6	3	2.4	4	3.3	1	0.8
BRAZIL																
Recife	4	3.2	4	3.2	3	2.4	5	4.0	4	4.2	2	2.1	3	3.1	4	4.2
Ribeirão Prêto	4	4.8	1	1.2	1	1.2	—	—	3	4.6	1	1.5	1	1.5	—	—
São Paulo	4	1.6	2	0.8	4	1.6	10	4.1	4	2.1	2	1.1	3	1.6	10	5.3
CANADA																
Sherbrooke	1	1.1	2	2.2	—	—	5	5.5	1	1.3	1	1.3	—	—	5	6.7
CHILE project	7	3.4	14	6.7	8	3.9	18	8.7	7	4.2	7	4.2	8	4.8	17	10.1
COLOMBIA																
Cali	3	3.0	4	4.0	4	4.0	3	3.0	2	2.5	4	4.9	3	3.7	3	3.7
Cartagena	—	—	3	3.5	5	5.8	3	3.5	—	—	1	1.5	5	7.3	3	4.4
Medellín	8	8.6	3	3.2	4	4.3	3	3.2	8	10.7	3	4.0	3	4.0	3	4.0
EL SALVADOR project	4	3.2	6	4.8	8	6.4	1	0.8	4	4.1	5	5.2	6	6.2	1	1.0
JAMAICA																
Kingston-St. Andrew	5	2.7	11	6.0	4	2.2	1	0.5	5	3.5	9	6.3	3	2.1	1	0.7
MEXICO																
Monterrey	2	0.9	1	0.5	14	6.4	—	—	2	1.2	1	0.6	11	6.5	—	—
UNITED STATES																
California project	3	1.5	11	5.4	1	0.5	10	4.9	1	0.6	9	5.6	1	0.6	9	5.6

[a] Rates per 100,000 population.

TABLE 144. Mortality[a] from Four Types of External Causes in Children Under 5 Years of Age and Under One Year in 15 Projects.

Project	Under 5 years								Under 1 year							
	Falls (E880–E887)		Obstruction, suffocation (E911–E913)		Homicide (E960–E969)		Rest of E800–E989		Falls (E880–E887)		Obstruction, suffocation (E911–E913)		Homicide (E960–E969)		Rest of E800–E989	
	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate
Total	70	3.3	124	5.9	36	1.7	124	5.9	27	5.7	99	20.9	22	4.6	57	12.0
ARGENTINA																
Chaco Province	—	—	5	6.5	7	9.1	5	6.5	—	—	5	28.4	5	28.4	4	22.7
San Juan Province	5	4.8	7	6.7	—	—	4	3.8	3	12.8	4	17.1	—	—	3	12.8
BOLIVIA project	7	4.4	4	2.5	4	2.5	16	10.1	—	—	4	10.6	2	5.3	6	16.0
BRAZIL																
Recife	11	8.9	6	4.8	—	—	10	8.1	6	19.7	3	9.9	—	—	2	6.6
Ribeirão Prêto	1	1.2	4	4.8	1	1.2	3	3.6	—	—	4	21.9	1	5.5	—	—
São Paulo	5	2.1	11	4.5	3	1.2	14	5.7	2	3.4	10	17.2	2	3.4	10	17.2
CANADA																
Sherbrooke	2	2.2	4	4.4	2	2.2	3	3.3	—	—	3	17.7	1	5.9	1	5.9
CHILE project	7	3.4	26	12.5	4	1.9	13	6.3	2	4.6	22	50.5	3	6.9	7	16.1
COLOMBIA																
Cali	3	3.0	4	4.0	1	1.0	5	4.9	1	4.7	4	19.0	1	4.7	1	4.7
Cartagena	6	7.0	4	4.7	—	—	6	7.0	2	11.2	3	16.8	—	—	4	22.3
Medellín	4	4.3	6	6.4	2	2.1	7	7.5	1	5.2	5	25.8	—	—	1	5.2
EL SALVADOR project	5	4.0	6	4.8	2	1.6	7	5.6	3	9.7	1	3.2	2	6.4	3	9.7
JAMAICA																
Kingston-St. Andrew	5	2.7	13	7.1	2	1.1	11	6.0	2	4.9	13	31.7	1	2.4	6	14.6
MEXICO																
Monterrey	4	1.8	13	6.0	1	0.5	12	5.5	3	5.7	10	18.9	1	1.9	6	11.3
UNITED STATES																
California project	5	2.5	11	5.4	7	3.4	8	3.9	2	4.5	8	17.9	3	6.7	3	6.7

[a] Rates under 1 year of age per 100,000 live births; others per 100,000 population.

deaths were of infants and several occurred soon after birth (infanticide because a child was not wanted).

The variety of external causes of death found in each project indicates the advisability of undertaking local studies of these problems to provide bases for preventive programs.

SUDDEN DEATH

Of the 35,095 deaths in the Investigation, 280 were classed as sudden death[a] (category 795). These occurred most frequently in infants aged 28 days to 5 months, 197 out of the 280 deaths being in that age group. Table 145 gives the numbers of deaths by age and the rates in infancy per 100,000 live births. Only 12 of the deaths were in children from 1–4 years old.

Four projects had high mortality in infancy, namely, San Juan Province, Chile,

[a] In the Investigation sudden death was defined as the death of a child who was believed to be in good health and without evidence of a specific disease or external cause in the clinical history or autopsy.

TABLE 145. Mortality[a] from Sudden Death (795) in Children Under 5 Years, by Age Group, in 15 Projects.

Project	Under 5 years	Under 1 year		Under 28 days		28 days-5 months		6-11 months		1-4 years
	No.	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.
Total	280	268	56.5	53	11.2	197	41.6	18	3.8	12
ARGENTINA										
Chaco Province	8	7	39.8	2	11.4	5	28.4	—	—	1
San Juan Province	22	22	94.2	5	21.4	16	68.5	1	4.3	—
BOLIVIA project	14	13	34.6	3	8.0	9	23.9	1	2.7	1
BRAZIL										
Recife	5	5	16.4	3	9.9	1	3.3	1	3.3	—
Ribeirão Prêto	6	5	27.4	3	16.4	2	11.0	—	—	1
São Paulo	18	16	27.5	3	5.2	13	22.4	—	—	2
CANADA										
Sherbrooke	6	6	35.4	—	—	5	29.5	1	5.9	—
CHILE project	51	50	114.7	5	11.5	42	96.4	3	6.9	1
COLOMBIA										
Cali	14	14	66.4	6	28.4	7	33.2	1	4.7	—
Cartagena	9	9	50.3	—	—	9	50.3	—	—	—
Medellín	16	13	67.0	6	30.9	7	36.1	—	—	3
EL SALVADOR project	12	11	35.5	3	9.7	7	22.6	1	3.2	1
JAMAICA										
Kingston-St. Andrew	36	35	85.4	12	29.3	22	53.7	1	2.4	1
MEXICO										
Monterrey	26	25	47.2	2	3.8	19	35.8	4	7.5	1
UNITED STATES										
California project	37	37	82.7	—	—	33	73.8	4	8.9	—

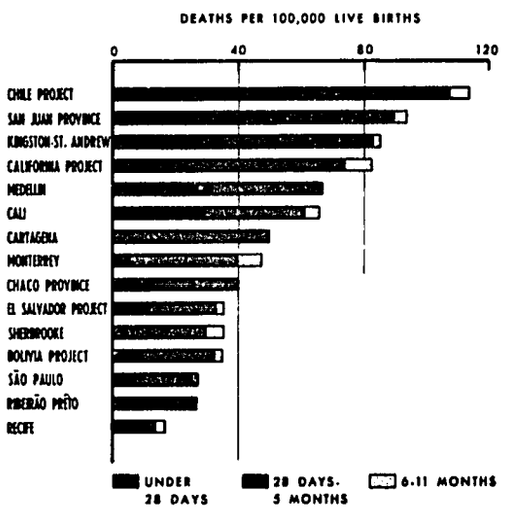
[a] Rates per 100,000 live births.

Kingston-St. Andrew, and California, with rates of from 82.7 to 114.7 per 100,000 live births (Figure 116). The latter three were projects with relatively low infant death rates from all causes.

In four projects the rates went from 47.2 to 67.0, while in the remaining seven they were below 40 per 100,000 live births. The three projects in Brazil had the lowest rates: 16.4 for Recife, 27.4 for Ribeirão Prêto, and 27.5 for São Paulo.

Nearly all infants in which the sudden death syndrome was underlying cause were found dead early in the morning, which agrees with findings in other studies (Bergman *et al.*, 1972). Although in certain instances the baby presented a few signs of unrest during the night, in most cases the

FIG. 116. Mortality from Sudden Death in Infancy, by Age Group, in 15 Projects.

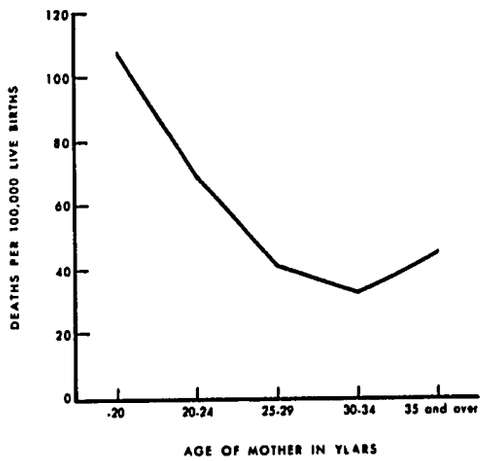


parents did not report any particular abnormality during the hours preceding the fatal event.

Low birth weight has been invoked by various authors (Valdes-Dapena, 1967) as a factor in sudden death on the basis of comparisons of percentages of low-birth-weight infants dying from that cause with those in control series or with low-birth-weight incidence in the community. Since in many areas birth weight was found to be low among infants dying in the first year of life, data were obtained for infants dying in the postneonatal period in whom sudden death (category 795) was assigned as cause. Of the 215 sudden deaths occurring in that age period, birth weights were known for 157, and in 27 of these (17.2 per cent) the weights were 2,500 grams or less. For areas with sufficient data regarding birth weights, the comparable percentage for deaths from all causes in the postneonatal period was 25.0. With the three Brazilian projects excluded (because of their low rates), 23.2 per cent of all postneonatal deaths were of infants with birth weights of 2,500 grams or less, and 17.8 per cent of the sudden deaths occurred in infants in that weight range. In summary, low birth weight did not appear to be a factor contributing to sudden death in the postneonatal period in the Investigation.

The data were analyzed also for possible relationship of sudden death to lack of breast feeding. Of the 164 postneonatal deaths from this cause for which the pertinent information was available, 99 were of infants who had been breast fed for at least one month (59.6 per cent), as compared with 52.2 per cent for deaths from all causes. With the three Brazilian projects excluded, the percentages were 63.8 and 59.3, respectively. There is therefore not sufficient difference to implicate lack of breast feeding.

FIG. 117. Mortality from Sudden Death in Infancy, by Age of Mother, in Seven Projects Combined.



For seven projects the data by maternal age were combined to explore any possible relationship between sudden death in infancy and age of mother at birth of child. The rates per 100,000 live births were as follows:

Maternal age	*Rate for sudden death*
Under 20 years	108.1
20–24 years	68.7
25–29 years	40.7
30–34 years	32.6
35 years and over	45.0

These rates, shown in Figure 117, imply that the infants of younger mothers are at greater risk of sudden death. This confirms the observations made by Steele and Langworth (1966) and Valdes-Dapena (1967), who found that mothers of affected infants were younger at the time of marriage, at the time of first pregnancy, and at the time of delivery of the infant studied.

The situation in regard to birth order was not clear owing in part to small numbers and the fact that distributions of live births were available for only four projects.

Chapter XII

Reproductive Patterns

In addition to the multiple causes of infant mortality, other factors such as maternal age and infants' birth order have a direct relationship to the size of infant death rates. These latter factors have already been discussed in Chapters VI and X, on neonatal mortality and congenital anomalies. One well-known investigation of causal factors in infant mortality in eight cities of the United States (Woodbury, 1925) drew attention to the influence of many biologic and socioeconomic factors, including age of mother and parity. In that study death rates were found to be lowest for infants of women 25–29 years old, and to be high for those of young mothers and of mothers in the age groups 35–39 years and 40 years and over. Mortality was excessive in infants of high birth orders.

Yerushalmy *et al.* (1940) utilized data from birth and death certificates in Upstate New York in the period 1936–1938 for studies of childbirth mortality that likewise dealt with the important relationship to birth order and maternal age. Social and biological factors related to infant mortality have been studied extensively in England and Wales by Morris and co-workers (Morris and Heady, 1955; Heady *et al.* 1955). Chase (1961–1963) analyzed matched birth and death certificates for 1950–1952 in Upstate New York for thorough study of such interrelationships.

Since similar analyses are not known to be available for countries or cities of Latin America, one of the goals of the Investigation was to evaluate these factors in the 15 projects. The reproductive histories of mothers of deceased children in several projects revealed that many of the children were of high birth order and that the losses through fetal deaths and deaths of those born alive were large. In this chapter data on birth order and maternal age are presented to show how much these factors may be involved in excessive infant mortality. Death rates calculated according to these two factors whenever sufficient bases were available reveal wide differences in the Latin American areas.

Birth rates are declining in several areas and this trend should have a favorable effect on infant mortality. Fortunately, data were available on births by age of mother and birth order for the Province of Santiago, and these showed a shift from older to younger mothers and from high to low birth orders in a period of rapid decline in the birth rate. Infant mortality has been reduced by such changes in the pattern of reproduction. Thus in planning for healthy infants and for reduction of mortality, these factors need to be taken into account, along with the causes of death.

Moreover, the analysis made in this chap-

ter of data on the reproductive history of mothers reveals that the excessive losses through fetal deaths and deaths of those born alive must have handicapped the families by repeated episodes of illness and mortality. To ensure survival of children from the hazards of the infant period, planning for pregnancies which are desired by the parents and which will result in healthy infants is the first essential.

MATERNAL AGE

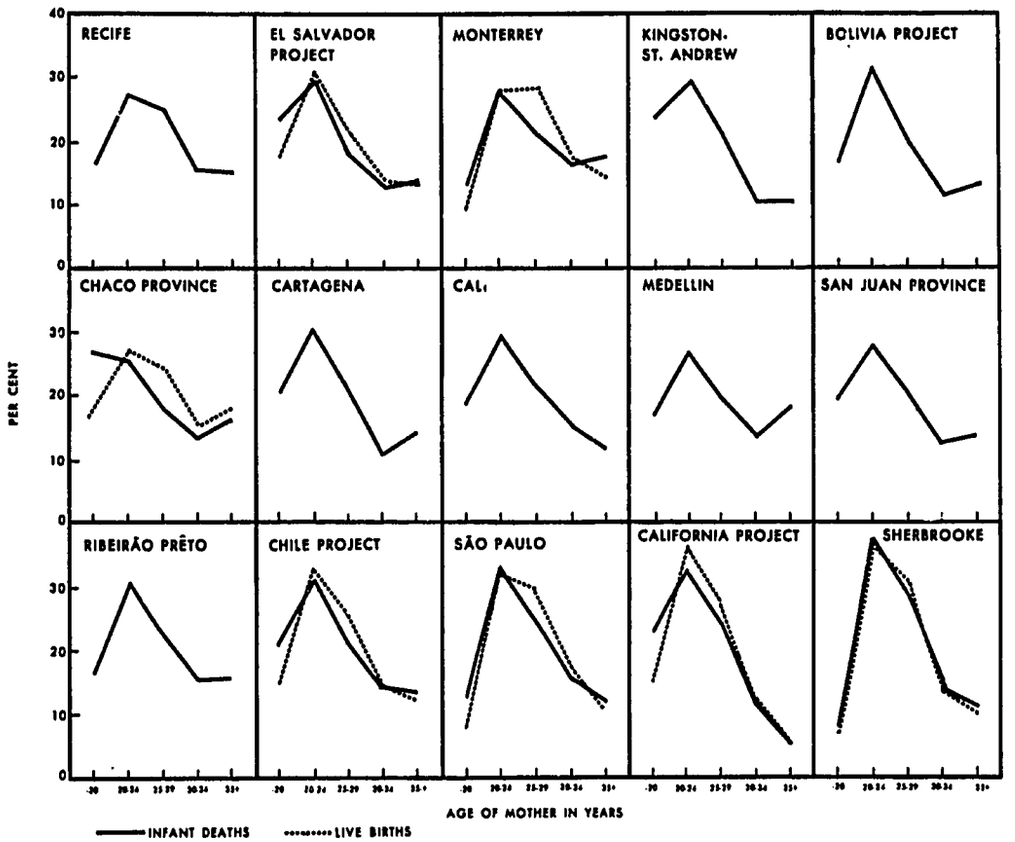
During the interviews conducted in the homes of deceased infants, the public health nurse or social worker obtained the dates of birth of parents and also the dates of termination and the result of each pregnancy and, if death occurred, the child's age at death. Usually the interviewers were successful in obtaining complete reproductive histories. However, even if a complete sequence of vital events was not obtained, usually birth order and age of mother at time of birth were available. These histories provided the bases for the analyses in this section.

The patterns of reproduction appear to vary widely in the 15 projects. Age of mothers at birth of deceased infants is analyzed first (Table 146). The percentage distributions by maternal age are shown in Figure 118 in descending order of the birth

TABLE 146. Infant Deaths by Age of Mother at Birth of Child in 15 Projects.

Project	Number							Per cent					
	Total	Under 20	20–24	25–29	30–34	35 and over	Unknown	Total	Under 20	20–24	25–29	30–34	35 and over
ARGENTINA													
Chaco Province	1,410	372	357	250	185	228	18	100.0	26.7	25.6	18.0	13.3	16.4
San Juan Province	1,900	380	530	403	251	277	59	99.9	20.6	28.8	21.9	13.6	15.0
BOLIVIA project	2,790	358	632	413	248	284	855	100.0	18.5	32.7	21.3	12.8	14.7
BRAZIL													
Recife	2,773	384	622	580	361	357	469	100.1	16.7	27.0	25.2	15.7	15.5
Ribeirão Prêto	959	137	257	189	131	132	113	100.0	16.2	30.4	22.3	15.5	15.6
São Paulo	3,788	445	1,152	861	566	425	339	100.0	12.9	33.4	25.0	16.4	12.3
CANADA													
Sherbrooke	310	23	113	86	45	33	10	100.1	7.7	37.7	28.7	15.0	11.0
CHILE project	2,404	477	712	481	331	313	90	100.0	20.6	30.8	20.8	14.3	13.5
COLOMBIA													
Cali	1,153	169	263	203	142	113	263	100.1	19.0	29.6	22.8	16.0	12.7
Cartagena	856	135	198	144	75	93	211	99.9	20.9	30.7	22.3	11.6	14.4
Medellín	924	131	204	150	106	145	188	100.0	17.8	27.7	20.4	14.4	19.7
EL SALVADOR project	2,742	646	803	498	358	369	68	100.0	24.2	30.0	18.6	13.4	13.8
JAMAICA													
Kingston-St. Andrew	1,589	377	466	335	172	178	61	100.0	24.7	30.5	21.9	11.3	11.6
MEXICO													
Monterrey	3,220	386	770	609	467	504	484	100.0	14.1	28.1	22.3	17.1	18.4
UNITED STATES													
California project	784	182	256	191	92	47	16	100.0	23.7	33.3	24.9	12.0	6.1

FIG. 118. Infant Deaths by Age of Mother at Birth of Child in 15 Projects, and Distribution of Live Births by Age of Mother in Seven Projects.



rates per 1,000 population (presented in Chapter II). These birth rates were as follows in the 15 projects:

Project	*Birth rate*
Recife	41.6
El Salvador project	40.4
Monterrey	39.8
Kingston-St. Andrew	38.0
Bolivia project	34.2
Chaco Province	33.7
Cartagena	32.5
Cali	31.1
Medellín	31.0
San Juan Province	30.4
Ribeirão Prêto	27.5
Chile project	26.1
São Paulo	24.8
California project	16.3
Sherbrooke	15.2

In Recife, which had the highest birth rate, 16.7 per cent of the mothers were under 20 years of age at the time of birth of the deceased infant; 27.0 per cent were 20–24 years old and 25.2 per cent were 25–29 years old, while 15.7 per cent were aged 30–34 years and 15.5 per cent 35 years and over. In the El Salvador project, where the birth

rate was also high, larger proportions of mothers were young (24.2 per cent under 20 years and 30.0 per cent aged 20–24 years), while Monterrey had a lower percentage under 20 years (14.1) and a higher percentage 35 years and over (18.4). The pattern in Kingston-St. Andrew (with the fourth highest birth rate) was similar to that in El Salvador, with a predominance of young mothers but with an even lower percentage 35 years and over (11.6). Thus, even in these projects with high birth rates and probably only very limited family planning, the patterns for maternal age of deceased infants are different.

The project in Bolivia* had one of the highest proportions of mothers aged 20–24 years—32.7 per cent. Higher percentages in this age group were noted only in the three projects with the lowest birth rates (São Paulo, California, and Sherbrooke). Chaco Province was unique, having the highest percentage of mothers in the lowest age group under 20 years (26.7 per cent).

Though there were similarities in the distribution by maternal age in the three projects with the lowest birth rates, there were marked differences too. The California project had a higher percentage of mothers under 20 years (23.7) than São Paulo (12.9), but only a very low percentage of mothers 35 years and over (6.1). In Sherbrooke, 37.7 per cent of mothers were in the age group 20–24 years but only 7.7 per cent were under 20 years. Thus, the patterns of the age distributions of mothers of deceased infants differed markedly in the 15 projects.

* Many families could not be located in La Paz, and therefore the number of deceased infants for whom mother's age was unknown was large (855) and the distribution is based on those with ages known (1,935). The effect of this cannot be determined but is not believed to be sufficient to invalidate the findings.

NEONATAL AND INFANT MORTALITY BY AGE OF MOTHER

To evaluate the implications of these wide differences among projects with respect to age of mother at birth of deceased child, the distributions of live births were obtained wherever possible so that death rates by maternal age could be calculated. Sufficient data on these distributions were available for only seven projects, five in Latin America and two in Northern America. Table 147 shows neonatal and infant mortality in these seven projects by age of mother in five age groups, while the rates in the five projects in Latin America are illustrated in Figure 119, in descending order of the infant death rates.

In all five of the Latin American projects mortality was lowest for infants of mothers in the age group 25–29 years. It was excessive for infants of young mothers and for those of mothers 35 years and over. Death rates became very high for products of mothers 40 years and over but sufficient data for presentation were not available for all projects. From the data on the Chile project it is clear that when the infant death rates are lower, the curves for neonatal and infant mortality are closer together than when the infant death rate is very high, as in the case of El Salvador. The neonatal rate for infants of mothers under 20 years in Chile—31.7 per 1,000 live births—was much lower than that in São Paulo (52.3). Nevertheless, the patterns of neo-

TABLE 147. Neonatal and Infant Mortality[a] by Age of Mother at Birth of Child in Seven Projects.

Age of mother in years	ARGENTINA Chaco Province	BRAZIL São Paulo	CANADA Sherbrooke	CHILE project	EL SALVADOR project	MEXICO Monterrey	UNITED STATES California project
	Neonatal mortality						
Total	32.3	33.7	13.5	26.6	29.6	26.0	12.7
Under 20	53.4	52.3	16.4	31.7	40.7	33.1	17.2
20-24	28.3	32.1	12.6	24.2	26.2	23.9	11.7
25-29	26.6	28.7	12.9	23.2	23.7	20.7	11.3
30-34	31.9	34.3	16.1	29.9	27.6	27.2	12.7
35 and over	27.1	37.2	12.8	30.2	34.5	34.1	14.0
	Infant mortality						
Total	80.1	65.1	18.3	55.2	88.4	60.7	17.5
Under 20	133.5	104.1	21.2	79.3	116.6	86.3	20.2
20-24	76.6	67.9	18.6	51.7	84.2	59.7	15.9
25-29	60.5	53.2	16.5	44.5	72.9	47.0	15.3
30-34	69.4	61.4	18.3	54.1	81.3	56.8	16.5
35 and over	72.8	67.4	20.3	59.8	93.6	77.4	17.5

[a] Deaths per 1,000 live births.

natal mortality in the various projects are in general similar, with fewer differences than those observed in infant mortality.

The projects in Sherbrooke and California are shown in Figure 120 using a smaller scale, the death rates being much lower than in the five Latin American projects. In these two projects infant mortality was also lowest for products of mothers 25–29 years old and much higher for those of the youngest mothers. The numbers were small in Sherbrooke, which probably accounts for

FIG. 119. Neonatal and Infant Mortality by Age of Mother in Five Latin American Projects.

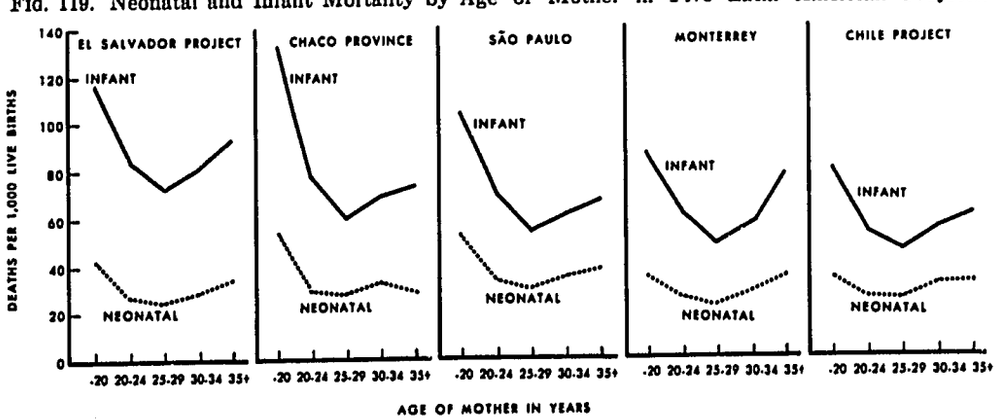
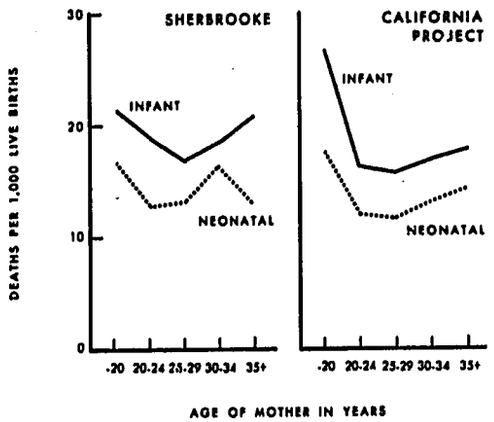


FIG. 120. Neonatal and Infant Mortality by Age of Mother in Sherbrooke and California Projects.



the unusual distribution of neonatal mortality, the rate being lower in infants of mothers 35 years and over.

The differences in these patterns indicate that age of mother at the time of birth of child is an important determinant of the level of neonatal and infant mortality. Infants born to young mothers (under 20 years) and to the older mothers (35 years and over) experience the highest mortality. In Chapter VI important relationships between certain causes of neonatal mortality and age of mothers were shown. The need for collection and analysis of data on the maternal age factor is therefore clear.

DISTRIBUTION OF LIVE BIRTHS BY AGE OF MOTHER

The percentage distributions of live births by age of mother in the seven projects for which these data were available are given in Table 148 to aid in the interpretation of the maternal age distributions presented in Table 146 and Figure 118 (in that figure the distributions of live births were shown by broken lines).

TABLE 148. Percentage Distribution of Live Births by Age of Mother in Seven Areas.

Age of mother in years	ARGENTINA Chaco Province	BRAZIL São Paulo	CANADA Sherbrooke	CHILE Province of Santiago	EL SALVADOR Department of San Salvador	MEXICO Monterrey	UNITED STATES Four counties of California
Total	99.9	100.0	100.1	100.1	100.0	100.0	99.9
Under 20	16.0	8.1	6.6	14.3	18.3	9.9	15.8
20-24	26.8	32.0	36.9	32.9	31.5	28.6	36.8
25-29	23.8	30.6	31.7	25.8	22.6	28.8	28.5
30-34	15.3	17.4	14.9	14.6	14.6	18.2	12.7
35 and over	18.0	11.9	9.9	12.5	13.0	15.5	6.1

Source: The distributions of live births by age of mother for mid-year 1969 were obtained from official reports of the National Health Service of Chile (1970) and the National Office of Statistics and Census of El Salvador (1970), and for 1970 from the California State Health Department; the other distributions were provided by the principal collaborators.

The size of the infant death rate in a given maternal age group depends in part on the number of live births in that age group, that is, the denominator of the rate. Thus the percentage distributions of live births and of infant deaths by age of mother have specific relationships. If the percentage of live births in a given age group is lower than the percentage of deceased infants in that age group, the infant death rate is higher than when the relationship is the reverse.

In the group of mothers under 20 years in all seven projects, the percentage of live births was less than that of deceased infants; infant mortality was high in this age group. In all projects, in the maternal age group with the lowest infant mortality (25–29 years) the percentages of live births were greater than those of deaths. Therefore, even though the distributions of live births by maternal age were not available for the other eight projects, the relationships can be seen. High proportions of live births among young mothers and mothers aged 35 years and over—the age groups in which infant death rates are high—result in high infant death rates.

In the five Latin American projects the percentages of live births among mothers under 20 years of age were as follows:

Project	*Per cent*
São Paulo	8.1
Monterrey	9.9
Chile	14.3
Chaco Province	16.0
El Salvador	18.3

These great differences are surprising, in the case of both Monterrey and El Salvador in Middle America which have high birth rates, and São Paulo and Chile which have relatively low ones. Moreover, the two projects in Northern America with low birth rates had distinctly different percentages of mothers under 20 years, namely, Sherbrooke (6.6 per cent) and California (15.8 per cent).

As for the mothers 35 years of age and over, the California project, with the lowest infant death rates, had a very low percentage of live births in that group. The percentages for the seven projects were:

Project	*Per cent*
California	6.1
Sherbrooke	9.9
São Paulo	11.9
Chile	12.5
El Salvador	13.0
Monterrey	15.5
Chaco Province	18.0

The first four of these projects are known to have the lowest birth rates. The very low percentage of births among mothers aged 35 years and over in the California project had a definite influence on its low infant death rate.

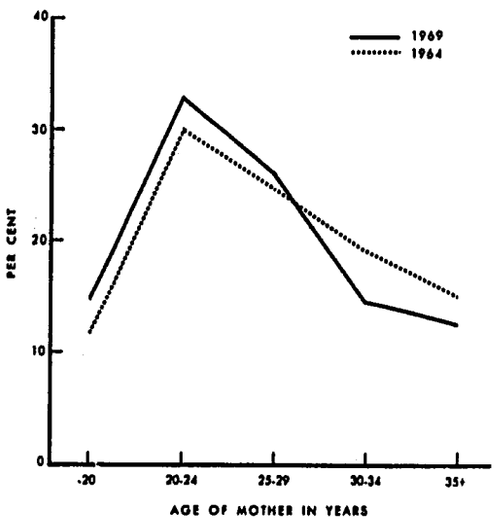
The Province of Santiago has experienced a rapid decline in its birth rate—from 37.6 in 1962 to 26.6 in 1969, a 29.3 per cent reduction. This changing pattern of reproduction brought about by family planning has resulted in a shift from older to younger mothers (Table 149 and Figure 121).

TABLE 149. Percentage Distribution of Live Births by Age of Mother in Province of Santiago, Chile (1962, 1964, and 1969).

Age group in years	1962	1964	1969
Less than 20	10.7	11.4	14.3
20-24	28.6	30.0	32.9
25-29	46.3	24.6	25.8
30-34		19.1	14.6
35 and over	14.4	14.9	12.5

Source: Chile, National Health Service (1963, 1965, 1970).

FIG. 121. Percentage Distribution of Live Births by Age of Mother in Province of Santiago, Chile.



Whereas 14.4 per cent of mothers were 35 years old or over in 1962, 12.5 per cent were in that age group in 1969. In 1964 (the first year with data available for the age groups 25–29 and 30–34 years) the percentage of mothers aged 30–34 years was 19.1 and by 1969 it had decreased to 14.6, or 23.6 per cent lower. Increases in the proportions of births among mothers in the age groups with the most favorable neonatal and infant mortality (20–24 and 25–29 years) have occurred. This shift from older to younger mothers (from 1964 to 1969) can be seen in Figure 121. Birth order, another factor of importance in evaluating the effect of a declining birth rate, is the subject of the next section.

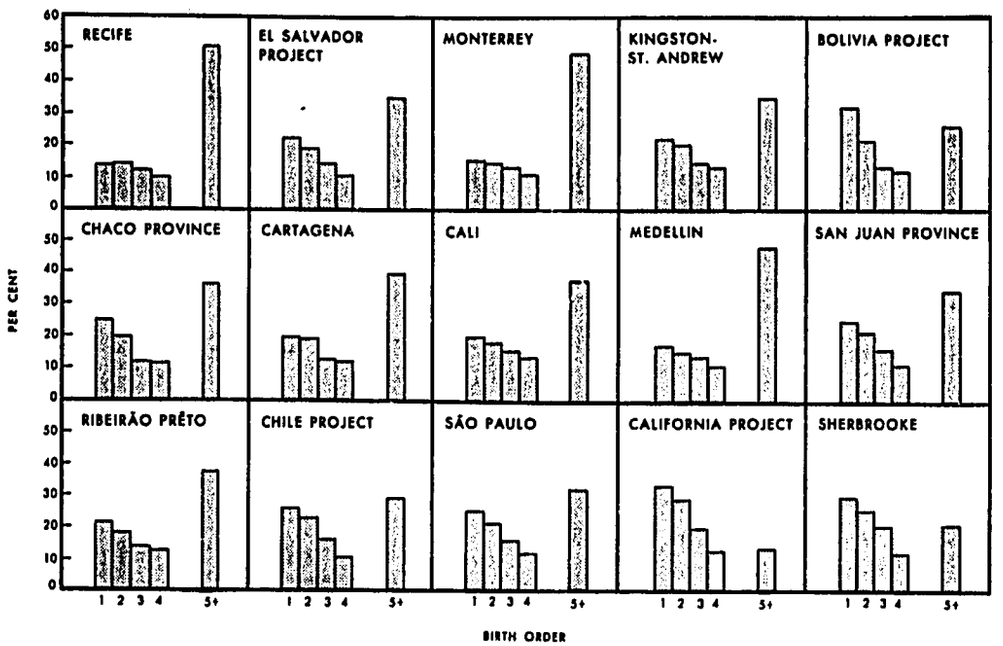
BIRTH ORDER

Birth order of the deceased infants has been studied on the same basis as the age distributions of mothers (Table 150 and Figure 122).

TABLE 150. Infant Deaths by Birth Order in 15 Projects.

Project	Number							Per cent					
	Total	1	2	3	4	5 and over	Unknown	Total	1	2	3	4	5 and over
ARGENTINA													
Chaco Province	1,410	341	253	162	142	491	21	100.0	24.6	18.2	11.7	10.2	35.3
San Juan Province	1,900	439	357	265	175	606	58	100.0	23.8	19.4	14.4	9.5	32.9
BOLIVIA project	2,790	603	392	236	211	488	860	99.9	31.2	20.3	12.2	10.9	25.3
BRAZIL													
Recife	2,773	317	322	273	228	1,174	459	100.0	13.7	13.9	11.8	9.9	50.7
Ribeirão Prêto	959	178	148	107	101	310	115	100.0	21.1	17.5	12.7	12.0	36.7
São Paulo	3,788	817	688	494	355	1,037	397	100.1	24.1	20.3	14.6	10.5	30.6
CANADA													
Sherbrooke	310	83	71	55	32	58	11	100.0	27.8	23.7	18.4	10.7	19.4
CHILE project	2,404	581	497	347	235	643	101	100.0	25.2	21.6	15.1	10.2	27.9
COLOMBIA													
Cali	1,153	172	159	133	116	335	238	100.0	18.8	17.4	14.5	12.7	36.6
Cartagena	856	142	132	87	85	288	122	100.0	19.3	18.0	11.9	11.6	39.2
Medellín	924	121	110	95	78	365	155	100.0	15.7	14.3	12.4	10.1	47.5
EL SALVADOR project	2,742	586	490	377	282	925	82	100.0	22.0	18.4	14.2	10.6	34.8
JAMAICA													
Kingston-St. Andrew	1,589	332	290	205	182	519	61	100.0	21.7	19.0	13.4	11.9	34.0
MEXICO													
Monterrey	3,220	406	384	333	270	1,317	510	100.1	15.0	14.2	12.3	10.0	48.6
UNITED STATES													
California project	784	241	211	136	85	92	19	100.0	31.5	27.6	17.8	11.1	12.0

FIG. 122. Infant Deaths by Birth Order in 15 Projects.



The percentage distributions of infant deaths by birth order are shown for the 15 projects in Figure 122, in descending order of the birth rates. In Recife, which had the highest birth rate, more than half the deceased infants were of fifth or higher birth orders; only 13.7 per cent were first births and 13.9 per cent second births. The pattern in Monterrey was similar, with 48.6 per cent fifth or later births.

The Bolivia project* had an unexpected distribution of infant deaths by birth order (as it did by age of mother). The highest percentage of deaths occurred in first births (31.2), and this proportion was similar to that in the California project, where 31.5 per cent were first births. However, for the rest of the birth orders the distributions in these two projects differed. In Bolivia 25.3 per cent of the infant deaths were of fifth or higher birth orders, while in California the percentage was only 12.0.

NEONATAL AND INFANT MORTALITY BY BIRTH ORDER

For four projects, two of them in Latin America, it was possible to analyze neonatal and infant mortality according to birth order (Table 151).

The two Latin American projects (Chile and Monterrey) had similar infant death rates for first births, 39.4 and 40.5 per 1,000 live births, and likewise excessive death rates for those of fifth and higher orders, 90.6 and 90.0, respectively (Figure 123). The infant rates in the two Northern American projects (California and Sherbrooke), shown in Figure 124 (with a smaller scale),

* The number of infant deaths with birth order unknown was large for this project and the effect of the large number on the finding is not known.

TABLE 151. Neonatal and Infant Mortality[a] by Birth Order in Four Projects.

Birth order	CHILE project		MEXICO Monterrey		CANADA Sherbrooke		UNITED STATES California project	
	Neonatal	Infant	Neonatal	Infant	Neonatal	Infant	Neonatal	Infant
Total	26.6	55.2	26.0	60.7	13.5	18.3	12.7	17.5
1	19.9	39.4	19.5	40.5	9.6	12.6	8.9	12.8
2	22.8	47.8	18.9	48.4	10.7	16.3	12.1	16.7
3	27.7	57.8	19.4	49.7	18.8	23.7	16.2	22.0
4	32.3	67.0	23.9	50.9	21.1	27.3	21.8	28.9
5 and over	42.4	90.6	38.1	90.0	22.3	30.5	23.5	30.6

[a] Rates per 1,000 live births.

were in general similar, increasing respectively from 12.8 and 12.6 per 1,000 live births for first births to 30.6 and 30.5 for those of fifth and higher orders.

Although mortality for birth order 5 and over is given only for that group as a whole, the death rates increase markedly within that group to very high rates for those of 10th or higher birth orders, as was shown by Woodbury (1925) in his study of mortality in eight cities in the United States. Thus, in projects of the Investigation, when large proportions of the infant deaths were of fifth or higher birth orders, as in Recife, many infant deaths would be of very high birth order. In 11 Latin American projects the proportions of infant deaths in the group of birth order 5 and over were above 30 per cent, namely:

Project	*Per cent*
Recife	50.7
Monterrey	48.6
Medellín	47.5
Cartagena	39.2
Ribeirão Prêto	36.7
Cali	36.6
Chaco Province	35.3
El Salvador	34.8
Kingston-St. Andrew	34.0
San Juan Province	32.9
São Paulo	30.6

The percentages for the projects in Chile

FIG. 123. Infant and Neonatal Mortality by Birth Order in Chile and Monterrey Projects.

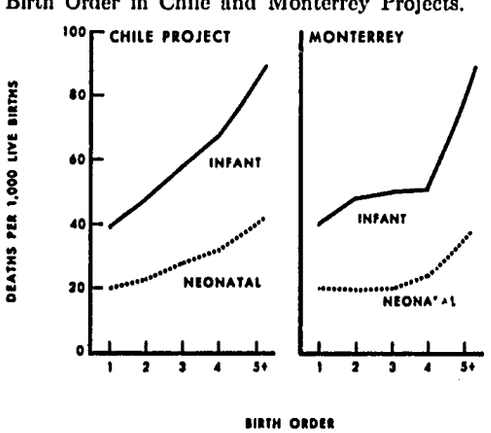
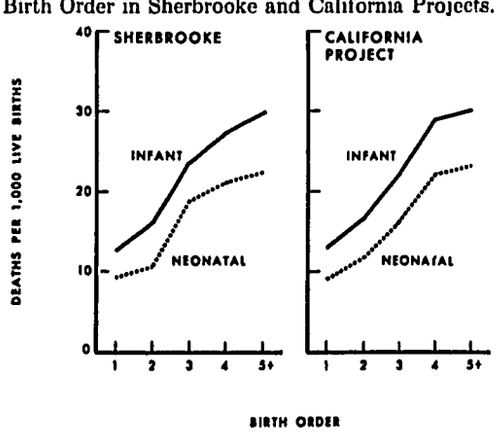


FIG. 124. Infant and Neonatal Mortality by Birth Order in Sherbrooke and California Projects.



and Bolivia were lower: 27.9 and 25.3, and those for Sherbrooke and California were much lower: 19.4 and 12.0, respectively.

It is clear, therefore, that birth order is a factor of great importance in the evaluation of infant mortality.

DISTRIBUTION OF LIVE BIRTHS BY BIRTH ORDER

The distribution of live births by birth order is most important for an understanding of the level of infant mortality. Irrespective of other factors, infants born to mothers with high parity have much lower chances of survival. In view of the evidence presented earlier regarding relatively low birth weights and excessive nutritional deficiency in many Latin American projects, questions are immediately raised in regard to the health of these mothers after many births as well as that of the products of gestation. Here is an important field for research and also a field for action to ensure the birth of healthy products who are able to survive infancy.

The distributions of live births utilized for the calculation of mortality were available for only four areas (Table 152). In both the Sherbrooke and the California projects more than 40 per cent were first births and the percentages for fifth and later births were low (11.6 and 6.9, respectively). In the Province of Santiago 35.4 per cent were first births, while in Monterrey the percentage was only 22.5.

In Santiago Province, a reduction of 38 per cent in the percentage of births of fifth and higher orders (from 27.5 in 1962 to 17.0 in 1969) contributed to a 29-per-cent decrease in the birth rate (Table 153 and Figure 125). The actual decrease in births of order 5 and above was from 26,349 in 1962 to 14,416 in 1969 (45.3 per cent). An increase occurred in the percentage of first births, from 25.7 in 1962 to 35.4 in 1969. Such shifts in distribution of births result in a reduction in infant mortality. Thus in Chile family planning, which led to the decline in the birth rate, produced a reduction in high-order births and number of older mothers which is having a very beneficial influence on survival of the newborn.

Both factors—age and parity of mother—

TABLE 152. Distribution of Live Births by Birth Order in Four Areas.

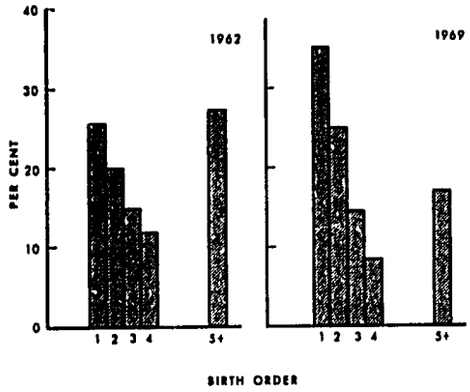
Birth order	CHILE Santiago Province	MEXICO Monterrey	CANADA Sherbrooke	UNITED STATES California project
Total	100.1	100.1	100.0	100.0
1	35.4	22.5	40.4	43.2
2	24.9	17.8	26.6	29.0
3	14.4	15.0	14.2	14.2
4	8.4	11.9	7.2	6.7
5 and over	17.0	32.9	11.6	6.9

TABLE 153. Distribution of Live Births by Birth Order, Province of Santiago, Chile (1962 and 1969).

Birth order	1962		1969	
	No.	%	No.	%
Total.....	95,722	99.9	84,791	100.1
1.....	24,641	25.7	29,974	35.4
2.....	19,001	19.9	21,096	24.9
3.....	14,401	15.0	12,186	14.4
4.....	11,339	11.8	7,119	8.4
5 and over...	26,340	27.5	14,416	17.0

Source: Chile, National Health Service (1963, 1970).

FIG. 125. Percentage Distribution of Live Births by Birth Order, Province of Santiago, Chile (1962 and 1969).



Source: Chile, National Health Service.

should be combined in the study of infant mortality. In the California project, though the distributions of live births were available, the numbers of deaths were too small for calculation of rates for each birth order by age of mother. An analysis made of neonatal mortality in the United States (Loeb, 1965) by maternal age and infant's birth order, in matched records for three months in 1950, showed high death rates for all birth orders in the group of mothers under 20 years of age, with the lowest occurring among first births. For the next age group, 20–24 years, an increase also occurred with higher birth order, the lowest rate being among first births. In the other maternal age groups the second births had a lower rate than the first. Extensive analyses have been made of neonatal and infant mortality in two cohort studies (Armstrong, 1972; and Chase, 1972-b) from linked records in 1950 and 1960 in the United States on the basis of birth weight as well as age of mother and birth order. For a full understanding of these problems in Latin American cities and countries, the distributions of all live births by age and parity of mothers and by birth weight are needed, together with similar data for all infant deaths.

OUTCOME OF PREVIOUS PREGNANCIES

Before the reproductive histories were utilized, the data they contained were reviewed for completeness and reliability. In this section, use has been made only of histories with complete information regarding the births and fetal deaths, i.e., data that appeared to be consistent in all respects. For example, several histories containing data on age of mother and birth order that were suitable for use in the previous section could not be used for this present analysis because the medical record indicated additional fetal losses and thus these histories were considered less reliable.

The total and average numbers of products of previous pregnancies among mothers of deceased children in the 15 projects are presented first in Table 154. With two

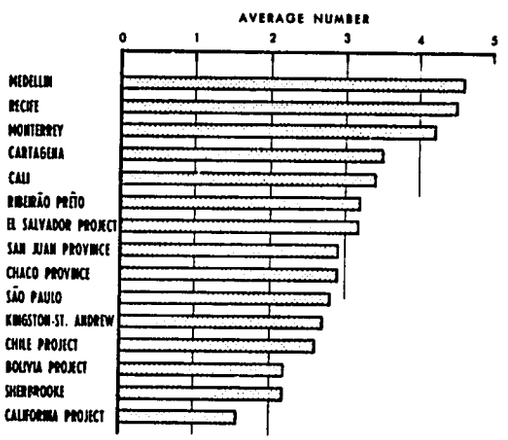
TABLE 154. Outcome of Previous Pregnancies of Mothers of Deceased Children Under 5 Years of Age in 18 Areas of 15 Projects.

Area	No. of mothers	Total products		Products lost					
				Total		Fetal deaths		Deaths	
		No.	Average	No.	%	No.	%	No.	%
ARGENTINA									
Chaco Province	1,605	4,610	2.9	732	15.9	147	3.2	585	12.7
San Juan Province	2,013	5,842	2.9	1,307	22.4	540	9.2	767	13.1
San Juan (city)	296	551	1.9	135	24.5	90	16.3	45	8.2
Suburban departments	723	2,128	2.9	501	23.5	215	10.1	286	13.4
Rural departments	994	3,163	3.2	671	21.2	235	7.4	436	13.8
BOLIVIA project	2,731	6,140	2.2	1,471	24.0	184	3.0	1,287	21.0
BRAZIL									
Recife	2,975	13,422	4.5	5,122	38.2	1,941	14.5	3,181	23.7
Ribeirão Prêto	969	3,119	3.2	862	27.6	475	15.2	387	12.4
São Paulo	3,736	10,533	2.8	3,125	29.7	1,590	15.1	1,535	14.6
CANADA									
Sherbrooke	330	729	2.2	200	27.4	138	18.9	62	8.5
CHILE project	1,837	4,785	2.6	1,131	23.6	590	12.3	541	11.3
COLOMBIA									
Cali	1,141	3,846	3.4	928	24.1	357	9.3	571	14.8
Cartagena	932	3,286	3.5	662	20.1	297	9.0	365	11.1
Medellín	1,011	4,637	4.6	1,285	27.7	603	13.0	682	14.7
EL SALVADOR project	3,607	11,588	3.2	3,853	33.2	848	7.3	3,005	25.9
San Salvador	2,592	7,656	3.0	2,487	32.5	622	8.1	1,865	24.4
Rural *municipios*	1,015	3,932	3.9	1,366	34.7	226	5.7	1,140	29.0
JAMAICA									
Kingston-St. Andrew	958	2,631	2.7	426	16.2	187	7.1	239	9.1
MEXICO									
Monterrey	3,046	12,654	4.2	2,797	22.1	1,121	8.9	1,676	13.2
UNITED STATES									
California project	898	1,458	1.6	399	27.4	250	17.1	149	10.2

exceptions, the projects are treated as a whole because of small numbers and similarity of the findings. For two projects with large rural areas (San Juan Province and El Salvador) the data were sufficient to permit analysis of both urban and rural areas.

The average number of products of previous pregnancies was over 4.0 in three projects (Medellín, Recife, and Monterrey) (Figure 126). In four other projects there were at least 3.0 previous products. In California and Sherbrooke, which had the lowest birth rates, the average number was only 1.6 and 2.2, respectively. It was surprising to find the small number of previous products in the Bolivia project, 2.2. There is an urgent

FIG. 126. Average Number of Products of Previous Pregnancies of Mothers of Deceased Children in 15 Projects.

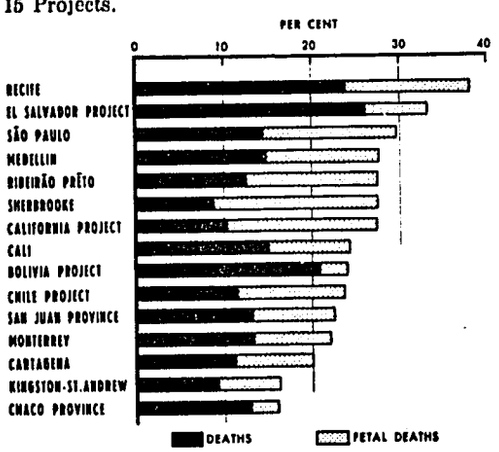


need for research to gain an understanding of patterns of reproduction and conditions of survival of products of pregnancy in this high-altitude area. The patterns appear to be unusual, judging from the evidence on age and parity of mothers of deceased children and from the small number of previous products.

In addition to these differences between projects, there are distinct differences within the two projects that have rural areas. In San Juan Province the average number of previous products in the rural departments (3.2) was much higher than that in the city of San Juan (1.9). Likewise, in the El Salvador project the averages were 3.9 products in the rural *municipios* and 3.0 in the city of San Salvador.

In Table 154 the vital losses in previous pregnancies are divided into fetal deaths and deaths of those born alive. In two projects with high death rates, Recife and El Salvador, more than 30 per cent of the products of previous pregnancies resulted in death (38.2 and 33.2 per cent, respectively) (Figure 127). This represents great reproductive wastage in terms of the products, a great biological expenditure for the mother, and also a serious psychological and financial impact on the family. In these two projects more than 20 per cent of the total previous products were lost by deaths of children born alive.

FIG. 127. Mortality of Products of Previous Pregnancies of Mothers of Deceased Children in 15 Projects.



In the next five projects with over 27.0 per cent of the products resulting in death (Ribeirão Prêto, São Paulo, Sherbrooke, Medellín, and California), more than half were fetal deaths in all except one project (Medellín). In São Paulo, Sherbrooke, and California, which had low birth rates, the percentages for loss as fetal deaths were 15.1, 18.9, and 17.1, respectively. Many of these were early fetal deaths or abortions. In São Paulo 82 per cent of the fetal deaths were classed as early fetal deaths (abortions). In San Juan Province, the city of San Juan had 16.3 per cent loss as fetal deaths. The two Northern American projects had the highest percentages for losses as fetal deaths, followed by Ribeirão Prêto and São Paulo.

In the Bolivia project 21.0 per cent of the products of previous pregnancies died after birth, but the percentage of reported fetal deaths was low, 3.0. Probably some losses were forgotten or were not stated because of reticence on the part of parents. Actually in this project, in half the families in which home interviews were conducted someone other than the mother provided the history —usually the father. A deficit of fetal deaths among the products of previous pregnancies is also suspected in Chaco Province, where losses of only 3.2 per cent were remembered.

In San Juan Province, losses as fetal deaths were recorded less frequently in the rural departments than in the city of San Juan. In that city 16.3 per cent of the products were fetal deaths, while the figure was only 7.4 per cent in the rural departments.

The following are two highly probable explanations for these high percentages of losses in previous pregnancies. First, the mothers of deceased children had experienced excessive pregnancy loss because they constitute a group of women who are vulnerable to diseases or conditions unfavorable for survival of the product. Another explanation is that the pregnancy was not desired and the abortions were provoked in some of the instances. In this Investigation no attempt was made to find out about induced abortions. However, several hospital records indicated that some of the neonatal deaths in the Investigation were in fact the result of procedures used to terminate the pregnancy. Therefore it is likely that these high percentages of products resulting in fetal deaths may be in part due to abortive procedures. It is clear that the highest percentages were usually in the areas with the lower birth rates.

INFANT MORTALITY IN PRODUCTS OF PREVIOUS PREGNANCIES

The infant death rates among products of previous pregnancies were much higher than those found in the Investigation, as is shown in Table 155 and Figure 128 for 14 projects.

In several projects infant mortality among the previous products of mothers was twice as high as in the Investigation. For example in Recife, while the rate in the Investigation was 91.2 per 1,000 live births, for previous products of those mothers it was 204.4. In all three projects in Brazil the relationship was of this order. In the Investigation in São Paulo the rate was 65.1 and in previous products 130.1. Actually in eight of the 14 projects the infant death rate was around twice as high in previous products as in the Investigation. Part of the explanation is that these areas had experienced high infant mortality in the past when many of these deaths occurred. Also, these mothers were perhaps particularly vulnerable because of their biologic or socio-environmental conditions.

In Sherbrooke the rate in previous products was 69.7, or nearly four times the rate in the Investigation (18.3). Although the

FIG. 128. Infant Mortality in the Investigation and in Products of Previous Pregnancies of Mothers of Deceased Children in 14 Projects.

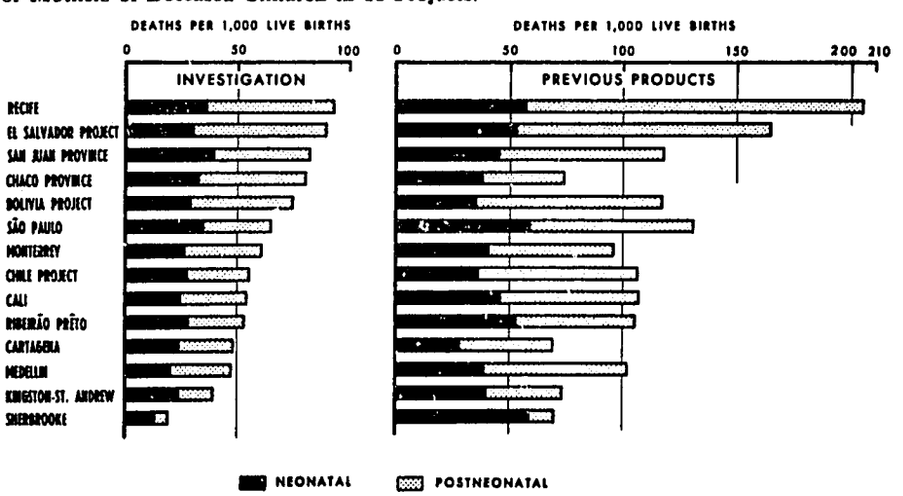


TABLE 155. Infant Mortality in Products of Previous Pregnancies of Mothers of Deceased Children and in Investigation, by Age Group, in 17 Areas of 14 Projects.

Area	Previous pregnancies							Investigation		
	Live births	Infant deaths						Infant death rate[a]		
		Total		Neonatal		Postneonatal				
	No.	No.	Rate	No.	Rate	No.	Rate	Total	Neonatal	Post-neonatal
ARGENTINA										
Chaco Province	4,453	329	73.9	170	38.2	159	35.7	80.1	32.3	47.8
San Juan Province	5,393	630	116.8	235	43.6	395	73.2	81.3	38.8	42.6
San Juan (city)	460	40	87.0	17	37.0	23	50.0	50.7	29.6	21.1
Suburban departments	1,908	232	121.6	91	47.7	141	73.9	87.9	44.6	43.3
Rural departments	2,925	358	122.4	127	43.4	231	79.0	94.5	39.6	54.9
BOLIVIA project	5,955	694	116.5	202	33.9	492	82.6	74.2	29.0	45.2
BRAZIL										
Recife	11,466	2,344	204.4	646	56.3	1,698	148.1	91.2	35.3	55.9
Ribeirão Prêto	2,642	275	104.1	136	51.5	139	52.6	52.6	28.2	24.3
São Paulo	8,913	1,160	130.1	518	58.1	642	72.0	65.1	33.7	31.5
CANADA										
Sherbrooke	588	41	69.7	34	57.8	7	11.9	18.3	13.5	4.8
CHILE project	4,177	442	105.8	146	35.0	296	70.9	55.2	26.6	28.5
COLOMBIA										
Cali	3,451	368	106.6	156	45.2	212	61.4	54.6	25.4	29.2
Cartagena	2,703	185	68.4	70	25.9	115	42.5	47.8	22.4	25.4
Medellín	3,948	399	101.1	150	38.0	249	63.1	47.6	19.7	27.9
EL SALVADOR project	10,733	1,753	163.3	599	55.8	1,154	107.5	88.4	29.6	58.8
San Salvador	7,030	1,162	165.3	375	53.3	787	111.9	81.7	28.2	53.6
Rural *municipios*	3,703	591	159.6	224	60.5	367	99.1	120.0	36.1	83.9
JAMAICA										
Kingston-St. Andrew	2,435	177	72.7	96	39.4	81	33.3	38.8	24.2	14.6
MEXICO										
Monterrey	11,494	1,096	95.4	455	39.6	641	55.8	60.7	26.0	34.8

[a] Rates per 1,000 live births.

experience is limited, this finding was unexpected. Unfortunately, reproductive histories were not obtained in the California project. It may be that when infant mortality becomes low, as in the Sherbrooke project, it is concentrated principally in the infants of vulnerable women—those whose reproductive history is unfavorable to survival of the infant.

The difference between infant mortality among products of previous pregnancies and that found in the Investigation was particularly marked in the postneonatal period. For the 14 projects combined, there was a 57-per-cent reduction in the postneonatal rate, compared with a 39-per-cent reduction in the neonatal rate. This difference reflects in part the pattern of changing infant mortality in the general population.

* * *

In terms of pregnancy losses as fetal deaths and as infant deaths, these mothers of children who died in infancy experienced excessive pregnancy wastage. These findings, coupled with those on maternal age and parity relationships to infant mortality, indicate the need for planning in order to ensure healthy reproduction in the future. Also, the many gaps in our information point to the need for research in these important fields and for collection of these facts routinely for all births and all infant deaths.

Chapter XIII

Breast Feeding

Breast feeding, because of its relationship to the child's survival, is one of the major factors to be considered in studies of infant mortality. The markedly different patterns observed in the Latin American projects come as a surprise. Until this Investigation revealed the wide variations, breast feeding was believed to be the usual method of feeding infants in early life in developing societies.

Several basic aspects of breast feeding were studied in depth at the symposium entitled The Uniqueness of Human Milk, the proceedings of which were published by the American Society of Clinical Nutrition (1971). This collection of technical papers on biochemical characteristics and anti-infection properties of human milk, as well as psychological, economic, and practical advantages of breast feeding, was published also in Spanish by the Pan American Health Organization (1971-c, 1972-b). In this series Jelliffe and Jelliffe (1971) gave a fine overview of the incomparable value of maternal milk for ensuring the survival and health of young children.

For 23 widely separated areas in Latin America, the Investigation has provided data on the current situation regarding the practice of breast feeding as well as the relationships between lack or insufficiency of breast milk and diarrheal disease and nutritional deficiency.

Studies by Gordon *et al.* (1963) on weanling diarrhea implicated the age of weaning as a time of high morbidity and mortality from diarrheal disease. Also Gordon *et al.* (1967) pointed out the exceedingly high death rates for that disease in the second year of life. The findings in this Investigation in nearly all the areas are indicative of an even more serious situation: a widespread lack of breast feeding or its early termination as well as excessive mortality from diarrheal disease and nutritional deficiency in the first year of life.

Data on breast feeding are presented for the 13 Latin American projects. In the Canadian project breast feeding was rare (only one deceased infant was breast fed), and in the California project home interviews were not conducted for the collection of such information.

The findings are analyzed by infant's age at death and also in relation to mother's educational level. The role of breast feeding in relation to two specific causes of mortality, diarrheal disease and nutritional deficiency, is studied in detail.

VARIATION IN PRACTICE OF BREAST FEEDING IN INFANCY

The wide variation in breast feeding in infancy in the Latin American projects can be seen in Table 156 and Figure 129. The proportion of infants dying in the first year of life who had been breast fed one month or longer was over 70 per cent in four

TABLE 156. Breast Feeding for One Month or Longer of Infants[a] Dying in First Year of Life[b] in 13 Latin American Projects.

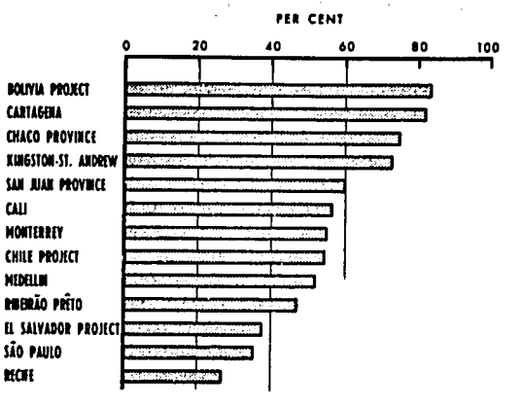
Project	Infants dying in first year of life	Breast fed one month or longer	
		No.	%
Total	12,106	6,353	52.5
ARGENTINA			
Chaco Province	806	603	74.8
San Juan Province	928	558	60.1
BOLIVIA project	1,088	911	83.7
BRAZIL			
Recife	1,414	379	26.8
Ribeirão Prêto	383	181	47.3
São Paulo	1,508	536	35.5
CHILE project	987	543	55.0
COLOMBIA			
Cali	433	244	56.4
Cartagena	352	283	81.8
Medellín	386	203	52.3
EL SALVADOR project	1,771	672	37.9
JAMAICA			
Kingston-St. Andrew	541	395	73.0
MEXICO			
Monterrey	1,507	840	55.7

[a] In families in which home interviews were conducted and information was provided.
[b] Excluding neonatal deaths.

projects (Bolivia, Cartagena, Chaco Province, and Kingston-St. Andrew). In three projects (El Salvador, São Paulo, and Recife) it was less than 40 per cent, while in the other six it varied from 47.3 to 60.1 per cent. Though the data for El Salvador are presented for the project as a whole, differences between the areas were noted; in the city of San Salvador only 34.1 per cent of deceased infants had been breast fed for at least a month, while in the rural *municipios* the proportion was higher—nearly half (49.7 per cent).

Since six months is the minimum period recommended for breast feeding, data are provided also for infants dying at 6–11 months of age who had been breast fed for at least six months (Table 157 and Figure 130). The experience was relatively favorable in only three projects (Bolivia, Chaco

FIG. 129. Breast Feeding for One Month or Longer of Infants Dying in Postneonatal Period in 13 Latin American Projects.



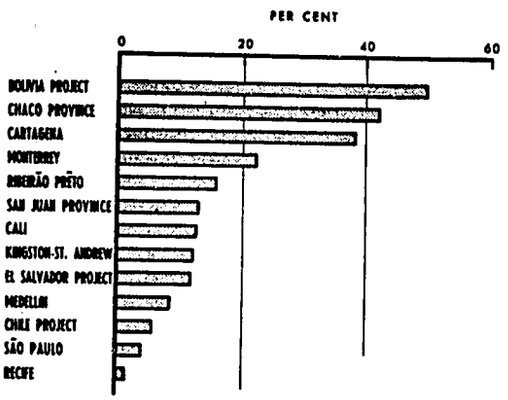
Province, and Cartagena), but even in these the percentages of those breast fed for that length of time were only 50.6, 42.7, and 38.7, respectively. In four projects (Medellín,

TABLE 157. Breast Feeding for Six Months or Longer of Infants[a] Dying at 6–11 Months of Age in 13 Latin American Projects.

Project	Infants dying at 6–11 months	Breast fed 6 months or longer	
		No.	%
Total	4,115	759	18.4
ARGENTINA			
Chaco Province	279	119	42.7
San Juan Province	243	32	13.2
BOLIVIA project	451	228	50.6
BRAZIL			
Recife	505	7	1.4
Ribeirão Prêto	99	16	16.2
São Paulo	338	14	4.1
CHILE project	229	13	5.7
COLOMBIA			
Cali	195	25	12.8
Cartagena	181	70	38.7
Medellín	171	15	8.8
EL SALVADOR project	717	86	12.0
JAMAICA			
Kingston-St. Andrew	253	32	12.6
MEXICO			
Monterrey	454	102	22.5

[a] In families in which home interviews were conducted and information was provided.

FIG. 130. Breast Feeding for Six Months or Longer of Infants Dying at 6–11 Months of Age in 13 Latin American Projects.



Chile, São Paulo, and Recife) the proportion was less than 10 per cent.

The findings in El Salvador were very surprising since Gordon *et al.* (1964) had reported breast feeding of long duration in Guatemala, a neighboring country. In their study of 301 infants in rural Guatemalan villages, they found that 98.7 per cent were breast fed from birth. They state: "The weaning process usually begins at about 6 months of age with the addition of foods other than breast milk, and ends about the close of the second year, the mode being 25.5 months."

In the El Salvador project, only 12.0 per cent of the infants dying at 6–11 months of age had been breast fed for six months. However, breast feeding was continued longer for a higher proportion in the rural *municipios:* 22.0 per cent breast fed for six months in contrast to 8.4 per cent in the city of San Salvador. The lack of mother's milk without supplementation of protein from other sources is probably one explanation for the high death rates from nutritional deficiency in the project in El Salvador.

The increasing use of hospitals for delivery of babies has probably resulted in an increase in artificial feeding. Also advertisements of milk substitutes and the intensive publicity given to them in various sectors of the population have probably had unfavorable influences.

AGE AT DEATH

The data on infant's age at death in relation to breast feeding is presented in Table 158. Among those dying in the neonatal period, the number breast fed was limited. In fact, of those who died in the first seven days of life, very few (from 0.0 to 17.3 per cent) received any breast milk (Figure 131). Of course many infants died in the first day or days of life in the hospital and so there was no opportunity for breast feeding for many.

Among those who died in the remainder of the neonatal period (7–27 days) breast feeding had been started before death for more than 60 per cent in four projects (Chaco Province, Bolivia, Cali, and Cartagena), while in three projects (San Juan Province, Medellín, and Kingston-St. Andrew) less than 40 per cent had been breast fed (Figure 132).

The reasons for not breast feeding as stated by the mother or other family member are given in Table 158. In several projects the reason given for more than half the infants who died at 7–27 days of age was that they were in the hospital (55.9 per cent

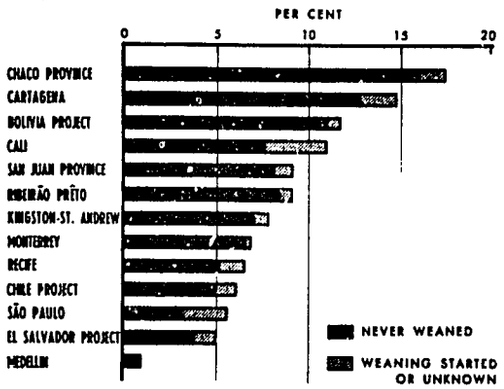
TABLE 158. Breast Feeding of Infants[a] Dying in Neonatal Period, in Two Age Groups, in 13 Latin American Projects.

Breast feeding and reason not breast fed	Under 7 days		7–27 days		Under 7 days		7–27 days		Under 7 days		7–27 days		Under 7 days		7–27 days		Under 7 days		7–27 days	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
	ARGENTINA Chaco Province				ARGENTINA San Juan Province				BOLIVIA project				BRAZIL Recife				BRAZIL Ribeirão Prêto			
Total	369	100.1	165	100.0	507	100.0	296	100.1	366	100.0	2[illegible]1	100.0	624	100.0	247	99.9	351	100.1	103	99.9
Not breast fed	305	82.7	53	32.1	460	90.7	184	62.2	323	88.3	60	20.6	584	93.6	106	42.9	319	90.9	57	55.3
Lack of milk	3	0.8	12	7.3	12	2.4	7	2.4	7	1.9	6	2.1	14	2.2	43	17.4	4	1.1	8	7.8
Child died	242	65.6	—	—	329	64.9	2	0.7	247	67.5	—	—	423	67.8	1	0.4	260	74.1	3	2.9
In hospital	36	9.8	21	12.7	104	20.5	151	51.0	49	13.4	35	12.0	120	19.2	29	11.7	55	15.7	38	36.9
Other	24	6.5	20	12.1	15	3.0	24	8.1	20	5.5	19	6.5	27	4.3	33	13.4	—	—	8	7.8
Weaning started	5	1.4	26	15.8	1	0.2	49	16.6	3	0.8	29	10.0	9	1.4	90	36.4	2	0.6	20	19.4
Weaning unknown	—	—	3	1.8	5	1.0	11	3.7	—	—	1	0.3	—	—	3	1.2	1	0.3	2	1.9
Never weaned	59	16.0	83	50.3	41	8.1	52	17.6	40	10.9	201	69.1	31	5.0	48	19.4	29	8.3	24	23.3
	BRAZIL São Paulo				CHILE project				COLOMBIA Cali				COLOMBIA Cartagena				COLOMBIA Medellín			
Total	1,028	100.1	664	100.0	414	100.0	224	100.0	305	100.0	75	100.0	142	100.0	64	100.0	211	100.0	49	99.9
Not breast fed	972	94.6	369	55.6	389	94.0	118	52.7	272	89.2	26	34.7	121	85.2	24	37.5	209	99.1	30	61.2
Lack of milk	6	0.6	47	7.1	6	1.4	4	1.8	7	2.3	5	6.7	2	1.4	4	6.2	1	0.5	1	2.0
Child died	755	73.4	9	1.4	284	68.6	2	0.9	206	67.5	—	—	82	57.7	1	1.6	149	70.6	—	—
In hospital	194	18.9	274	41.3	94	22.7	107	47.8	43	14.1	18	24.0	30	21.1	13	20.3	54	25.6	25	51.0
Other	17	1.7	39	5.9	5	1.2	5	2.2	16	5.2	3	4.0	7	4.9	6	9.4	5	2.4	4	8.2
Weaning started	18	1.8	228	34.3	5	1.2	46	20.5	10	3.3	21	28.0	3	2.1	18	28.1	—	—	8	16.3
Weaning unknown	6	0.6	13	2.0	—	—	2	0.9	—	—	—	—	—	—	—	—	—	—	1	2.0
Never weaned	32	3.1	54	8.1	20	4.8	58	25.9	23	7.5	28	37.3	18	12.7	22	34.4	2	0.9	10	20.4
	EL SALVADOR project				JAMAICA Kingston-St. Andrew				MEXICO Monterrey											
Total	567	100.0	303	100.0	641	100.0	238	100.0	608	100.1	312	100.0								
Not breast fed	539	95.1	127	41.9	591	92.2	153	64.3	567	93.3	184	59.0								
Lack of milk	12	2.1	13	4.3	4	0.6	—	—	9	1.5	31	9.9								
Child died	409	72.1	4	1.3	380	59.3	7	2.9	418	68.8	6	1.9								
In hospital	94	16.6	75	24.8	194	30.3	133	55.9	120	19.7	107	34.3								
Other	24	4.2	35	11.6	13	2.0	13	5.5	20	3.3	40	12.8								
Weaning started	7	1.2	103	34.0	4	0.6	18	7.6	—	—	16	5.1								
Weaning unknown	—	—	—	—	2	0.3	1	0.4	1	0.2	20	6.4								
Never weaned	21	3.7	73	24.1	44	6.9	66	27.7	40	6.6	92	29.5								

[a] In families in which home interviews were conducted and information was provided.

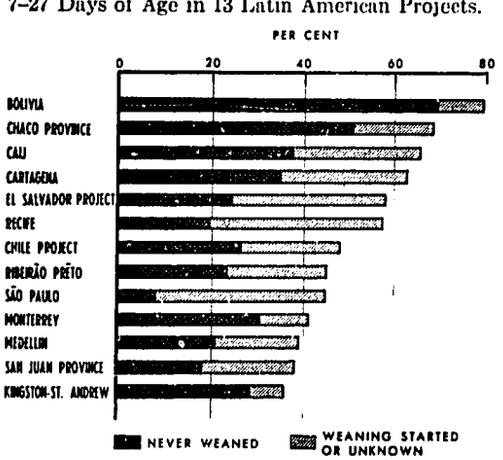
in Kingston-St. Andrew, 51.0 in San Juan Province, and 51.0 in Medellín). The situation was quite different in Recife; here lack of milk was the reason given for 17.4 per cent of such infants, and though breast feeding was started in 57.1 per cent evidently it was without sufficient success, for weaning was started in 36.4 per cent of the infants 7–27 days of age. A public health nurse in Recife (dos Santos, 1970) has commented on the lack of breast milk and inability of mothers to breast feed their in-

FIG. 131. Breast Feeding of Infants Dying in First Seven Days of Life in 13 Latin American Projects.



fants. As mothers in Recife have expressed their desire to breast feed, the causes of this difficulty deserve attention. In the El Salvador project as well, weaning was started in a high proportion of the infants 7–27 days of age (34.0 per cent). Since both these areas had excessive death rates from nutritional deficiency and high proportions of the infants dying in the neonatal period had unusually low birth weights, the possibility that the mother's nutritional status was not satisfactory for breast feeding should be investigated. Low protein content and decreased volume of milk have been reported by Bailey (1965) in women with sustained malnutrition, and Jelliffe and Jelliffe (1971) have shown that if starving is prolonged lactation even stops. Only in the project in Bolivia had a high percentage (69.1) of these infants never been weaned before death. In the others (with the exception of Chaco Province, with 50.3 per cent never weaned), although breast feeding was started in relatively favorable proportions, it was continued in less than 40 per cent of the infants.

FIG. 132. Breast Feeding of Infants Dying at 7–27 Days of Age in 13 Latin American Projects.



For infants dying in two postneonatal periods (28 days–5 months and 6–11 months) the situation was in general similar to that for infants dying in the neonatal period (Table 159). For the first of these two age groups, smaller proportions of the infants had been breast fed for a month or longer in the projects in São Paulo, El Salvador, and Recife. Likewise, only 4.0 per cent in Recife and 4.4 per cent in São Paulo had not been weaned before death (Figure 133). On the other hand, in the projects in Cartagena, Bolivia, Chaco Province, and Kingston-St. Andrew more than 60 per cent of these infants had been breast fed for at least a month, and from 25.7 to 59.7 per cent had never been weaned. Thus, there is considerable variation in the patterns of breast feeding in this critical age period. Although breast feeding may have been discontinued because of illness of the child, the low proportions breast fed for at least one month as well as the small proportion never weaned (less than 20 per cent in seven projects) indicate that many of these infants were deprived of this high-quality protective food.

For infants dying at 6–11 months, although higher proportions had been breast

TABLE 159. Breast Feeding of Infants[a] Dying in Postneonatal Period, in Two Age Groups, in 13 Latin American Projects.

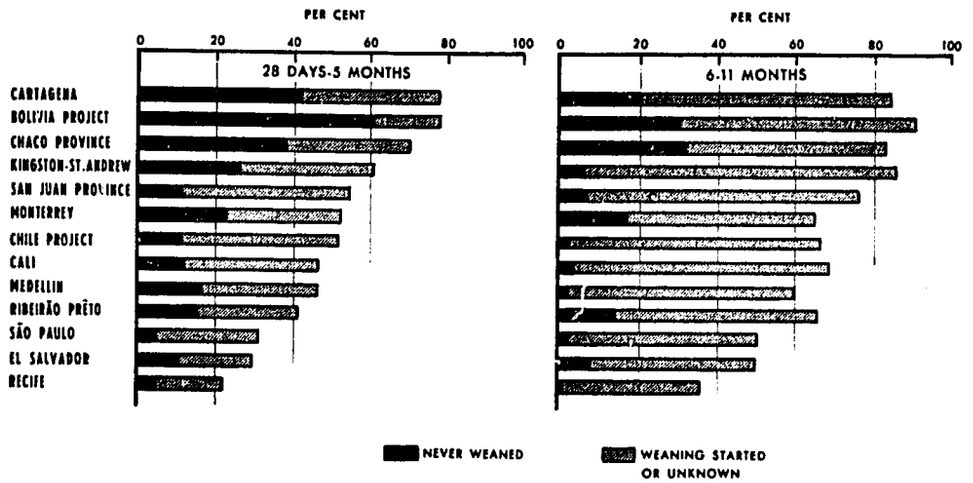
Breast feeding and duration	Age at death: 28 days–5 months		Age at death: 6–11 months		Age at death: 28 days–5 months		Age at death: 6–11 months		Age at death: 28 days–5 months		Age at death: 6–11 months		Age at death: 28 days–5 months		Age at death: 6–11 months		Age at death: 28 days–5 months		Age at death: 6–11 months	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
	ARGENTINA Chaco Province				ARGENTINA San Juan Province				BOLIVIA project				BRAZIL Recife				BRAZIL Ribeirão Prêto			
Total	527	100.0	279	100.0	685	100.1	243	100.0	637	100.0	451	100.0	909	100.0	505	99.9	284	100.0	99	99.9
Not breast fed	91	17.3	30	10.8	108	15.8	18	7.4	63	9.9	22	4.9	213	23.4	83	16.4	78	27.5	13	13.1
Less than 1 month	66	12.5	16	5.7	205	29.9	39	16.0	76	11.9	16	3.5	499	54.9	240	47.5	89	31.3	22	22.2
1 and 2 months	126	23.9	39	14.0	215	31.4	72	29.6	84	13.2	59	13.1	142	15.6	134	26.5	65	22.9	32	32.3
3 months or longer	36	6.8	95	34.1	47	6.9	83	34.2	25	3.9	220	48.8	10	1.1	37	7.3	6	2.1	18	18.2
Months unknown	12	2.3	11	3.9	37	5.4	15	6.2	9	1.4	1	0.2	9	1.0	8	1.6	6	2.1	—	—
Never weaned	196	37.2	88	31.5	73	10.7	16	6.6	380	59.7	133	29.5	36	4.0	3	0.6	40	14.1	14	14.1
	BRAZIL São Paulo				CHILE project				COLOMBIA Cali				COLOMBIA Cartagena				COLOMBIA Medellín			
Total	1,170	100.0	338	100.1	758	100.1	229	100.0	238	99.8	195	100.0	171	100.0	181	99.9	217	100.1	171	100.0
Not breast fed	315	26.9	63	18.6	157	20.7	38	16.6	47	19.7	24	12.3	23	13.5	19	10.5	55	25.3	36	21.1
Less than 1 month	489	41.8	105	31.1	211	27.8	38	16.6	81	34.0	37	19.0	14	8.2	8	4.4	62	28.6	32	18.7
1 and 2 months	252	21.5	103	30.5	265	35.0	79	34.5	57	23.9	62	31.8	39	22.8	35	19.3	52	24.0	59	34.5
3 months or longer	34	2.9	50	14.8	30	4.0	66	28.8	25	10.5	64	32.8	20	11.7	79	43.6	11	5.1	39	22.8
Months unknown	29	2.5	9	2.7	15	2.0	3	1.3	1	0.4	2	1.0	5	2.9	3	1.7	3	1.4	1	0.6
Never weaned	51	4.4	8	2.4	80	10.6	5	2.2	27	11.3	6	3.1	70	40.9	37	20.4	34	15.7	4	2.3
	EL SALVADOR project				JAMAICA Kingston-St. Andrew				MEXICO Monterrey											
Total	1,054	100.0	717	100.1	288	100.0	253	99.9	1,053	100.0	454	99.9								
Not breast fed	319	30.3	146	20.4	60	20.8	17	6.7	387	36.8	133	29.3								
Less than 1 month	421	39.9	213	29.7	51	17.7	18	7.1	120	11.4	27	5.9								
1 and 2 months	152	14.4	132	18.4	84	29.2	74	29.2	154	14.6	73	16.1								
3 months or longer	34	3.2	132	18.4	12	4.2	115	45.5	43	4.1	99	21.8								
Months unknown	21	2.0	42	5.9	7	2.4	14	5.5	112	10.6	46	10.1								
Never weaned	107	10.2	52	7.3	74	25.7	15	5.9	237	22.5	76	16.7								

[a] In families in which home interviews were conducted and information was provided.

fed for at least a month than in the younger group, the percentage never weaned was very small (less than 10) in eight projects. However, there appears to be consistency in the patterns of breast feeding in the two age groups. In fact, the three projects with the highest proportions of infants never weaned were the same in both age groups—namely, Cartagena, Bolivia, and Chaco Province—and Recife had the lowest proportions in both age groups.

Three steps seem to be indicated in order to overcome this serious problem of lack or insufficiency of breast feeding. First, causes and factors responsible for early weaning and lack of breast feeding should be ascer-

FIG. 133. Breast Feeding for One Month or Longer of Infants Dying in Two Postneonatal Periods in 13 Latin American Projects.



tained; second, mass education of future mothers is advisable, to impress upon them the invaluabe role of human milk in ensuring the survival and health of their infants; and third, if breast feeding is impossible because of insufficient milk in a malnourished mother, food supplementation for that mother is advisable; or if breast feeding is impossible for another reason, high-quality nutrients should be provided to the infant.

EDUCATION OF MOTHER

Improvement in socioeconomic status as measured by mother's educational level appeared to have a detrimental effect on breast feeding in some of the projects (Table 160). Mothers with secondary or university education breast fed lower or slightly lower proportions of the deceased infants in all projects (except San Juan Province) than did mothers with no education. In many of the projects, however, the numbers of mothers with secondary or university education were small and thus the corresponding differences in breast feeding were not significant.

The three projects in Brazil and the one in El Salvador had the lowest percentages of deceased infants breast fed for one month or longer. When these four projects are combined the percentages are as follows by education of mother:

Education of mother	*Per cent breast fed one month or longer*
Secondary or university	24.1
Primary, 3 years and more	33.8
Primary, 1 and 2 years	38.3
None	35.8

For the group of mothers with secondary or university education in these projects, only 24.1 per cent of the infants dying in the postneonatal period had been breast fed for one month or longer, while for mothers with

TABLE 160. Breast Feeding for One Month or Longer of Infants[a] Dying in Postneonatal Period, by Educational Level of Mother,[b] in 13 Latin American Projects.

Mother's educational level	Total	Breast fed one month or longer		Total	Breast fed one month or longer		Total	Breast fed one month or longer		Total	Breast fed one month or longer		Total	Breast fed one month or longer	
		No.	%		No.	%		No.	%		No.	%		No.	%
	ARGENTINA Chaco Province			ARGENTINA San Juan Province			BOLIVIA project			BRAZIL Recife			BRAZIL Ribeirão Prêto		
Total	806	603	74.8	928	558	60.1	1,088	911	83.7	1,414	379	26.8	383	181	47.3
Secondary, university	18	6	33.3	71	41	57.7	190	149	78.4	53	14	26.4	25	8	32.0
Primary, 3 years and over	272	187	68.8	521	329	63.1	419	357	85.2	349	80	22.9	147	69	46.9
Primary, 1 and 2 years	218	179	82.1	217	123	56.7	159	132	83.0	237	68	28.7	94	45	47.9
None	298	231	77.5	119	65	54.6	320	273	85.3	775	217	28.0	117	59	50.4
	BRAZIL São Paulo			CHILE Project			COLOMBIA Cali			COLOMBIA Cartagena			COLOMBIA Medellín		
Total	1,508	536	35.5	987	543	55.0	433	244	56.4	352	288	81.8	388	203	52.3
Secondary, university	89	22	24.7	199	106	53.3	44	18	40.9	20	12	60.0	39	14	35.9
Primary, 3 years and over	611	213	34.9	587	321	54.7	214	124	57.9	175	147	84.0	187	104	55.6
Primary, 1 and 2 years	319	128	40.1	91	55	60.4	99	58	58.6	81	68	84.0	95	53	55.8
None	489	173	35.4	110	61	55.5	76	44	57.9	76	61	80.3	67	32	47.8
	EL SALVADOR Project			JAMAICA Kingston-St. Andrew			MEXICO Monterrey								
Total	1,771	672	37.9	541	395	73.0	1,507	840	55.7						
Secondary, university	124	26	21.0	39	21	53.8	127	61	48.0						
Primary, 3 years and over	762	270	35.4	452	337	74.6	799	451	56.4						
Primary, 1 and 2 years	275	113	41.1	27	21	77.8	274	155	56.6						
None	610	263	43.1	23	16	69.6	307	173	56.4						

[a] Excluding neonatal deaths.
[b] In families in which home interviews were conducted and information was provided.

less education the percentages were significantly higher (from 33.8 to 38.3).

The combined figures for four projects with the highest percentages of deceased infants breast fed for one month or longer (Bolivia, Cartagena, Chaco Province, and Kingston-St. Andrew) also revealed a significant difference between the group of mothers with secondary or university education (70.4 per cent of the infants breast fed for at least a month) and those with no education (81.0 per cent).

Breast feeding may not be of such vital importance in the highest socioeconomic groups as in those living in unfavorable conditions (as measured here by educational level). Nevertheless, it is unfortunate that the more privileged mothers do not appreciate the value of breast feeding and do not set the example so that even higher proportions of less fortunate mothers will provide their infants with this valuable food.

In the Chile project the difference was slight and not significant; 55.5 per cent

of mothers with no education and 53.3 per cent of those with secondary or university education breast fed their babies for one month or longer.

Plank and Milanesi (1973) state that the data from their study of rural communities in Chile suggest that early weaning may be a concomitant of socioeconomic development. They found that a higher proportion (62.3 per cent) of mothers with at least six years' education weaned their children before 6 months of age than did those with less than three years' schooling; the percentage for the latter group (37.6) was significantly lower.

These observations should be of concern to educators and health officials because the success of efforts to promote breast feeding among population groups in which this practice is lifesaving requires that the better-educated women participate actively (Guthrie and Guthrie, 1966). Convincing such mothers of the advantages of breast feeding is essential in order to enlist their active participation.

DIARRHEAL DISEASE AND BREAST FEEDING

The protection afforded by human milk against infection has been the subject of numerous studies, as reviewed recently by Mata and Wyatt (1971). There seems to be a general consensus that breast feeding, when compared to other sources of nutrients, is accompanied by lower rates of attack by infectious diseases and that such protection is not limited to defense against infections of the intestinal tract. The following are five main mechanisms through which human milk spares infants from infective and parasitic diseases.

First, human colostrum is very rich in immunoglobulins against bacterial and viral diseases. All these immunoglobulins (except IgA synthesized by the mammary gland) are very similar to those found in blood serum. Although their levels decrease after parturition they remain in significant levels in milk for prolonged periods (Mata and Urrutia, 1971). These antibodies, acting in the intestine, protect the infant from the effects of continuous exposure to infection in developing areas.

Second, a constituent in human milk, the bifidus factor (or factors), promotes the development of the characteristic microflora of the intestinal tract, thereby creating an unfavorable environment for implantation of pathogenic bacteria and protozoa.

Third, other protective components of human milk such as lysozyme (Rosenthal and Lieberman, 1931), antibody-producing cells, and phagocytic cells of colostrum (and milk) play a role in the limitation of infection by certain bacteria.

Fourth, although breast milk may contain a few bacteria, under certain circumstances its use saves susceptible infants from being exposed to ingestion of large amounts of pathogenic bacteria and protozoa in localities where clean water and hygienic facilities are not available.

Finally, and no less important, is the overall protection provided by a satisfactory nutritional state resulting from adequate intake of necessary nutrients, and the safeguards it affords against repeated episodes of infection.

The patterns of mortality from diarrheal disease in the first few months of life were found to differ markedly in the Latin American projects (Chapter VIII, Figure 71). Exceedingly high death rates were noted in the first few months of life in Recife and São Paulo. These projects are in areas where breast feeding is practiced only on a very limited scale. In contrast, the death rates in the Bolivia project, in Cartagena, and in Kingston-St. Andrew seemed to be relatively low and constant by month of age in the first year of life. These areas were found to have higher proportions of infants breast fed for at least a month. Several of the above-mentioned factors concerning mother's milk are probably involved in the reduction of mortality from diarrheal disease; with breast feeding there may be less exposure to infectious agents and also some immunity may be obtained through the milk or the infant's nutritional status may be better.

Deaths from diarrheal disease are analyzed in this section according to the history of breast feeding, with four divisions made: (1) breast fed and never weaned; (2) breast fed for at least a month; (3) breast fed for less than a month; and (4) not breast fed. Table 161 gives the numbers and percentages of deaths from all causes that were due to diarrheal disease in these four groups (those with months of breast feeding unknown are included with those breast fed for one month or longer).

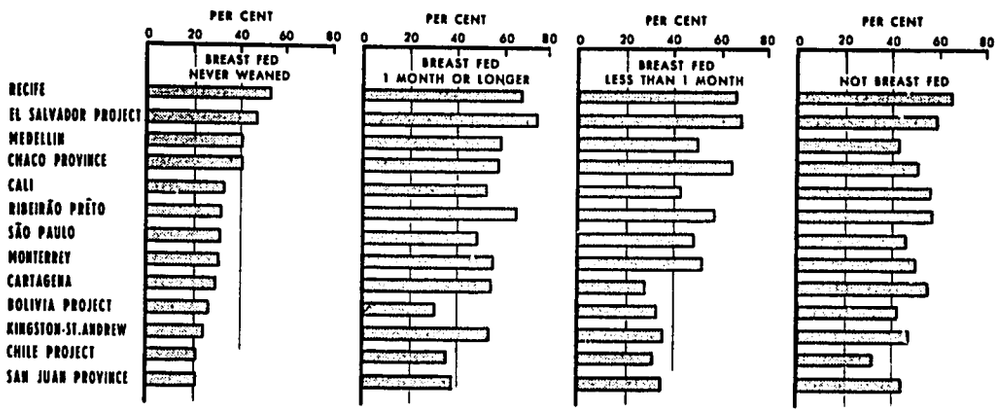
In Figure 134 the projects are shown first (left section) according to the proportions of deaths from all causes that were due to

TABLE 161. Deaths from Diarrheal Disease as Underlying Cause According to Breast Feeding of Infants[a] Dying at 28 Days–5 Months of Age in 13 Latin American Projects.

Project	Breast fed never weaned			Breast fed one month or longer			Breast fed less than one month			Not breast fed		
	Deaths	Diarrheal disease		Deaths	Diarrheal disease		Deaths	Diarrheal disease		Deaths	Diarrheal disease	
		No.	%		No.	%		No.	%		No.	%
Total	1,405	446	31.7	2,286	1,175	51.4	2,384	1,292	54.2	1,916	991	51.7
ARGENTINA												
Chaco Province	196	80	40.8	174	101	58.0	66	43	65.2	91	48	52.7
San Juan Province	73	15	20.5	299	113	37.8	205	74	36.1	108	49	45.4
BOLIVIA project	380	100	26.3	118	37	31.4	76	25	32.9	63	27	42.9
BRAZIL												
Recife	36	19	52.8	161	110	68.3	499	339	67.9	213	141	66.2
Ribeirão Prêto	40	13	32.5	77	51	66.2	89	52	58.4	78	45	57.7
São Paulo	51	16	31.4	315	155	49.2	489	242	49.5	315	149	47.3
CHILE project	80	17	21.2	310	109	35.2	211	68	32.2	157	51	32.5
COLOMBIA												
Cali	27	9	33.3	83	44	53.0	81	36	44.4	47	27	57.4
Cartagena	70	20	28.6	64	35	54.7	14	4	28.6	23	13	56.5
Medellín	34	14	41.2	66	39	59.1	62	32	51.6	55	24	43.6
EL SALVADOR project	107	51	47.7	207	155	74.9	421	294	69.8	319	190	59.6
JAMAICA												
Kingston-St. Andrew	74	18	24.3	103	56	54.4	51	19	37.3	60	29	48.3
MEXICO												
Monterrey	237	74	31.2	309	170	55.0	120	64	53.3	387	198	51.2

[a] In families in which home interviews were conducted and information was provided.

FIG. 134. Percentage of Infants Dying at 28 Days–5 Months of Age from Diarrheal Disease According to Breast Feeding in 13 Latin American Projects.



diarrheal disease in infants breast fed and never weaned. These percentages ranged from 52.8 in Recife down to 20.5 in San Juan Province. In the other three groups higher proportions of the deaths were due to diarrheal disease. In the 13 projects combined, 31.7 per cent of infants breast fed and never weaned died from this cause, in contrast to 51.4 per cent of infants breast fed one month or longer, 54.2 per cent of those breast fed less than a month, and 51.7 per cent of those never breast fed. Thus, breast feeding without weaning is seen to be beneficial, being accompanied by a smaller proportion of deaths from diarrheal disease. This is important indirect evidence of the protective value of breast feeding.

Other factors probably affected mortality from diarrheal disease. Two of the areas with highest percentages of deaths from this cause in those breast fed and never weaned —Recife (52.8) and Chaco Province (40.8) —are areas where only small proportions of the homes are provided with water supplies. The Chile project, with the second lowest percentage (21.2), is in an area where a very high proportion of the homes have water supplies. Thus, multiple factors are involved in mortality from diarrheal disease. However, the evidence presented in this Chapter, as well as in the section on diarrheal disease in Chapter VIII, justifies breast feeding as an important preventive measure in Latin America.

NUTRITIONAL DEFICIENCY AND BREAST FEEDING

The biochemical and nutritional characteristics of human milk were recently reviewed by Jelliffe and Jelliffe (1971) and György (1971). Some of the important properties can be summarized as follows:

Lipids, an important source of energy for young infants, though present in human milk in smaller proportions than in cow's milk, provide the needed essential fatty acids. The action of lipase in human milk

favors better absorption of fatty acids. Calcium absorption and metabolism are more efficient, and some hematinics are present in higher concentrations.

Other properties such as cystine and lactose provided in high levels, presence of nucleotides (indirectly involved in protein synthesis), easier digestion of protein (tensional characteristics of curd), as well as more efficient utilization of fat and of calcium explain the excellent growth and brain development attained by the child with breast feeding in the first 4–6 months of life.

Through the protective mechanisms against infection (of which good nutrition is an important one) human milk favors a positive balance of nutrients, and hence normal growth and development.

Data on the relationship between breast feeding and nutritional deficiency as underlying or associated cause of death are presented in Table 162 and Figures 135 and 136 for the two age groups in the postneonatal period (28 days–5 months and 6–11 months).

As can be seen in Figure 135, nutritional deficiency as underlying or associated cause was less frequent in infants breast fed and never weaned than in infants who were breast fed not at all or for only limited periods.

For the group dying at 28 days–5 months of age, the Chile project had the lowest proportion of those breast fed and never weaned who had nutritional deficiency (17.5) and the percentages for the other three categories of breast feeding, though more than twice as high, were relatively favorable (39.4, 44.5, and 46.5). In Kingston-St. Andrew and Cali also the percentages were low, particularly among those breast fed and never weaned (23.0 and 18.5).

In this same age group, Recife and Chaco Province had the highest percentages of infants breast fed and unweaned who had nutritional deficiency (50.0 and 43.4) but here the percentages for infants with less breast feeding were even higher. The pattern of lowest percentages of nutritional deficiency in those breast fed and never weaned and higher percentages in the other groups was noted in all projects.

For infants dying in the next age group, 6–11 months, the numbers breast fed and never weaned were small and the percentages are shown for only eight projects (Figure 136). There are distinct differences, as was the case for those dying at 28 days–5 months. In the projects in Ribeirão Prêto, Bolivia, and Chaco Province the percentages of those not breast fed at all who had nutritional deficiency were 92.3, 72.7, and 63.3, while the percentages for those breast fed and never weaned were 57.1, 49.6, and 47.7.

For the five projects in which the numbers breast fed and never weaned were too small for calculation of percentages, the data for the three other divisions of breast feeding are presented. The numbers in some of the projects were small in certain of the groups, but in general they indicate that the experience in infants *not breast fed at all* was the most unfavorable. In all except one of the 13 projects more than 60 per cent of those infants had nutritional deficiency. In the groups that had been breast fed one month or more the percentages were in general lower. The data for the 13 projects combined are shown in Figure 137, and it can be seen that lower proportions of the deceased infants breast fed and never weaned had nutritional deficiency as an underlying or associated cause than did those never breast fed or weaned before death.

Certain of the findings are puzzling. In the El Salvador project the percentages of infants with nutritional deficiency who had been breast fed for less than one month or

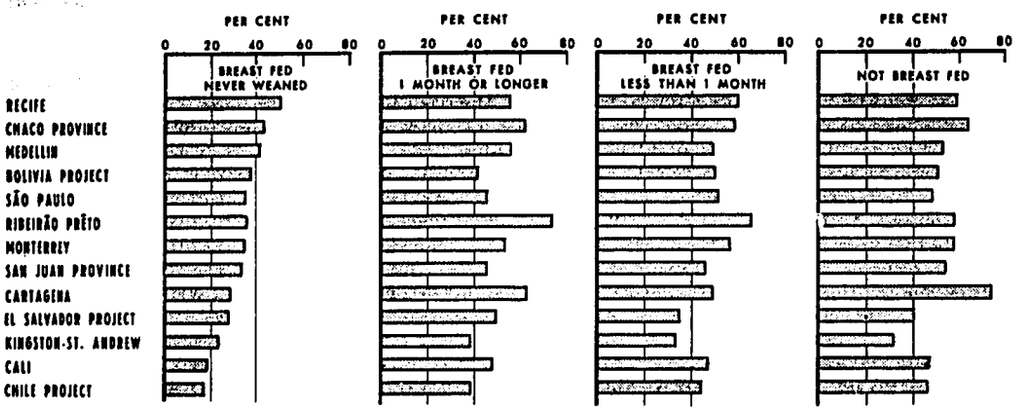
not at all were in general lower than in comparable groups in most of the other projects. In both areas of El Salvador the death rates from nutritional deficiency were very high, as was shown in Chapter IX (Table 90). Also, in Recife no real difference was

TABLE 162. Infant Deaths[a] from Nutritional Deficiency as Underlying or Associated Cause According to Breast Feeding, in Two Age Groups, in 13 Latin American Projects.

Project	Breast fed never weaned			Breast fed one month or longer			Breast fed less than one month			Not breast fed		
	Deaths	Nutritional deficiency		Deaths	Nutritional deficiency		Deaths	Nutritional deficiency		Deaths	Nutritional deficiency	
		No.	%		No.	%		No.	%		No.	%
	28 days–5 months											
Total	1,405	479	34.1	2,286	1,124	49.2	2,384	1,191	50.0	1,916	986	51.5
ARGENTINA												
Chaco Province	196	85	43.4	174	108	62.1	66	39	59.1	91	58	63.7
San Juan Province	73	24	32.9	299	136	45.5	205	97	47.3	108	58	53.7
BOLIVIA project	380	141	37.1	118	48	40.7	76	39	51.3	63	32	50.8
BRAZIL												
Recife	36	18	50.0	161	91	56.5	499	299	59.9	213	125	58.7
Ribeirão Prêto	40	14	35.0	77	56	72.7	89	59	66.3	78	45	57.7
São Paulo	51	18	35.3	315	143	45.4	489	255	52.1	315	154	48.9
CHILE project	80	14	17.5	310	122	39.4	211	94	44.5	157	73	46.5
COLOMBIA												
Cali	27	5	18.5	83	39	47.0	81	38	46.9	47	22	46.8
Cartagena	70	20	28.6	64	40	62.5	14	7	50.0	23	17	73.9
Medellín	34	14	41.2	66	37	56.1	62	31	50.0	55	29	52.7
EL SALVADOR project	107	29	27.1	207	102	49.3	421	148	35.2	319	131	41.1
JAMAICA												
Kingston-St. Andrew	74	17	23.0	103	39	37.9	51	17	33.3	60	19	31.7
MEXICO												
Monterrey	237	80	33.8	309	163	52.8	120	68	56.7	387	223	57.6
	6–11 months											
Total	457	207	45.3	2,205	1,293	58.6	811	480	59.2	642	415	64.6
ARGENTINA												
Chaco Province	88	42	47.7	145	97	66.9	16	9	56.2	30	19	63.3
San Juan Province	16	5	31.2	170	84	49.4	39	18	46.2	18	14	77.8
BOLIVIA project	133	66	49.6	280	164	58.6	16	11	68.8	22	16	72.7
BRAZIL												
Recife	3	2	#	179	133	74.3	240	177	73.8	83	54	65.1
Ribeirão Prêto	14	8	57.1	50	38	76.0	22	19	86.4	13	12	92.3
São Paulo	8	6	#	162	85	52.5	105	61	58.1	63	40	63.5
CHILE project	5	1	#	148	75	50.7	38	17	44.7	38	26	68.4
COLOMBIA												
Cali	6	2	#	128	75	58.6	37	13	35.1	24	17	70.8
Cartagena	37	14	37.8	117	89	76.1	8	6	#	19	17	89.5
Medellín	4	3	#	99	63	63.6	32	25	78.1	36	27	75.0
EL SALVADOR project	52	19	36.5	306	151	49.3	213	99	46.5	146	80	54.8
JAMAICA												
Kingston-St. Andrew	15	4	26.7	203	94	46.3	18	8	44.4	17	13	76.5
MEXICO												
Monterrey	76	35	46.1	218	145	66.5	27	17	63.0	133	80	60.2

[a] In families in which home interviews were conducted and information was provided.
Percentages are not calculated for a base of less than 10.

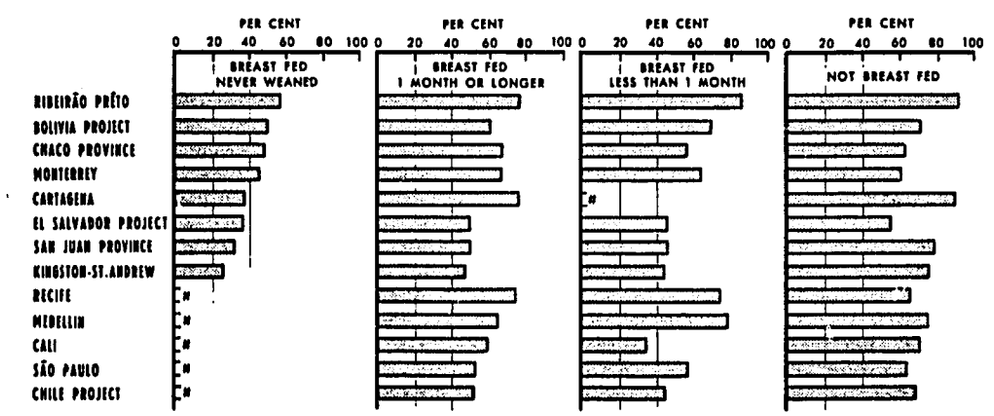
FIG. 135. Percentage of Infants Dying at 28 Days–5 Months of Age from Nutritional Deficiency as Underlying or Associated Cause According to Breast Feeding in 13 Latin American Projects.



found between frequency of nutritional deficiency in infants who had been breast fed and in those who had not. Greater exploration of the multiple factors involved—including mother's nutritional state and infant's weight at birth, as well as breast feeding—is essential for an understanding of the complex health problems causing excessive mortality in infants and young children in Latin America.

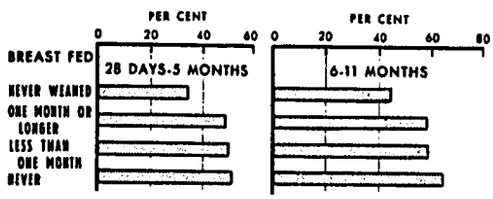
Wyon and Gordon (1971) were able to analyze mortality in infancy and early childhood in a longitudinal study of 11 villages in the Khanna region of rural Punjab, India. Breast feeding and also the infant's age at the time of addition of solid food were known. In this population group, in which neonatal mortality was excessive (74 per 1,000 live births), these authors reported that "virtually all infants died who did not

FIG. 136. Percentage of Infants Dying at 6–11 Months of Age from Nutritional Deficiency as Underlying or Associated Cause According to Breast Feeding in 13 Latin American Projects.



#=Insufficient number.

FIG. 137. Percentage of Infant Deaths from Nutritional Deficiency as Underlying or Associated Cause According to Breast Feeding, in Two Age Groups, in 13 Latin American Projects Combined.



receive breast milk in the first months of life. Mothers breast fed their children for an average (median) duration of 26 months. . . . At two months after birth, 25 per cent of mothers had started to give their children milk of animal origin as a supplement, 50 per cent by six months, and 75 per cent by 10 months. . . . Delay in starting solid food was associated with a greatly increased risk of death." They further stated that "although all had essentially the same infections, the more children were deprived of adequate food the more frequently they died." Also, "between the ages of 12 and 18 months the few children taking solid food but no longer receiving breast milk had a higher death rate than children receiving breast milk and food. This suggests the importance of high-quality protein as part of the diet at these ages."

Plank and Milanesi (1973) studied infant feeding practices in 15 rural Chilean communities and found that once weaning was started, continued breast feeding offered no apparent protection. "Giving these babies other [supplemental] foods, however, seemed to improve their chances of staying alive. Death rates in the second and third trimesters were about 70 per cent higher for bottle-fed infants receiving no additional foods than for those on a broader diet."

Such studies of communities are providing a measure of the excessive mortality among infants who do not receive sufficient supplemental foods once weaning is started. The findings of the Investigation are revealing the limited extent of breast feeding in most areas in Latin America and the high proportion of deaths from diarrheal disease and nutritional deficiency among infants receiving little or no breast milk. If mortality is to be reduced and the health of survivors protected, adequate food supplies must be made available.

In the educational programs undertaken by health personnel major emphasis should be placed on the importance of mother's milk to the health of the child. Action at the community level to encourage breast feeding, with the active participation of organized groups and of health authorities, is an urgent need in developing areas. Mothers in those areas should be made to realize that breast feeding their young infants is vital for the child's survival, and for that reason should constitute an integral part of effective reproductive function.

Chapter XIV

Socioeconomic and Related Factors

One of the Investigation's goals was to study the interrelationships of diseases and factors responsible for mortality. To provide a background for the study of socioeconomic data, information is presented first on the presence of parents in the homes of deceased children and on their marital status. The information obtained in the home interviews on occupation of father and education of mother is then analyzed.

A classic study on mortality by occupation of deceased males in 10 states of the United States was made by Whitney (1934). Puffer (1948), on analyzing mortality in Tennessee, found that tuberculosis death rates in white males were three times higher for laborers than for professional workers. Additional analyses have been made in the United States using matched data from death certificates and from census schedules for 1950 (Guralnick, 1959). The English have studied mortality for five social classes as well as for specific occupation groups at 10-year intervals, beginning with data from the 1921 census (Registrar-General, England and Wales, 1927, 1938). Chase (1961–1963), in her studies of infant mortality in Upstate New York, included occupation of father as one of the measures of socioeconomic level.

As pointed out by Kitagawa and Hauser (1963), in the United States the only item on the death certificate providing a measure of socioeconomic status is occupation, but its usefulness is limited because of the discrepancies between usual occupation as recorded on the certificate and the last occupation entered on the census schedule. Those authors conducted a study in which death certificates for a four-month period in that country were matched with census schedules for 1 April 1960; from those schedules they obtained sufficient data on several socioeconomic variables, including occupation and education, for analyses of differential mortality. They found education to be a satisfactory measure of socioeconomic status (Kitagawa and Hauser, 1968).

Rosenwaike (1971) utilized the education attainment of mothers as a measure of socioeconomic status in studying the incidence of low birth weight in Maryland in 1968. He found that among white mothers with less than 10 years' schooling the incidence of births of products weighing 2,500 grams or less was 10.7 per cent, which was more than twice the percentage for mothers with four years of college (4.4). This same author, in referring to a paper by Hendricks (1967), stated the following in regard to education as a parameter of socioeconomic status: "Education itself has been called a common denominator among the factors interrelated in the maternal, biolog-

ical, and environmental background; that is, education reflects the preparation of persons for responsible parenthood."

In this chapter occupation of father is explored as a measure of socioeconomic status, but the analysis of mortality according to educational level of mother proved to be a more sensitive measure.

MARITAL RELATIONSHIP OF PARENTS

In 14 widely separated projects* in this Investigation, differences were found in the composition of households in which the deceased children lived. Table 163 provides data on the presence of parents in the home and on their marital relationship.

* As home interviews were not conducted in the project in California, information on marital status of parents and on educational level was not obtained.

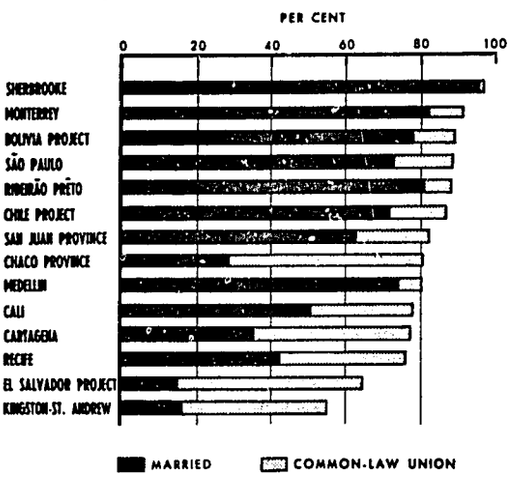
In 12 projects, 75 per cent or more of the families had both parents living in the home, the highest percentage (97.3) being in Sherbrooke (Figure 138). Monterrey and the Bolivia project were next in order, with 91.4 and 88.8 per cent, respectively. In only two projects were the percentages lower than 75 (El Salvador 64.5, and Kingston-St. Andrew 54.8).

TABLE 163. Presence of Parents in the Homes of Deceased Children Under 5 Years of Age, and Parents' Marital Status, in 14 Projects.

Project	Total families[a]	Both parents in household						Mother only		Father only		Neither	
		Total		Married		Common-law union							
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Total	27,844	22,340	80.2	15,233	54.7	7,107	25.5	4,696	16.9	272	1.0	536	1.9
ARGENTINA													
Chaco Province	1,645	1,326	80.6	455	27.7	871	52.9	275	16.7	21	1.3	23	1.4
San Juan Province	1,995	1,650	82.7	1,256	63.0	394	19.7	303	15.2	8	0.4	34	1.7
BOLIVIA project	2,739	2,433	88.8	2,134	77.9	299	10.9	264	9.6	33	1.2	9	0.3
BRAZIL													
Recife	3,115	2,380	76.4	1,317	42.3	1,063	34.1	522	16.8	52	1.7	161	5.2
Ribeirão Prêto	989	869	87.9	803	81.2	66	6.7	104	10.5	2	0.2	14	1.4
São Paulo	3,669	3,245	88.4	2,667	72.7	578	15.8	367	10.0	18	0.5	39	1.1
CANADA													
Sherbrooke	329	320	97.3	315	95.7	5	1.5	7	2.1	1	0.3	1	0.3
CHILE project	1,892	1,633	86.3	1,355	71.6	278	14.7	224	11.8	4	0.2	31	1.6
COLOMBIA													
Cali	1,151	901	78.3	586	50.9	315	27.4	209	18.2	25	2.2	16	1.4
Cartagena	862	668	77.5	304	35.3	364	42.2	164	19.0	16	1.9	14	1.6
Medellín	983	783	79.7	727	74.0	56	5.7	171	17.4	5	0.5	24	2.4
EL SALVADOR project	3,685	2,376	64.5	512	13.9	1,864	50.6	1,136	30.8	57	1.5	116	3.1
JAMAICA													
Kingston-St. Andrew	1,703	934	54.8	270	15.9	664	39.0	721	42.3	15	0.9	33	1.9
MEXICO													
Monterrey	3,087	2,822	91.4	2,532	82.0	290	9.4	229	7.4	15	0.5	21	0.7

[a] In families in which home interviews were conducted and information was provided.

FIG. 138. Percentage of Families of Deceased Children Under 5 Years of Age with Both Parents Present in the Home, and Parents' Marital Status, in 14 Projects.



Common-law union was the marital state reported in over half the families in two projects(Chaco Province 52.9 per cent, and El Salvador 50.6 per cent). In the Kingston-St. Andrew and El Salvador projects only a small proportion of the parents were married (15.9 and 13.9 per cent) and the mother was the only parent present in a high proportion of the homes (42.3 and 30.8 per cent, respectively). It is known that in Kingston-St. Andrew children often live in the home of grandparents so that the mother is free to work. Marino (1970) has described the relatively unstable forms of marital unions in Jamaica and other Caribbean islands.

The percentage of families in which neither parent was present in the home was largest in Recife (5.2 per cent). In a few instances the mother had died and in others the child lived with grandparents, but many of those with neither parent present were adopted children.

These findings on marital relationship of parents are important for understanding the analysis of occupation of father and education of mother. In unstable unions the father's occupation may not be known and, moreover, may have little relation to mortality.

OCCUPATION OF FATHER

Exploration of the use of occupation as a parameter in studying mortality when distribution of population by occupation groups is unknown was made in connection with the Inter-American Investigation of Mortality in adults (Curiel and Puffer, 1969). In that study data were divided into three social classes (A, B, and C) according to the categories listed in the International Standard Classification of Occupations of the International Labor Office (1957). The study demonstrated that the proportion of deaths from tuberculosis was higher in Class C (principally unskilled workers) than in Class A (professional workers or executives); this relationship had been known in terms of death rates from the work of Whitney (1934). Thus the use of proportions instead of death rates proved satisfactory in that Investigation of Mortality, and the method has been used again here.

The distributions of occupations of fathers of deceased children are given for the 25 areas of the 15 projects in Table 164. Actually high proportions of the parents

TABLE 164. Deaths of Children[a] Under 5 Years of Age by Occupation of Father in 25 Areas of 15 Projects.

Father's occupation	ARGENTINA, Chaco Province				ARGENTINA, San Juan Province						BOLIVIA				BRAZIL Recife		BRAZIL Ribeirão Prêto (city)	
	Resistencia		Rural departments		San Juan (city)		Suburban departments		Rural departments		La Paz		Viacha					
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Total	829	100.0	816	100.0	286	99.8	720	100.0	990	99.8	2,632	100.0	134	99.9	3,116	100.1	417	99.9
Professional	8	1.0	3	0.4	13	4.5	7	1.0	4	0.4	112	4.3	3	2.2	27	0.9	12	2.9
Administrative	—	—	1	0.1	4	1.4	4	0.6	1	0.1	17	0.6	—	—	9	0.3	1	0.2
Clerical	22	2.7	5	0.6	23	8.0	21	2.9	15	1.5	277	10.5	4	3.0	78	2.5	12	2.9
Sales workers	60	7.2	23	2.8	40	14.0	42	5.8	35	3.5	271	10.3	8	6.0	380	12.2	48	11.5
Farmers, etc.	93	11.2	471	57.7	18	6.3	225	31.2	607	61.3	25	0.9	5	3.7	27	0.9	25	6.0
Miners, etc.	—	—	—	—	—	—	—	—	20	2.0	23	0.9	—	—	2	0.1	1	0.2
Transport	55	6.6	19	2.3	29	10.1	25	3.5	31	3.1	292	11.1	14	10.4	231	7.4	33	7.9
Craftsmen	410	49.5	189	23.2	95	33.2	267	37.1	140	14.1	1,124	42.7	57	42.5	1,275	40.9	222	53.2
Service[b]	69	8.3	16	2.0	27	9.4	48	6.7	40	4.0	197	7.5	15	11.2	386	12.4	30	7.2
Unspecified	112	13.5	89	10.9	37	12.9	81	11.2	97	9.8	294	11.2	28	20.9	701	22.5	33	7.9

Father's occupation	BRAZIL, Ribeirão Prêto				BRAZIL São Paulo		CANADA Sherbrooke		CHILE				COLOMBIA					
	Franca		Communities						Santiago		Comunas		Cali		Cartagena		Medellin	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Total	364	100.0	209	100.0	3,705	100.0	329	100.1	1,701	100.0	195	99.9	1,154	100.1	862	100.0	988	100.0
Professional	4	1.1	—	—	77	2.1	36	10.9	56	3.3	2	1.0	31	2.7	17	2.0	22	2.2
Administrative	2	0.5	—	—	34	0.9	6	1.8	11	0.6	—	—	14	1.2	1	0.1	4	0.4
Clerical	9	2.5	9	4.3	190	5.1	18	5.5	102	6.0	1	0.5	40	3.5	58	6.7	38	3.8
Sales workers	20	5.5	9	4.3	369	10.0	17	5.2	173	10.2	7	3.6	145	12.6	111	12.9	131	13.3
Farmers, etc.	46	12.6	70	33.5	34	0.9	41	12.5	44	2.6	88	45.1	53	4.6	43	5.0	29	2.9
Miners, etc.	—	—	—	—	7	0.2	5	1.5	10	0.6	10	5.1	16	1.4	—	—	2	0.2
Transport	25	6.9	18	8.6	323	8.7	20	6.1	152	8.9	7	3.6	120	10.4	93	10.8	90	9.1
Craftsmen	198	54.4	86	41.1	1,817	49.0	144	43.8	846	49.7	46	23.6	471	40.8	327	37.9	455	46.1
Service[b]	15	4.1	2	1.0	343	9.3	14	4.3	156	9.2	19	9.7	112	9.7	47	5.5	74	7.5
Unspecified	45	12.4	15	7.2	511	13.8	28	8.5	151	8.9	15	7.7	152	13.2	165	19.1	143	14.5

Father's occupation	EL SALVADOR				JAMAICA				MEXICO Monterrey		UNITED STATES			
	San Salvador		Rural municipios		Metropolitan Kingston		St. Andrew, rural				San Francisco		California, suburban	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Total	2,650	99.9	1,036	100.0	1,565	100.1	147	100.1	3,091	100.1	234	99.9	664	100.1
Professional	69	2.6	7	0.7	34	2.2	—	—	70	2.3	28	12.0	51	7.7
Administrative	6	0.2	—	—	4	0.3	1	0.7	8	0.3	3	1.3	26	3.9
Clerical	158	6.0	18	1.7	63	4.0	1	0.7	124	4.0	12	5.1	37	5.6
Sales workers	262	9.9	32	3.1	108	6.9	5	3.4	300	9.7	15	6.4	39	5.9
Farmers, etc.	200	7.5	612	59.1	43	2.7	66	44.9	62	2.0	1	0.4	10	1.5
Miners, etc.	—	—	—	—	1	0.1	—	—	17	0.5	—	—	3	0.5
Transport	243	9.2	44	4.2	135	8.6	7	4.8	274	8.9	8	3.4	34	5.1
Craftsmen	1,212	45.7	202	19.5	826	52.8	42	28.6	1,727	55.9	48	20.5	234	35.2
Service[b]	271	10.2	32	3.1	142	9.1	8	5.4	184	6.0	66	28.2	96	14.5
Unspecified	229	8.6	89	8.6	209	13.4	17	11.6	325	10.5	53	22.6	134	20.2

[a] In families in which home interviews were conducted, except for California project where data were obtained from birth certificates or other records.
[b] Includes members of the armed forces.

were young adults, especially in areas that had low birth rates. The father's employment experience may have been of only a few years' duration. Craftsman was the occupation reported most frequently in the cities. In the distinctly rural areas of Chaco and San Juan Provinces and of the El Salvador project, high percentages of the fathers were farmers (57.7, 61.3, and 59.1). Also in the *comunas* of Chile and in rural St. Andrew, 45.1 and 44.9 per cent were farmers. In the suburban departments of San Juan Province, Viacha in the Bolivia project, Ribeirão Prêto communities, and suburban California, the distribution of occupations differed from those in the nearby cities. (These distributions were helpful also in providing data for description of the areas.)

From the home interviews, information on occupation was obtained for fathers of deceased children in 14 projects; for the California project it was obtained from other sources. To analyze the data for each project, it was necessary to divide occupations into four groupings. As the numbers of professional workers and executives were too small to constitute a group, they were incorporated with administrative, clerical, and sales workers to form Group A. The other groups were skilled workers (B), semi- and unskilled workers (C), and the fourth group (D) which included service workers and members of armed forces. Table 165 gives the codes of the ILO Classification in these four groups.

The distributions of deaths of children

TABLE 165. Grouping of Occupations on the Basis of the International Standard Classification of Occupations,[a] with Codes.

Group	Occupation	Code
A	1. Professional, technical, administrative workers	
	Professional, technical, and related workers	00–0Y
	Administrative, executive, and managerial workers	10–11
	Working proprietors, wholesale and retail trade	30
	Deck officers, engineer officers, and pilots, ship	60
	Aircraft pilots, navigators, and flight engineers	62
	2. Clerical and sales workers	
	Clerical workers	20–29
	Sales workers	31–33
	Conductors and brakemen, railway	65
	Inspectors, supervisors, traffic controllers and dispatchers, transport	66
	Telephone, telegraph, and related telecommunication operators	67
B	Skilled workers	
	Craftsmen	70–78
	Production-process workers	80–87
C	1. Semi-skilled workers	
	Bricklayers, plasterers, and construction workers	79
	Deck, engine-room ratings (ship), barge crews, boatmen	61
	Drivers and firemen, railway engine	63
	Drivers, road transport	64
	Workers in transport and communication occupations (not elsewhere classified)	69
	2. Unskilled workers	
	Farm and related workers	40–44
	Miners	50–59
	Freight handlers	88
	Laborers (not elsewhere classified)	89
D	Service workers	
	Postmen, messengers	68
	Service, sport and recreation workers	90–99
	Members of the armed forces[b]	—4

[a] International Labor Office, 1957.
[b] Code for this item assigned by staff of the Investigation.

in three age groups (neonatal, postneonatal, and 1–4 years of age) are presented for these four occupational groups of fathers in Table 166.

TABLE 166. Deaths of Children[a] Under 5 Years, in Three Age Groups, by Occupation of Father in 15 Projects.

Father's occupational group	Neonatal		Post-neonatal		1–4 years		Neonatal		Post-neonatal		1–4 years		Neonatal		Post-neonatal		1–4 years	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
	ARGENTINA, Chaco Province						ARGENTINA, San Juan Province						BOLIVIA project					
Total	483	100.0	708	100.0	253	99.9	727	100.0	827	100.1	227	100.0	590	100.1	967	100.0	886	99.9
Professional, clerical, etc. . . . A	65	13.5	53	7.5	15	5.9	93	12.8	86	10.4	34	15.0	220	37.3	287	29.7	205	23.1
Skilled workers . . . . . B	86	17.8	122	17.2	36	14.2	114	15.7	98	11.9	29	12.8	195	33.1	335	34.6	322	36.3
Semi- and unskilled workers . C	300	62.1	497	70.2	185	73.1	467	64.2	591	71.5	153	67.4	118	20.0	258	26.7	280	31.6
Service workers . . . . . D	32	6.6	36	5.1	17	6.7	53	7.3	52	6.3	11	4.8	57	9.7	87	9.0	79	8.9
	BRAZIL, Recife						BRAZIL, Ribeirão Prêto						BRAZIL, São Paulo					
Total	730	100.0	1,102	100.1	582	100.0	420	100.0	352	100.0	125	100.0	1,514	100.0	1,314	100.0	366	100.0
Professional, clerical, etc. . . . A	181	24.8	231	21.0	102	17.5	82	19.5	34	9.7	11	8.8	384	25.4	239	18.2	57	15.6
Skilled workers . . . . . B	219	30.0	338	30.7	192	33.0	144	34.3	85	24.1	36	28.8	459	30.3	413	31.4	115	31.4
Semi- and unskilled workers . C	216	29.6	351	31.9	192	33.0	171	40.7	214	60.8	73	58.4	509	33.6	497	37.8	163	44.5
Service workers . . . . . D	114	15.6	182	16.5	96	16.5	23	5.5	19	5.4	5	4.0	162	10.7	165	12.6	31	8.5
	CANADA, Sherbrooke						CHILE project						COLOMBIA, Cali					
Total	186	100.0	66	100.0	49	100.0	604	100.0	899	100.0	227	100.0	359	100.0	366	100.0	277	100.0
Professional, clerical, etc. . . . A	53	28.5	14	21.2	10	20.4	161	26.7	152	16.9	49	21.6	94	26.2	80	21.9	64	23.1
Skilled workers . . . . . B	75	40.3	28	42.4	20	40.8	234	38.7	372	41.4	76	33.5	105	29.2	115	31.4	76	27.4
Semi- and unskilled workers . C	48	25.8	18	27.3	17	34.7	145	24.0	287	31.9	69	30.4	107	29.8	127	34.7	108	39.0
Service workers . . . . . D	10	5.4	6	9.1	2	4.1	64	10.6	88	9.8	33	14.5	53	14.8	44	12.0	29	10.5
	COLOMBIA, Cartagena						COLOMBIA, Medellín						EL SALVADOR project					
Total	177	100.0	275	100.0	245	100.0	244	100.0	324	100.0	277	100.0	818	99.9	1,621	100.0	929	100.1
Professional, clerical, etc. . . . A	60	33.9	72	26.2	62	25.3	67	27.5	74	22.8	59	21.3	182	22.2	272	16.8	114	12.3
Skilled workers . . . . . B	45	25.4	74	26.9	53	21.6	82	33.6	95	29.3	78	28.2	195	23.8	441	27.2	207	22.3
Semi- and unskilled workers . C	60	33.9	109	39.6	110	44.9	74	30.3	124	38.3	115	41.5	358	43.8	747	46.1	535	57.6
Service workers . . . . . D	12	6.8	20	7.3	20	8.2	21	8.6	31	9.6	25	9.0	83	10.1	161	9.9	73	7.9
	JAMAICA, Kingston-St. Andrew						MEXICO, Monterrey						UNITED STATES, California project					
Total	780	100.0	472	99.9	234	100.0	874	100.0	1,354	100.0	538	99.9	462	100.0	168	100.0	81	100.0
Professional, clerical, etc. . . . A	125	16.0	62	13.1	33	14.1	193	22.1	219	16.2	96	17.8	131	28.4	57	33.9	26	32.1
Skilled workers . . . . . B	279	35.8	142	30.1	61	26.1	328	37.5	438	36.0	149	27.7	139	30.1	48	28.6	24	29.6
Semi- and unskilled workers . C	291	37.3	214	45.3	114	48.7	302	34.6	543	40.1	259	48.1	80	17.3	29	17.3	14	17.3
Service workers . . . . . D	85	10.9	54	11.4	26	11.1	51	5.8	104	7.7	34	6.3	112	24.2	34	20.2	17	21.0

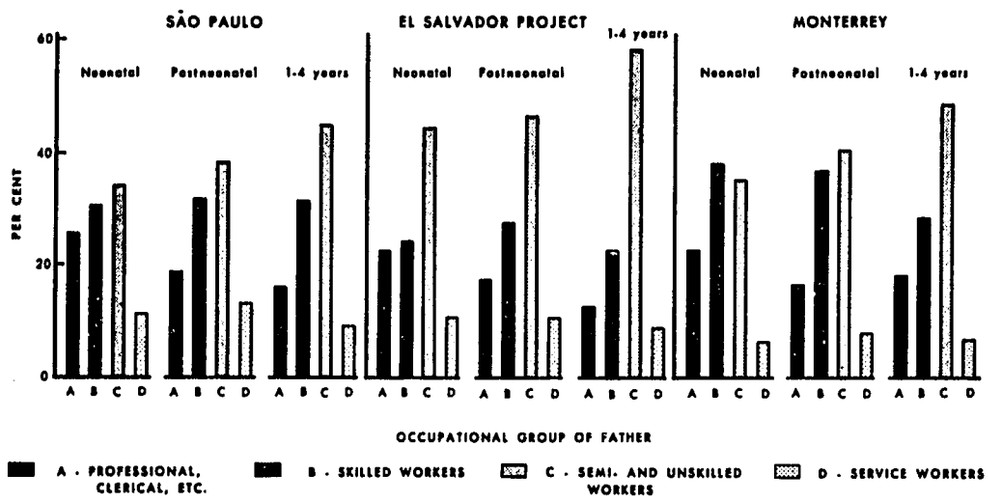
[a] In families in which home interviews were conducted, except for California project where data were obtained from birth certificates or other records.

To illustrate the findings, the data for three projects in which the numbers of deaths were large (São Paulo, El Salvador, and Monterrey) are presented in Figure 139. Distinct differences can be seen in these three. The percentages of fathers in Group A (professional, clerical, etc.) were less for children dying at 1–4 years of age than for those dying in the neonatal period; the reverse was noted for Group C fathers (semi- and unskilled workers), the percentage being highest for children dying at 1–4 years. It is probable that this distribution of neonatal deaths according to father's occupation is similar to that in the general population of those areas.

Similar differences were noted in several other projects, as can be seen in Table 166 (Chaco Province, Bolivia, Ribeirão Prêto, Cali, Cartagena, and Medellín) while in a few (Recife, Chile, Kingston-St. Andrew, and Sherbrooke) the differences by father's occupation according to infant's age group were small. In two projects (San Juan Province and California) this type of difference was not found.

The completeness and quality of the data on occupation varied among the projects, classification being difficult because of the local terminology used. Though these difficulties are minimized by grouping, the data are subject to misinterpretation. For this reason, education of mother was explored as a more satisfactory index of socioeconomic status.

FIG. 139. Deaths of Children Under 5 Years, in Three Age Groups, by Occupation of Father in Three Projects.



EDUCATION OF MOTHER

Data on years of schooling of mothers of deceased children were obtained during the home interviews in 14 projects. For the 13 Latin American projects combined, satisfactory information on this point was available for 27,606 mothers (14.7 per cent more than

the number of fathers for whom occupation was stated).

Relatively small proportions of the mothers had secondary or university education in the Latin American projects (the few who had technical education were incorporated in this group). Mothers with primary education were divided into two groups: those with at least three years of schooling and those with one or two years. The final group included mothers stated to have no education and others who were considered as having no education since none was stated. As the level of education reached was lower in rural and suburban areas than in cities, the data are presented for each of the 23 areas of the 14 projects (Table 167).

The wide variation in mother's education is illustrated first for cities (Figure 140). The Sherbrooke project had the highest pro-

TABLE 167. Educational Level of Mothers[a] of Deceased Children Under 5 Years of Age in 23 Areas of 14 Projects.

Area	Total mothers	Secondary or university education		Primary, three years and over		Primary, one and two years		None	
		No.	%	No.	%	No.	%	No.	%
Total	27,936	3,038	10.9	12,636	45.2	4,662	16.7	7,600	27.2
ARGENTINA									
Chaco Province									
Resistencia	829	43	5.2	381	46.0	186	22.4	219	26.4
Rural departments	816	16	2.0	189	23.2	230	28.2	381	46.7
San Juan Province									
San Juan (city)	286	88	30.8	152	53.1	28	9.8	18	6.3
Suburban departments	720	78	10.8	429	59.6	141	19.6	72	10.0
Rural departments	990	33	3.3	537	54.2	264	26.7	156	15.8
BOLIVIA									
La Paz	2,632	441	16.8	990	37.6	357	13.6	844	32.1
Viacha	134	7	5.2	41	30.6	26	19.4	60	44.8
BRAZIL									
Recife	3,116	164	5.3	829	26.6	505	16.2	1,618	51.9
Ribeirão Prêto									
Ribeirão Prêto (city)	417	50	12.0	184	44.1	87	20.9	96	23.0
Franca	364	31	8.5	150	41.2	88	24.2	95	26.1
Communities	209	9	4.3	81	38.8	44	21.1	75	35.9
São Paulo	3,705	299	8.1	1,522	41.1	764	20.6	1,120	30.2
CANADA									
Sherbrooke	329	200	60.8	118	35.9	4	1.2	7	2.1
CHILE									
Santiago	1,701	476	28.0	929	54.6	131	7.7	165	9.7
Comunas	195	20	10.3	101	51.8	33	16.9	41	21.0
COLOMBIA									
Cali	1,154	143	12.4	575	49.8	259	22.4	177	15.3
Cartagena	862	70	8.1	441	51.2	178	20.6	173	20.1
Medellín	988	132	13.4	492	49.8	218	22.1	146	14.8
EL SALVADOR									
San Salvador	2,650	243	9.2	1,259	47.5	348	13.1	800	30.2
Rural *municipios*	1,036	15	1.4	247	23.8	152	14.7	622	60.0
JAMAICA									
Metropolitan Kingston	1,565	176	11.2	1,287	82.2	55	3.5	47	3.0
St. Andrew rural	147	11	7.5	103	70.1	15	10.2	18	12.2
MEXICO									
Monterrey	3,091	293	9.5	1,599	51.7	549	17.8	650	21.0

[a] In families in which home interviews were conducted and information was provided.

FIG. 140. Educational Level of Mothers of Deceased Children Under 5 Years of Age in 14 Cities.

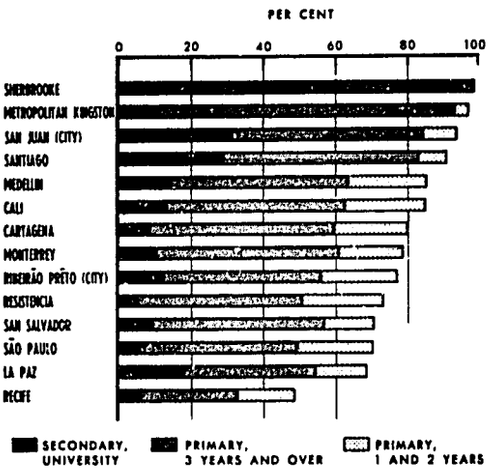
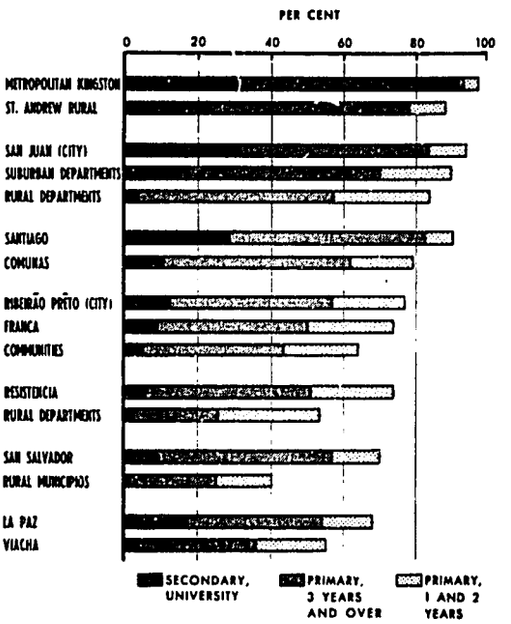


FIG. 141. Educational Level of Mothers of Deceased Children Under 5 Years of Age in 16 Areas of Seven Projects.



portion of mothers with at least one year of education (97.9 per cent) and also the highest with secondary or university education (60.8 per cent). In Metropolitan Kingston, though the percentage with secondary or university education was not high (11.2), that for mothers with three or more years' primary education was very high (82.2) and many had completed primary school. In the Latin American projects, the cities of San Juan and Santiago had the highest percentages of mothers with secondary or university education (30.8 and 28.0). At least half the mothers in all the cities except Recife had received at least some education. In Recife the percentage was 48.1.

The differences in educational level between urban or suburban and rural areas of seven projects can be seen in Figure 141. The levels were low in the rural areas of Chaco Province and of El Salvador and in Viacha, Bolivia, where mothers with no education constituted 44.8 to 60.0 per cent of the total. In all seven projects the level was highest in cities and lowest in rural areas. The two projects with very high infant death rates in rural areas (as well as high rates in cities)—El Salvador and Bolivia—had the lowest educational levels of these seven. The widest variations were noted in El Salvador, where 60.0 per cent of mothers had no education in the rural *municipios*, or twice the percentage for the city of San Salvador (30.2).

Such great diversity in educational level of mothers, taken as an indicator of socioeconomic conditions, is a factor that must be taken into account when planning health programs. Written educational material can seldom be an effective means of reaching mothers with little or no schooling.

Mortality by Age Group

In Table 168 mortality of children in the same three age groups as those used above

for occupation of father (neonatal, postneonatal, and 1–4 years) is presented for 14 projects according to mother's educational level. In comparing the percentage distributions in these three groups, a distinct difference is seen at once. In Chaco Province, for example, 6.9 per cent of mothers of deceased neonates had secondary or university

TABLE 168. Educational Level of Mothers of Deceased Children[a] Under Five Years, in Three Age Groups, in 14 Projects.

Mother's education level	Neonatal		Post-neonatal		1–4 years		Neonatal		Post-neonatal		1–4 years		Neonatal		Post-neonatal		1–4 years	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
	ARGENTINA, Chaco Province						ARGENTINA, San Juan Province						BOLIVIA project					
Total	539	100.1	819	100.1	287	100.0	809	100.0	940	100.1	247	100.0	675	100.0	1,119	100.1	972	100.0
Secondary, university	37	6.9	18	2.2	4	1.4	98	12.1	71	7.6	30	12.1	185	27.4	192	17.2	71	7.3
Primary, 3 years and over	228	42.3	274	33.5	68	23.7	478	59.1	526	56.0	114	46.2	255	37.8	426	38.1	350	36.0
Primary, 1 and 2 years	120	22.3	220	26.9	76	26.5	150	18.5	218	23.2	65	26.3	89	13.2	161	14.4	133	13.7
None	154	28.6	307	37.5	139	48.4	83	10.3	125	13.3	38	15.4	146	21.6	340	30.4	418	43.0
	BRAZIL, Recife						BRAZIL, Ribeirão Prêto						BRAZIL, São Paulo					
Total	893	99.9	1,463	100.0	760	100.1	458	100.0	386	100.1	146	100.0	1,714	100.0	1,555	99.9	436	100.0
Secondary, university	84	9.4	53	3.6	27	3.6	62	13.5	25	6.5	3	2.1	193	11.3	89	5.7	17	3.9
Primary, 3 years and over	296	33.1	349	23.9	184	24.2	214	46.7	147	38.1	54	37.0	758	44.2	613	39.4	151	34.6
Primary, 1 and 2 years	143	16.0	239	16.3	123	16.2	86	18.8	94	24.4	39	26.7	339	19.8	324	20.8	101	23.2
None	370	41.4	822	56.2	426	56.1	96	21.0	120	31.1	50	34.2	424	24.7	529	34.0	167	38.3
	CANADA, Sherbrooke						CHILE project						COLOMBIA, Cali					
Total	203	100.0	73	100.0	53	100.0	643	100.0	1,001	100.0	252	100.0	382	100.1	444	100.0	328	100.0
Secondary, university	129	63.5	44	60.3	27	50.9	240	37.3	199	19.9	57	22.6	82	21.5	44	9.9	17	5.2
Primary, 3 years and over	71	35.0	23	31.5	24	45.3	317	49.3	591	59.0	122	48.4	200	52.4	217	48.9	158	48.2
Primary, 1 and 2 years	1	0.5	2	2.7	1	1.9	41	6.4	93	9.3	30	11.9	70	18.3	102	23.0	87	26.5
None	2	1.0	4	5.5	1	1.9	45	7.0	118	11.8	43	17.1	30	7.9	81	18.2	66	20.1
	COLOMBIA, Cartagena						COLOMBIA, Medellín						EL SALVADOR project					
Total	208	99.9	356	100.0	298	100.0	263	100.0	398	100.0	327	100.0	875	100.0	1,778	100.0	1,033	100.0
Secondary, university	40	19.2	20	5.6	10	3.4	60	22.8	39	9.8	33	10.1	101	11.5	124	7.0	33	3.2
Primary, 3 years and over	102	49.0	176	49.4	163	54.7	149	56.7	188	47.2	155	47.4	394	45.0	765	43.0	347	33.6
Primary, 1 and 2 years	37	17.8	81	22.8	60	20.1	33	12.5	95	23.9	90	27.5	89	10.2	276	15.5	135	13.1
None	29	13.9	79	22.2	65	21.8	21	8.0	76	19.1	49	15.0	291	33.3	613	34.5	518	50.1
	JAMAICA, Kingston-St. Andrew						MEXICO, Monterrey											
Total	882	99.9	549	100.0	281	100.0	958	100.1	1,528	99.9	605	100.0						
Secondary, university	123	13.9	39	7.1	25	8.9	131	13.7	129	8.4	33	5.5						
Primary, 3 years and over	724	82.1	453	82.5	213	75.8	526	54.9	805	52.7	268	44.3						
Primary, 1 and 2 years	25	2.8	28	5.1	17	6.0	152	15.9	277	18.1	120	19.8						
None	10	1.1	29	5.3	26	9.3	149	15.6	317	20.7	184	30.4						

[a] In families in which home interviews were conducted and information was provided.

education while 28.6 per cent had no schooling. Of the mothers of children dying at 1–4 years only 1.4 per cent had the better education and nearly half (48.4 per cent) had none. Mothers of infants dying in the neonatal period are more closely representative of the general population, while those of children dying at 1–4 years are the ones most affected by unfavorable socioeconomic and environmental conditions.

The percentage distributions for the three age groups are illustrated in Figure 142. While there are variations, in general the pattern is clear. Mothers of children dying at 1–4 years had less education than those of infants dying soon after birth in the neonatal period.

The differentiation of four educational levels was less useful in the projects in Sherbrooke and Jamaica because of the small numbers of mothers who had no schooling or primary education of only one and two years, although slight differences were noted in the same direction as observed in other projects.

For the 13 Latin American projects combined, the percentages for the three age groups of deceased children differed widely, as shown below:

Age group	*Secondary or university education*	*No education*
Neonatal period	15.4	19.9
Postneonatal period	8.4	28.8
1–4 years	6.0	36.7

As can be seen, of the children dying in the neonatal period, 15.4 per cent of the mothers had secondary or university education, while in the 1–4 year age group the proportion was only 6.0. The reverse was true of children of mothers with no education: 19.9 per cent of the deaths in the neonatal period but 36.7 per cent (almost twice the proportion) of those at 1–4 years were of children of mothers with no education. These significant differences in distributions of deaths by mother's education indicate that the factors responsible for mortality in these age periods must differ also.

The data by occupation of father, when analyzed for the 13 Latin American projects combined, revealed differences that were much smaller than those noted for education of mother. This was an added indication of the greater usefulness of this latter parameter.

Another method of presenting the data can be used to further analyze the role of education (Table 169 and Figure 143). In Chapter V it was pointed out that in the two projects with the lowest death rates (California and Sherbrooke) more than 60 per cent of all deaths under 5 years were neonatal deaths (63.5 and 61.7 per cent, respectively). In four of the Latin American projects, out of the deaths of children under 5 years whose mothers had secondary or university education, more than 60 per cent were neonatal deaths. These projects were: Ribeirão Prêto with 68.9 per cent, Kingston-St. Andrew 65.8 per cent, São Paulo 64.5, and Chaco Province 62.7 per cent. To judge from this general comparison, conditions would seem to be approximately as favorable for these selected groups of women in Latin American areas as for mothers in the California and Sherbrooke projects.

Figure 143 shows clearly that among the better educated mothers the proportions of deaths under 5 years occurring in the neonatal period were much higher in Latin American projects. In fact, in five projects the low percentages for neonatal deaths (less than 20) among uneducated mothers are evidence of the high proportions occurring in the postneonatal period and at 1–4 years, the ages at which mortality can be reduced to low levels through preventive

FIG. 142. Educational Level of Mothers of Deceased Children Under 5 Years, in Three Age Groups, in 14 Projects.

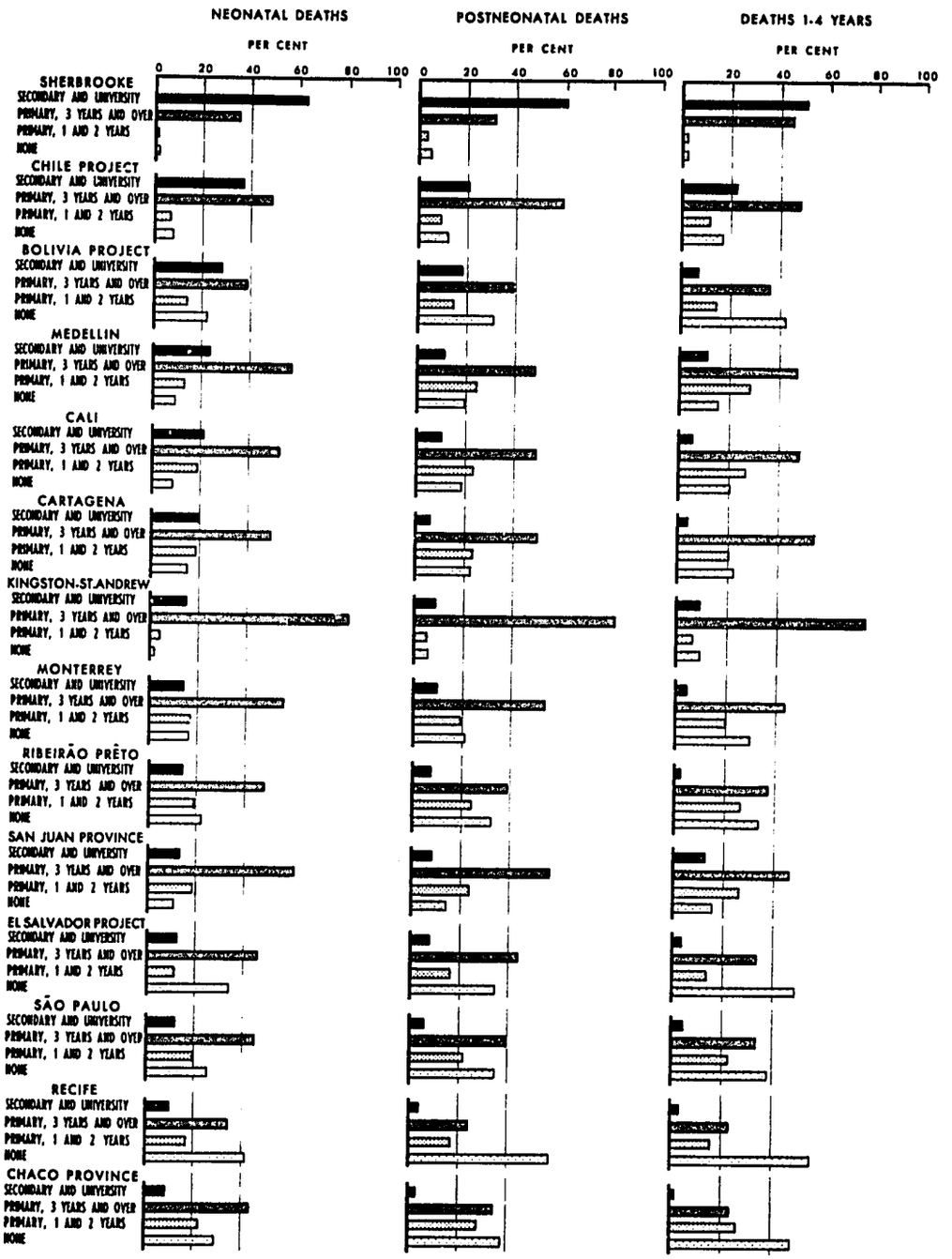


TABLE 169. Percentage of Deaths of Children[a] Under Five Years of Age Occurring in Neonatal Period Whose Mothers Had Secondary or University Education or No Education in 14 Projects.

Project	Secondary or university education			No education		
	Total deaths	Neonatal		Total deaths	Neonatal	
		No.	%		No.	%
Total	3,038	1,565	51.5	7,600	1,850	24.3
ARGENTINA						
Chaco Province	59	37	62.7	600	154	25.7
San Juan Province	199	98	49.2	246	83	33.7
BOLIVIA project	448	185	41.3	904	146	16.2
BRAZIL						
Recife	164	84	51.2	1,618	370	22.9
Ribeirão Prêto	90	62	68.9	266	96	36.1
São Paulo	299	193	64.5	1,120	424	37.9
CANADA						
Sherbrooke	200	129	64.5	7	2	#
CHILE project	496	240	48.4	206	45	21.8
COLOMBIA						
Cali	143	82	57.3	177	30	16.9
Cartagena	70	40	57.1	173	29	16.8
Medellín	132	60	45.5	146	21	14.4
EL SALVADOR project	258	101	39.1	1,422	291	20.5
JAMAICA						
Kingston-St. Andrew	187	123	65.8	65	10	15.4
MEXICO						
Monterrey	293	131	44.7	650	149	22.9

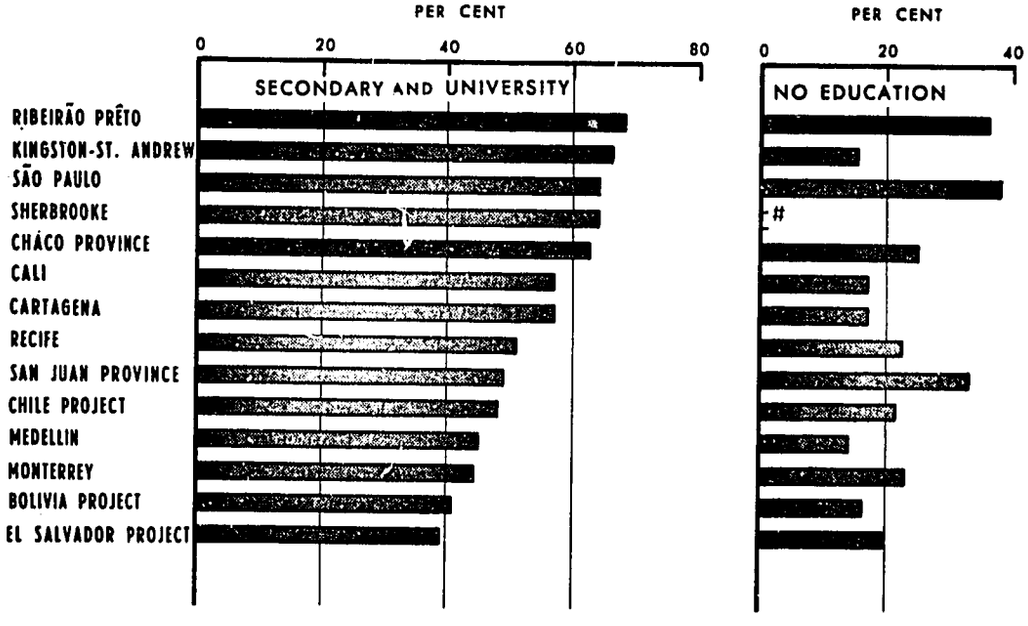
[a] In families in which home interviews were conducted and information was provided.
Percentages are not calculated for a base of less than 10.

programs. These five projects were Kingston-St. Andrew (with 15.4 per cent neonatal deaths), Cali (16.9 per cent), Cartagena (16.8), Medellín (14.4), and the Bolivia project (16.2). This analysis using education as the measure points up sections of the population in which there are serious health problems. Even though Kingston-St. Andrew had a favorable infant death rate and had a high proportion of deaths in the neonatal group (52.0 per cent of all deaths under 5 years), the low percentage of deaths in the neonatal period among mothers with no education (15.4) is indicative of a situation in which conditions are unfavorable and health programs are needed.

Mortality by Causes

Educational level having thus proved to be a useful measure, the specific causes of death were further analyzed according to this factor in three age groups (neonatal, postneonatal, and 1–4 years). The causes of neonatal deaths are considered first (Table 170). This analysis includes only deaths of children in whose homes inter-

FIG. 143. Percentage of Deaths of Children Under 5 Years of Age Occurring in Neonatal Period Whose Mothers Had Secondary and University Education or No Education in 14 Projects.



Insufficient number

views were conducted, and therefore the totals are not the same as those presented in Chapters V–XI for causes of death.

Five groups of causes are given, according to the four educational levels of mothers in 14 projects. Figure 144 presents the percentages for certain perinatal causes, infectious diseases, respiratory diseases, and congenital anomalies; the projects are shown in descending order of the percentages of deaths due to certain perinatal causes for the first educational level (mothers with secondary or university education). In the first project listed, Chaco Province, the percentages due to perinatal causes decreased from a high figure for mothers with the better education to a much lower percentage for those with no education. The reverse was true for deaths from infectious diseases, the higher percentage being in the group with no education. In many projects this same relationship is clear.

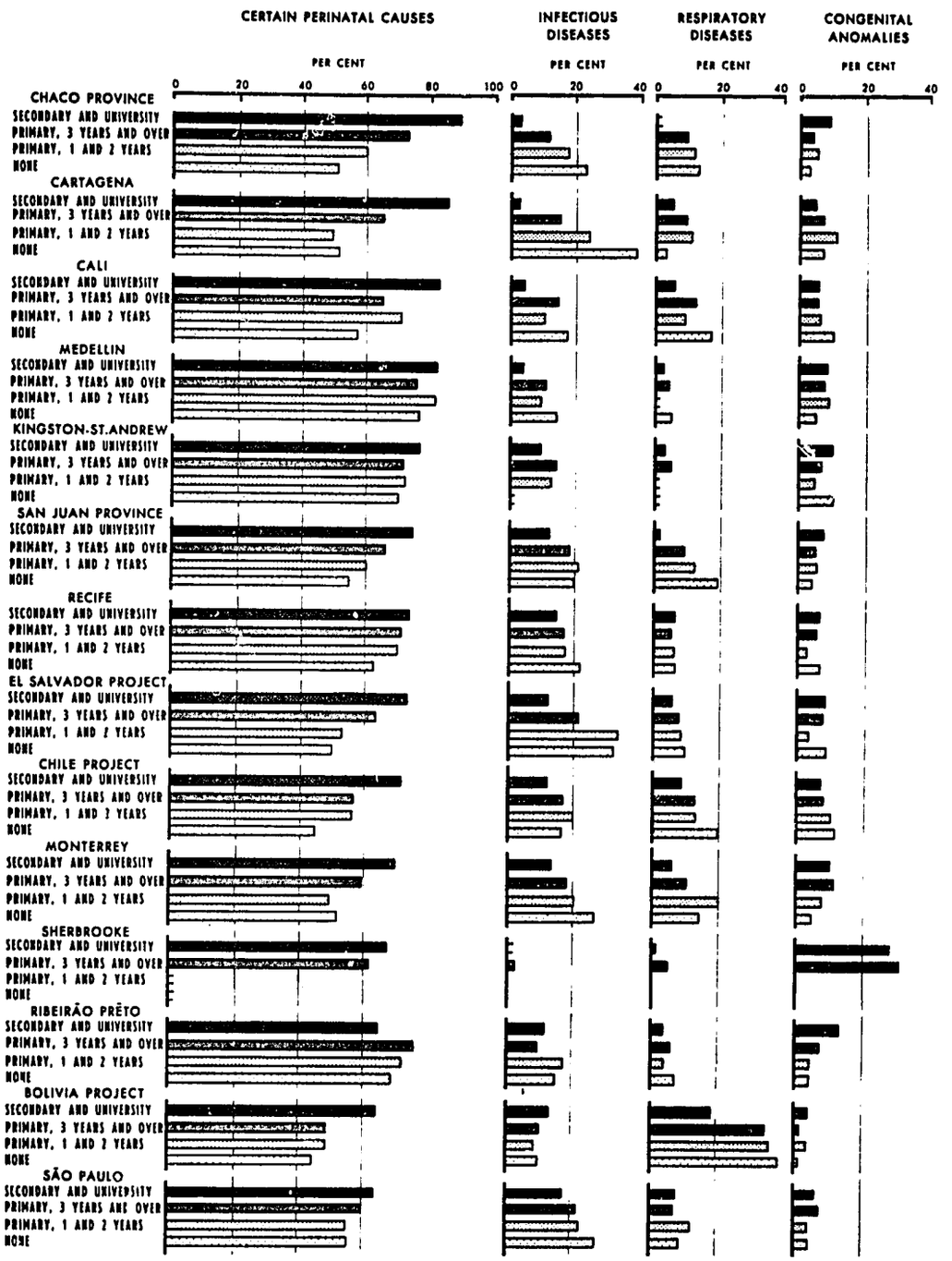
These data on perinatal causes can be related to the findings in regard to neonatal mortality presented in Chapter VI. In the following projects with low neonatal death rates, very high proportions of the neonatal deaths were due to certain perinatal causes: California 74.4, Medellín 76.0, Kingston-St. Andrew 71.3, and Ribeirão Prêto 71.1. For mothers with secondary or university education the percentages of neonatal deaths due

TABLE 170. Underlying Causes of Neonatal Deaths,[a] by Educational Level of Mother, in 14 Projects.

Cause group	Secondary, university		Primary, 3 years and over		Primary, 1 and 2 years		None		Secondary, university		Primary, 3 years and over		Primary, 1 and 2 years		None	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
	ARGENTINA, Chaco Province								ARGENTINA, San Juan Province							
All causes	37	100.0	228	100.0	120	100.0	154	99.9	98	99.9	478	100.0	150	100.0	83	100.0
Infectious diseases	1	2.7	26	11.4	21	17.5	35	22.7	12	12.2	87	18.2	31	20.7	16	19.3
Respiratory diseases	—	—	21	9.2	14	11.7	19	12.3	1	1.0	42	8.8	19	12.7	16	19.3
Congenital anomalies	3	8.1	7	3.1	6	5.0	4	2.6	7	7.1	23	4.8	8	5.3	3	3.6
Certain perinatal causes	33	89.2	167	73.2	72	60.0	79	51.3	73	74.5	314	65.7	90	60.0	46	55.4
Other	—	—	7	3.1	7	5.8	17	11.0	5	5.1	12	2.5	2	1.3	2	2.4
	BOLIVIA project								BRAZIL, Recife							
All causes	185	99.9	255	100.0	89	100.1	146	100.0	84	100.1	296	100.1	143	100.0	370	99.9
Infectious diseases	23	12.4	27	10.6	7	7.9	13	8.9	12	14.3	49	16.6	24	16.8	81	21.9
Respiratory diseases	33	17.8	90	35.3	32	36.0	58	39.7	5	6.0	12	4.1	8	5.6	22	5.9
Congenital anomalies	7	3.8	3	1.2	3	3.4	2	1.4	5	6.0	15	5.1	3	2.1	23	6.2
Certain perinatal causes	119	64.3	123	48.2	43	48.3	65	44.5	62	73.8	210	70.9	100	69.9	232	62.7
Other	3	1.6	12	4.7	4	4.5	8	5.5	—	—	10	3.4	8	5.6	12	3.2
	BRAZIL, Ribeirão Prêto								BRAZIL, São Paulo							
All causes	62	100.0	214	99.9	86	100.0	96	100.1	193	100.0	758	99.9	339	100.0	424	99.9
Infectious diseases	7	11.3	20	9.3	15	17.4	14	14.6	33	17.1	163	21.5	77	22.7	117	27.6
Respiratory diseases	2	3.2	12	5.6	3	3.5	7	7.3	15	7.8	54	7.1	42	12.4	37	8.7
Congenital anomalies	8	12.9	15	7.0	4	4.7	4	4.2	13	6.7	57	7.5	15	4.4	23	5.4
Certain perinatal causes	40	64.5	162	75.7	62	72.1	66	68.8	123	63.7	455	60.0	188	55.5	235	55.4
Other	5	8.1	5	2.3	2	2.3	5	5.2	9	4.7	29	3.8	17	5.0	12	2.8
	CANADA, Sherbrooke								CHILE project							
All causes	129	100.0	71	100.0	1	#	1	#	240	100.0	317	100.0	41	100.0	45	100.0
Infectious diseases	—	—	1	1.4	—	—	—	—	28	11.7	51	16.1	8	19.5	7	15.6
Respiratory diseases	1	0.8	3	4.2	—	—	—	—	19	7.9	39	12.3	5	12.2	9	20.0
Congenital anomalies	37	28.7	22	31.0	—	—	—	—	16	6.7	24	7.6	4	9.8	5	11.1
Certain perinatal causes	87	67.4	44	62.0	1	#	2	#	171	71.2	178	56.2	23	56.1	20	44.4
Other	4	3.1	1	1.4	—	—	—	—	6	2.5	25	7.9	1	2.4	4	8.9
	COLOMBIA, Cali								COLOMBIA, Cartagena							
All causes	82	100.1	200	100.0	70	100.0	30	100.1	40	100.0	102	100.0	37	99.9	29	99.9
Infectious diseases	3	3.7	27	13.5	7	10.0	5	16.7	1	2.5	15	14.7	9	24.3	11	37.9
Respiratory diseases	4	4.9	23	11.5	6	8.6	5	16.7	2	5.0	9	8.8	4	10.8	1	3.4
Congenital anomalies	4	4.9	10	5.0	4	5.7	3	10.0	2	5.0	7	6.9	4	10.8	2	6.9
Certain perinatal causes	68	82.9	130	65.0	50	71.4	17	56.7	34	85.0	67	65.7	18	48.6	15	51.7
Other	3	3.7	10	5.0	3	4.3	—	—	1	2.5	4	3.9	2	5.4	—	—
	COLOMBIA, Medellín								EL SALVADOR project							
All causes	60	100.0	149	100.0	33	100.0	21	100.1	101	100.1	394	100.0	89	100.0	291	100.1
Infectious diseases	2	3.3	16	10.7	3	9.1	3	14.3	12	11.9	83	21.1	30	33.7	94	32.3
Respiratory diseases	1	1.7	6	4.0	—	—	1	4.8	5	5.0	28	7.1	7	7.9	26	8.9
Congenital anomalies	5	8.3	11	7.4	3	9.1	1	4.8	8	7.9	26	6.6	3	3.4	23	7.9
Certain perinatal causes	49	81.7	112	75.2	27	81.8	16	76.2	74	73.3	249	63.2	47	52.8	142	48.8
Other	3	5.0	4	2.7	—	—	—	—	2	2.0	8	2.0	2	2.2	6	2.1
	JAMAICA, Kingston-St. Andrew								MEXICO, Monterrey							
All causes	123	99.9	724	99.9	25	100.0	10	100.0	131	99.9	526	100.0	152	99.9	149	100.0
Infectious diseases	11	8.9	98	13.5	3	12.0	—	—	17	13.0	93	17.7	30	19.7	39	26.2
Respiratory diseases	3	2.4	31	4.3	—	—	—	—	7	5.3	51	9.7	31	20.4	21	14.1
Congenital anomalies	12	9.8	48	6.6	1	4.0	1	10.0	13	9.9	58	11.0	11	7.2	6	4.0
Certain perinatal causes	94	76.4	517	71.4	18	72.0	7	70.0	92	70.2	313	59.5	75	49.3	77	51.7
Other	3	2.4	30	4.1	3	12.0	2	20.0	2	1.5	11	2.1	5	3.3	6	4.0

[a] In families in which home interviews were conducted and information was provided.
Percentages are not calculated for a base of less than 10.

FIG. 144. Underlying Causes of Neonatal Deaths by Educational Level of Mother in 14 Projects.



to perinatal causes were also high (over 70.0), while for those with no education they were much lower. These percentages of neonatal deaths due to perinatal causes are given below for mothers in these two groups in 10 projects:

	Secondary or university education	*No education*
Argentina		
Chaco Province	89.2	51.3
San Juan Province	74.5	55.4
Brazil		
Recife	73.8	62.7
Chile project	71.2	44.4
Colombia		
Cali	82.9	56.7
Cartagena	85.0	51.7
Medellín	81.7	76.2
El Salvador project	73.3	48.8
Jamaica		
Kingston-St. Andrew	76.4	70.0
Mexico		
Monterrey	70.2	51.7

In seven of the 10 projects the percentages for mothers with no education were less than 60. While they were high in Medellín and Kingston-St. Andrew, in those projects the numbers of mothers with no education were small (21 and 10, respectively).

On the other hand, in the Bolivia and São Paulo projects among children of mothers with secondary or university education the proportions of neonatal deaths due to perinatal causes were lower (64.3 and 63.7) than in the 10 projects listed above. In these two projects the percentages for mothers without education were lower (44.5 and 55.4) than for those with the better education. In the Ribeirão Prêto project this relationship was not found.

In Sherbrooke the percentage of neonatal deaths due to certain perinatal causes was 67.4 for mothers with secondary or university education; as was seen in Chapter X, congenital anomalies were responsible for a high proportion of the neonatal deaths (28.7), which accounted in part for the lower percentage of deaths in that age group due to perinatal causes. In only three neonatal deaths did the mothers have less than three years' schooling, and so this division by education is not useful in that project. The high proportions of neonatal deaths due to perinatal causes for mothers of higher educational levels is, of course, evidence of the low proportions due to infectious diseases.

In regard to infectious diseases, the relationship to education of mother in the case of neonatal deaths was the reverse of that observed for perinatal causes. Among mothers with no education, more than 20 per cent of neonatal deaths were due to infectious diseases in six projects. These percentages, along with those for mothers with secondary or university education, were as follows:

	Secondary or university education	*No education*
Argentina		
Chaco Province	2.7	22.7
Brazil		
Recife	14.3	21.9
São Paulo	17.1	27.6
Colombia		
Cartagena	2.5	37.9
El Salvador project	11.9	32.3
Mexico		
Monterrey	13.0	26.2

Mothers lacking education had higher proportions of their infants die in the neonatal period from infectious diseases than did mothers with secondary or university education. It can be seen, therefore, that educational level serves as a useful indicator

even within the group of mothers of infants dying in the neonatal period.

There are other points that can be made from the analysis of this material. One is in reference to neonatal mortality from diseases of the respiratory system, which shows a relationship to mother's education similar to that described for infectious diseases. Another concerns congenital anomalies. The causes of such conditions may differ according to the specific types, and may or may not have any relationship to socioeconomic conditions. In analyzing the data for El Salvador, however, it was noted that anomalies of the nervous system occurred somewhat more frequently in mothers with no education than in those with education. This is a clue that can be used in conjunction with other clues to undertake further exploration and research into the causation of anomalies of this system.

Certain causes of death in the postneonatal period and at 1–4 years of age in 14 projects also were analyzed using education of mother as a measure of socioeconomic conditions. Earlier in this chapter it was shown that the proportions of deaths among deceased children of mothers with little or no education were higher in these age groups than in the neonatal period.

Of the postneonatal deaths, the percentages due to infectious diseases as underlying causes are shown by education of mother in Table 171 and Figure 145. In general, the proportions due to these causes were lower for mothers with secondary or university education than for those with no schooling. When high proportions of the postneonatal deaths were caused by infectious diseases, as in the El Salvador project, there was very little difference according to mother's educational level.

Table 171 provides similar data for children dying at 1–4 years of age. Though the numbers become small, differences according to mother's education are clear. For these children in the 14 projects combined the percentages of deaths from infectious diseases were as follows in the case of mothers with no schooling and those with the higher education:

Secondary or university education	34.9
No education	63.4

The numbers of deaths from nutritional deficiency as underlying or associated cause, in the postneonatal period and at 1–4 years, are given according to mother's educational level in Table 172. The proportions of such deatns were consistently smaller in the case of mothers with secondary or university education than for those with less schooling. The percentages for postneonatal deaths are shown in Figure 146.

The data for the 13 Latin American projects are combined in Table 173 and Figure 147. Here it can be seen clearly that the percentages of children with nutritional deficiency dying in the postneonatal period and at 1–4 years were much higher in the case of mothers with no education (57.0 and 68.3, respectively) than for those with secondary or university education (37.2 and 35.3 per cent). The differences are obviously significant and they show that education is a valuable measure to use in differentiating groups in terms of nutritional deficiency. Utilization of this measure in studies of living children is desirable.

* * *

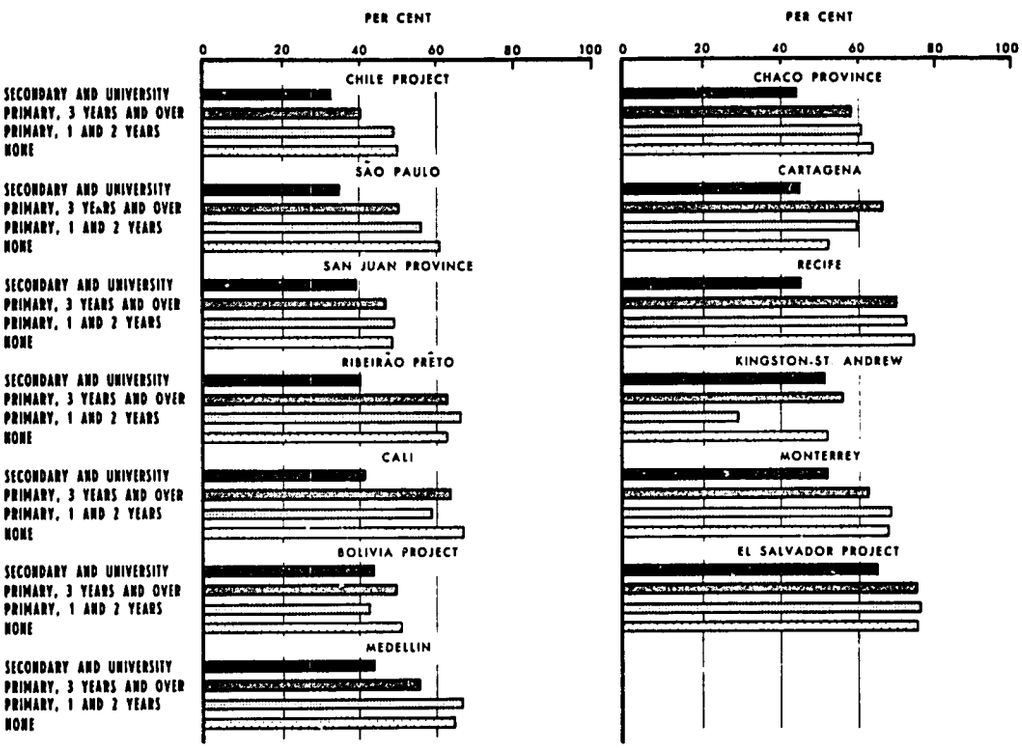
To summarize, two measures of socioeconomic conditions have been utilized in this study of mortality in childhood—occupation of father and education of mother. The second of these measures proved by far the more useful and valid. In fact, in sev-

TABLE 171. Deaths[a] Due to Infectious Diseases as Underlying Causes, in Two Age Groups, by Educational Level of Mother in 14 Projects.

Project	Secondary or university			Primary, 3 years and over			Primary, 1 and 2 years			None		
	Total	Infectious diseases		Total	Infectious diseases		Total	Infectious diseases		Total	Infectious diseases	
		No.	%		No.	%		No.	%		No.	%
	Postneonatal											
Total	1,086	463	42.6	5,553	3,188	57.4	2,210	1,348	61.0	3,560	2,329	65.4
ARGENTINA												
Chaco Province	18	8	44.4	274	160	58.4	220	135	61.4	307	196	63.8
San Juan Province	71	28	39.4	526	247	47.0	218	107	49.1	125	61	48.8
BOLIVIA project	192	83	43.2	426	210	49.3	161	68	42.2	340	174	51.2
BRAZIL												
Recife	53	24	45.3	349	245	70.2	239	173	72.4	822	610	74.2
Ribeirão Prêto	25	10	40.0	147	92	62.6	94	62	66.0	120	75	62.5
São Paulo	89	31	34.8	613	306	49.9	324	181	55.9	529	320	60.5
CANADA												
Sherbrooke	44	2	4.5	23	1	4.3	2	—	—	4	—	—
CHILE project	199	65	32.7	591	239	40.4	93	45	48.4	118	59	50.0
COLOMBIA												
Cali	44	18	40.9	217	138	63.6	102	59	57.8	81	54	66.7
Cartagena	20	9	45.0	176	117	66.5	81	48	69.3	79	41	51.9
Medellín	39	17	43.6	188	103	54.8	95	63	66.3	76	49	64.5
EL SALVADOR project	124	81	65.3	765	576	75.3	276	211	76.4	613	461	75.2
JAMAICA												
Kingston-St. Andrew	39	20	51.3	453	252	55.6	28	8	28.6	29	15	51.7
MEXICO												
Monterrey	129	67	51.9	805	502	62.4	277	188	67.9	317	214	67.5
	1–4 years											
Total	387	135	34.9	2,371	1,263	53.3	1,077	624	57.9	2,190	1,389	63.4
ARGENTINA												
Chaco Province	4	—	—	68	29	42.6	76	42	55.3	139	93	66.9
San Juan Province	30	7	23.3	114	47	41.2	65	26	40.0	38	21	55.3
BOLIVIA project	71	38	53.5	350	243	69.4	133	99	74.4	418	300	71.8
BRAZIL												
Recife	27	18	66.7	184	106	57.6	123	69	56.1	426	279	65.5
Ribeirão Prêto	3	—	—	54	24	44.4	39	21	53.8	50	20	40.0
São Paulo	17	5	29.4	151	56	37.1	101	44	43.6	167	81	48.5
CANADA												
Sherbrooke	27	1	3.7	24	2	8.3	1	—	—	1	—	—
CHILE project	57	11	19.3	122	31	25.4	30	5	16.7	43	8	18.6
COLOMBIA												
Cali	17	7	41.2	158	80	50.6	87	47	54.0	66	36	54.5
Cartagena	10	6	60.0	163	90	55.2	60	30	50.0	65	37	56.9
Medellín	33	13	39.4	155	86	55.5	90	57	63.3	49	28	57.1
EL SALVADOR project	33	17	51.5	347	238	68.6	135	97	71.9	518	369	71.2
JAMAICA												
Kingston-St. Andrew	25	6	24.0	213	69	32.4	17	5	29.4	26	6	23.1
MEXICO												
Monterrey	33	6	18.2	268	162	60.4	120	82	68.3	184	111	60.3

[a] In families in which home interviews were conducted and information was provided.

FIG. 145. Percentage of Postneonatal Deaths Due to Infectious Diseases as Underlying Causes by Educational Level of Mother in 13 Latin American Projects.



eral Latin American projects it was shown that among children of mothers with secondary or university education high proportions of the deaths occurred in the neonatal period, as was the case also in areas with low neonatal mortality, and that high proportions of these neonatal deaths were due to certain perinatal causes, as was true also in areas with low neonatal death rates.

In contrast, among mothers with no education the proportions of deaths were high after the neonatal period, that is, in age groups in which poor socioeconomic conditions favor excessive mortality. Moreover, high proportions of these deaths after the neonatal period were due to infectious diseases, and nutritional deficiency was one of the multiple causes involved in 57.0 per cent of the postneonatal deaths and 68.3 per cent of those of children 1–4 years of age in the 13 Latin American projects combined.

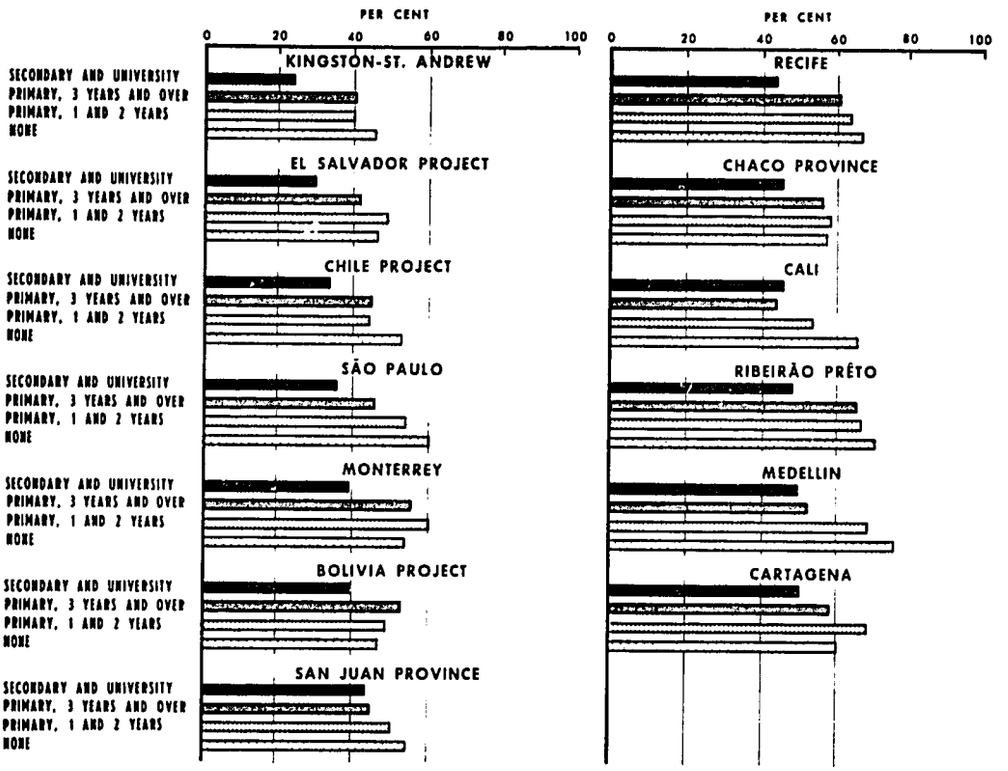
Kitagawa and Hauser (1968), utilizing data on adults in the United States, found a clear relationship between causes of death and education. Their final comment is important: "It is necessary in concluding to point out that education alone cannot be considered the factor that accounts for the

TABLE 172. Deaths[a] from Nutritional Deficiency as Underlying or Associated Cause in Children Under 5 Years, in Two Age Groups, by Educational Level of Mother in 14 Projects.

Project	Secondary or university			Primary, 3 years and over			Primary, 1 and 2 years			None		
	Total	Nutritional deficiency		Total	Nutritional deficiency		Total	Nutritional deficiency		Total	Nutritional deficiency	
		No.	%		No.	%		No.	%		No.	%
	Postneonatal											
Total	1,086	393	36.2	5,553	2,680	48.3	2,210	1,228	55.6	3,560	2,026	56.9
ARGENTINA												
Chaco Province	18	8	44.4	274	153	55.8	220	127	57.7	307	174	56.7
San Juan Province	71	30	42.3	526	234	44.5	218	110	50.5	125	68	54.4
BOLIVIA project	192	75	39.1	426	220	51.6	161	77	47.8	340	157	46.2
BRAZIL												
Recife	53	23	43.4	349	212	60.7	239	152	63.6	822	548	66.7
Ribeirão Prêto	25	12	48.0	147	96	65.3	94	62	66.0	120	84	70.0
São Paulo	89	31	34.8	613	274	44.7	324	177	54.6	529	316	59.7
CANADA												
Sherbrooke	44	5	11.4	23	—	—	2	—	—	4	—	—
CHILE project	199	66	33.2	591	263	44.5	93	40	43.0	118	61	51.7
COLOMBIA												
Cali	44	20	45.5	217	93	42.9	102	54	52.9	81	53	65.4
Cartagena	20	10	50.0	176	102	58.0	81	55	67.9	79	47	59.5
Medellín	39	19	48.7	188	97	51.6	95	65	68.4	76	57	75.0
EL SALVADOR project	124	36	29.0	765	313	40.9	276	133	48.2	613	280	45.7
JAMAICA												
Kingston-St. Andrew	39	9	23.1	453	181	40.0	28	11	39.3	29	13	44.8
MEXICO												
Monterrey	129	49	38.0	805	442	54.9	277	165	59.6	317	168	53.0
	1–4 years											
Total	387	128	33.1	2,371	1,343	56.6	1,077	685	63.6	2,190	1,496	68.3
ARGENTINA												
Chaco Province	4	1	#	68	34	50.0	76	52	68.4	139	88	63.3
San Juan Province	30	6	20.0	114	45	39.5	65	25	38.5	38	19	50.0
BOLIVIA project	71	30	42.3	350	214	61.1	133	82	61.7	418	255	61.0
BRAZIL												
Recife	27	11	40.7	184	119	64.7	123	89	72.4	426	326	76.5
Ribeirão Prêto	3	1	#	54	34	63.0	39	24	61.5	50	33	66.0
São Paulo	17	5	29.4	151	60	39.7	101	53	52.5	167	90	53.9
CANADA												
Sherbrooke	27	1	3.7	24	4	16.7	1	—	—	1	—	—
CHILE project	57	18	31.6	122	45	36.9	30	9	30.0	43	20	46.5
COLOMBIA												
Cali	17	5	29.4	158	99	62.7	87	58	66.7	66	46	69.7
Cartagena	10	5	50.0	163	113	69.3	60	49	81.7	65	58	89.2
Medellín	33	11	33.3	155	96	61.9	90	63	70.0	49	37	75.5
EL SALVADOR project	33	13	39.4	347	233	67.1	135	93	68.9	518	388	74.9
JAMAICA												
Kingston-St. Andrew	25	10	40.0	213	84	39.4	17	10	58.8	26	13	50.0
MEXICO												
Monterrey	33	11	33.3	268	163	60.8	120	78	65.0	184	123	66.8

[a] In families in which home interviews were conducted and information was provided.
Percentages are not calculated for a base of less than 10.

FIG. 146. Postneonatal Deaths from Nutritional Deficiency as Underlying or Associated Cause by Educational Level of Mother in 13 Latin American Projects.



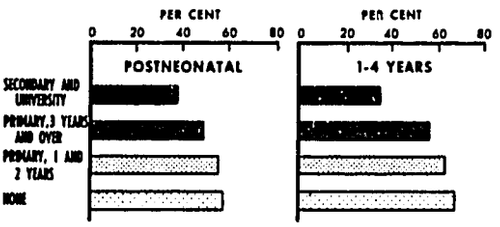
great variation in causes of death reported here. Education alone is also undoubtedly an important variable in accounting for differential mortality, but, as used in this study, the education factor includes all the other socioeconomic variables associated

TABLE 173. Deaths[a] from Nutritional Deficiency as Underlying or Associated Cause in Children Under 5 Years, in Two Age Groups, by Educational Level of Mother in 13 Latin American Projects Combined.

Mother's educational level	Postneonatal			1-4 years		
	Total deaths	With nutritional deficiency		Total deaths	With nutritional deficiency	
		No.	%		No.	%
Secondary or university	1,042	388	37.2	360	127	35.3
Primary, 3 years and over	5,530	2,680	48.5	2,347	1,339	57.1
Primary, 1 and 2 years	2,208	1,228	55.6	1,076	685	63.7
None	3,556	2,026	57.0	2,189	1,496	68.3

[a] In families in which home interviews were conducted and information was provided.

FIG. 147. Deaths from Nutritional Deficiency as Underlying or Associated Cause in Children Under 5 Years, in Two Age Groups, by Educational Level of Mother in 13 Latin American Projects Combined.



with it, of which there are many. They include income, level of occupation, working conditions, style of life, diet and nutrition, quality of housing, differential fertility, urban-rural residence, regional residence, and many other items with which education shows high intercorrelations."

In the Latin American projects education can be taken as a measure of many socioeconomic variables. Persons with little or no education are usually the ones with low incomes, poor housing, inadequate water supplies, and poor environmental conditions. Mothers without education are found more frequently in the rural areas, as the data indicate, and high proportions of their children have nutritional deficiency, which is an indication of inadequate food supplies. Education, therefore, is an appropriate measure for use in further research and also in planning health programs.

Chapter XV

Medical Attention

Medical attention rendered during pregnancy and delivery to mothers of deceased children, as well as that received by the children, can be studied from data collected in the interviews of families during the course of the Investigation. In many instances data obtained from hospitals and other sources complemented that information. In this report reference will be made to services provided and to several parameters pertaining to deceased children and their mothers in the hope that this information will serve as a basis for action to solve the problems uncovered.

PRENATAL CARE

Prenatal care, as defined by Willson *et al.* (1971), is a program of examination, evaluation, observation, treatment, and education of pregnant women, directed toward making pregnancy, labor, and delivery as normal and safe as possible for mothers and their infants.

Even before pregnancy, high reproductive risk can be recognized by making use of various measures such as mother's age, parity, general state of health, and stature, the history in regard to health and survival of previous products, family's socioeconomic conditions, and others. A scoring system such as that suggested by Perkin (1968) could help to establish norms that might be utilized as a basis for preventing vital wastage and serious maternal and infant morbidity.

Once gestation has begun, surveillance during the first trimester is essential in order to assess the general health of the mother and detect specific disorders such as anemia, infection, cardiac or renal diseases, and endocrine conditions. Nutrition and health education should be started at this time (if it has not before) and prevention of teratogenic factors should be stressed. A program for the remainder of pregnancy and for childbirth should be outlined according to the level of risk established.

The success achieved in collecting information on prenatal care varied among the projects, depending on the possibility of conducting family interviews and on the quality of clinical records.

The data on prenatal care for mothers of deceased infants are presented in Table 174, according to the stage of pregnancy in which the care was first received. Figure 148 shows the percentages of mothers who attended a prenatal service at any time

during pregnancy, and also of those who received care within the first trimester, the period which is considered most crucial.

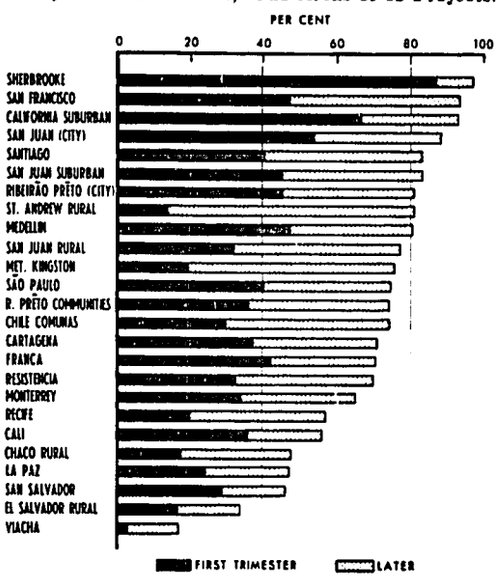
The percentages receiving care in the first trimester varied from 86.7 in Sherbrooke and 66.0 in suburban California to 2.6 in Viacha, Bolivia. In six areas of the Latin American projects at least 40 per cent of mothers had prenatal care within that period, but in six others the proportion was less than 20 per cent. In fact, more than half the mothers in the rural departments of Chaco Province, in La Paz and Viacha, and in San Salvador and rural *municipios*

TABLE 174. Month of Pregnancy in Which First Visit for Prenatal Care Was Reported for Mothers of Deceased Infants in 25 Areas of 15 Projects.

Area	Number of mothers[a]							Percentage[b]					
	Total	No care	Month of pregnancy					Total	No care	Month of pregnancy			
			1–3	4–5	6–7	8–9	Unknown			1–3	4–5	6–7	8–9
Total	21,858	7,330	6,743	3,804	2,484	604	893	100.0	33.5	32.9	18.6	12.1	2.9
ARGENTINA													
Chaco Province													
Resistencia	693	209	203	138	73	33	37	100.0	30.2	31.7	21.5	11.4	5.2
Rural departments	621	331	94	55	84	22	35	100.0	53.3	17.2	10.1	15.4	4.0
San Juan Province													
San Juan (city)	244	28	122	38	33	8	15	99.9	11.5	53.7	16.7	14.5	3.5
Suburban departments	618	106	261	120	81	22	28	100.1	17.2	44.7	20.5	13.9	3.8
Rural departments	839	188	254	163	162	42	30	99.9	22.4	31.7	20.4	20.2	5.2
BOLIVIA													
La Paz	1,613	863	326	158	126	27	113	100.0	53.5	23.8	11.5	9.2	2.0
Viacha	89	74	2	4	6	1	2	100.0	83.1	2.6	5.2	7.8	1.3
BRAZIL													
Recife	2,264	965	422	430	333	77	37	100.0	42.6	19.2	19.6	15.1	3.5
Ribeirão Prêto													
Ribeirão Prêto (city)	355	67	148	56	55	10	19	100.0	18.9	44.6	16.9	16.6	3.0
Franca	297	88	113	36	22	20	18	100.1	29.6	41.7	13.3	8.1	7.4
Communities	176	45	59	35	22	7	8	100.0	25.6	35.7	21.2	13.3	4.2
São Paulo	3,108	782	1,174	634	333	74	111	99.9	25.2	39.6	21.4	11.2	2.5
CANADA													
Sherbrooke	275	9	234	22	2	3	5	100.0	3.3	86.7	8.2	0.7	1.1
CHILE													
Santiago	1,436	244	545	364	194	29	60	100.0	17.0	40.0	26.7	14.2	2.1
Comunas	167	43	47	48	17	7	5	100.0	25.7	29.3	30.0	10.6	4.4
COLOMBIA													
Cali	796	345	264	91	59	10	27	100.0	43.3	35.3	12.2	7.9	1.3
Cartagena	545	159	184	98	50	23	31	100.0	29.2	36.7	19.5	10.0	4.6
Medellín	643	126	286	150	41	11	29	100.0	19.6	47.1	24.7	6.8	1.8
EL SALVADOR													
San Salvador	1,941	1,044	489	198	92	21	97	99.9	53.8	28.2	11.4	5.3	1.2
Rural *municipios*	605	401	86	60	30	9	19	100.0	66.3	15.7	10.9	5.5	1.6
JAMAICA													
Metropolitan Kingston	1,290	307	243	322	334	66	18	100.0	23.8	19.2	25.4	26.4	5.2
St. Andrew, rural	104	20	13	50	14	2	5	99.9	19.2	13.3	51.1	14.3	2.0
MEXICO													
Monterrey	2,427	838	762	381	260	77	109	100.0	34.5	33.7	16.9	11.5	3.4
UNITED STATES													
San Francisco	189	12	83	57	25	—	12	100.0	6.3	47.1	32.4	14.2	—
California, suburban	523	36	329	96	36	3	23	100.0	6.9	66.0	19.3	7.2	0.6

[a] In families in which home interviews were conducted and information was provided.
[b] It was assumed that mothers for whom month of first visit was unknown were distributed in the same way as those with month specified.

FIG. 148. Percentage of Mothers of Deceased Infants Receiving Prenatal Care, by Stage of Pregnancy at the First Visit, in 25 Areas of 15 Projects.



of El Salvador received no prenatal care at all. It is obvious, therefore, that there are areas in which timely action to ensure successful pregnancy is not possible for large numbers of women because of the inadequacy of prenatal care services during the early months of pregnancy. The lack of these basic services is particularly serious for groups of women at greater risk, such as those in areas distant from urban facilities.

During the intermediate stage of pregnancy (second trimester) certain maternal and fetal disorders predominate, such as fetal pathology from infections (syphilis, toxoplasmosis, and other infectious diseases) which can interfere with normal development of the central nervous system; premature separation of placenta or unsatisfactory development of placental function; and appearance of new maternal disorders such as early toxemia, or exacerbation of pre-existing conditions. Even under conditions of adequate control, some women may require admission to hospital for special care.

New knowledge has led to few practical improvements in prenatal care during the last trimester (WHO, 1965). Abnormal conditions present in early stages of pregnancy acquire compounded severity as gestation progresses and this is often the reason for late first consultations. Under these circumstances the result is often early termination of pregnancy or the birth of a low weight infant in poor physical condition. Fetal hypoxia frequently occurs in the last months of complicated pregnancies (with placental insufficiency) and is a precursor of postnatal morbidity and mortality.

The numbers and percentages of mothers of deceased infants who received prenatal care for the first time during the second and third trimesters of pregnancy are shown in Table 174 and Figure 148. As for mothers who received prenatal attention at any period during pregnancy, the percentages varied greatly among the areas of the 15 projects. In nine areas more than 80 per cent of the pregnant women received prenatal care; at the other extreme, there were five areas in which less than half received such care. These data reflect the need to increase the coverage of these important health services.

Data on the number of prenatal care visits reported for mothers of deceased infants are presented in Table 175 and Figure 149 for 23 areas of 14 projects (such data were not obtained in the California project). In only four areas, (Sherbrooke, San Juan city, San Juan suburban, and Ribeirão Prêto city) had as high as 20 per cent of mothers attended prenatal clinics seven or more times. In those areas where only small percentages of mothers had received any prenatal attention, the proportions who had made four or more visits were low, and

TABLE 175. Visits for Prenatal Care Reported for Mothers of Deceased Infants in 23 Areas of 14 Projects.

Area	Number of mothers[a]						Percentage[b]				
	Total	None	1-3	4-6	7 or more	Unknown	Total	None	1-3	4-6	7 or more
Total	21,146	7,282	5,195	4,923	2,431	1,315	100.0	34.4	27.2	25.7	12.7
ARGENTINA											
Chaco Province											
Resistencia	693	209	167	162	52	103	100.0	30.2	30.6	29.7	9.5
Rural departments	621	331	138	63	12	77	100.0	53.3	30.3	13.8	2.6
San Juan Province											
San Juan (city)	244	28	70	63	73	10	100.1	11.5	30.1	27.1	31.4
Suburban departments	618	106	196	150	138	28	100.0	17.2	33.5	25.7	23.6
Rural departments	839	188	339	165	113	34	100.0	22.4	42.6	20.8	14.2
BOLIVIA											
La Paz	1,613	863	216	225	194	115	100.0	53.5	15.8	16.5	14.2
Viacha	89	74	11	4	—	—	100.0	83.1	12.4	4.5	—
BRAZIL											
Recife	2,264	965	674	453	108	64	100.0	42.6	31.3	21.1	5.0
Ribeirão Prêto											
Ribeirão Prêto (city)	355	67	112	85	66	25	100.0	18.9	34.5	26.2	20.4
Franca	297	88	81	62	52	14	100.0	29.6	29.2	22.4	18.8
Communities	176	45	68	31	20	12	100.0	25.6	42.5	19.4	12.5
São Paulo	3,108	782	782	990	400	154	100.0	25.2	26.9	34.1	13.8
CANADA											
Sherbrooke	275	9	33	112	101	20	100.0	3.3	13.0	44.0	39.7
CHILE											
Santiago	1,436	244	289	532	250	121	100.0	17.0	22.4	41.2	19.4
Comunas	167	43	39	54	26	5	100.0	25.7	24.4	33.7	16.2
COLOMBIA											
Cali	796	345	133	177	102	39	100.0	43.3	18.3	24.4	14.0
Cartagena	545	159	181	104	53	48	100.0	29.2	37.9	21.8	11.1
Medellín	643	126	142	243	79	53	99.9	19.6	24.6	42.1	13.7
EL SALVADOR											
San Salvador	1,941	1,044	325	352	142	78	100.0	53.8	18.3	19.9	8.0
Rural *municipios*	605	401	111	60	15	18	100.0	66.3	20.1	10.0	2.7
JAMAICA											
Metropolitan Kingston	1,200	307	437	304	154	88	100.0	23.8	37.2	25.9	13.1
St. Andrew, rural	104	20	45	31	7	1	100.0	19.2	43.8	30.2	6.8
MEXICO											
Monterrey	2,427	838	606	501	274	208	100.0	34.5	28.7	23.8	13.0

[a] In families in which home interviews were conducted and information was provided.
[b] It was assumed that mothers for whom the number of visits was unknown were distributed in the same way as those for whom one or more visits were specified.

especially low in rural areas: in Chaco Province, 16.4 per cent in the rural departments compared with 39.2 per cent in the city of Resistencia; in Bolivia, 4.5 per cent in Viacha and 30.7 per cent in La Paz; and in El Salvador, 13.6 per cent in the rural *municipios* and 27.9 per cent in the city of San Salvador. In Recife as well, only a small percentage (26.1) of mothers had made at least four visits.

The two rural areas with the lowest proportions of mothers receiving any prenatal care—namely, Viacha (16.9 per cent) and rural *municipios* of El Salvador (33.7 per cent)—had very high infant death rates (123.5 and 120.0 per 1,000 live births, respectively); and conversely, areas in which nearly all mothers received prenatal care had low death rates. Table 176 gives these percentages in descending order, along with

FIG. 149. Percentage of Mothers of Deceased Infants Who Received Prenatal Care, by Number of Visits, in 23 Areas of 14 Projects.

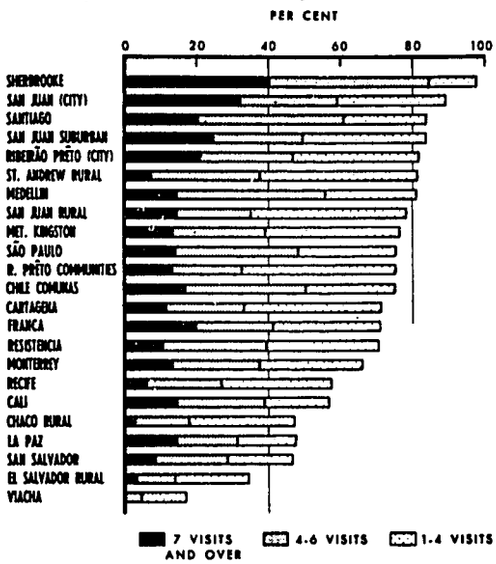


TABLE 176. Percentage of Mothers of Deceased Infants Who Received Prenatal Care, and Infant Death Rates in 25 Areas of 15 Projects.

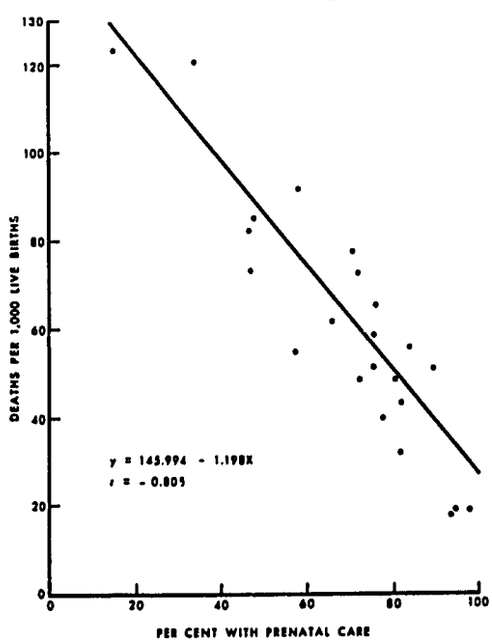
Area	% of mothers with prenatal care	Infant death rate[a]
Sherbrooke	96.7	18.3
San Francisco	93.7	18.5
California, suburban	93.1	17.2
San Juan (city)	88.5	50.7
Santiago	83.0	54.9
San Juan, suburban	82.8	87.9
Ribeirão Prêto (city)	81.1	43.0
St. Andrew, rural	80.8	31.6
Medellín	80.4	47.6
San Juan, rural	77.6	94.5
Metropolitan Kingston	76.2	39.5
São Paulo	74.8	65.1
Ribeirão Prêto, communities	74.4	50.8
Chile, *comunas*	74.3	57.9
Cartagena	70.8	47.8
Franca	70.4	71.5
Resistencia	69.8	76.2
Monterrey	65.5	60.7
Recife	57.4	91.2
Cali	56.7	54.6
Chaco, rural	46.7	85.0
La Paz	46.5	73.0
San Salvador	46.2	81.7
El Salvador, rural	33.7	120.0
Viacha	16.9	123.5

[a] Per 1,000 live births.

the infant death rates for comparison. Figure 150 shows the inverse relation found between infant death rates and percentages of mothers receiving prenatal care in 25 areas of the 15 projects. The correlation coefficient of −0.805 was significant.

The data therefore indicate that lack of prenatal care is one of the important elements in the complex of unfavorable conditions affecting the health of mother and child in many of these areas. As was evident from the study of mortality by mother's educational level in Chapter XIV, there are segments of these societies in which infant mortality is excessive, especially after the neonatal period when enviromental factors influence the level of mortality. Prenatal care is one of the services that must be made available to women in such areas if reductions in mortality in infancy are to be effected.

FIG. 150. Infant Death Rate and Percentage of Mothers of Deceased Infants Who Received Prenatal Care in 25 Areas of 15 Projects.



PLACE OF BIRTH

A woman who maintains good health and is able to avoid complications during pregnancy is apt to deliver a healthy baby, withstanding the stress of normal labor after 40 weeks of gestation and having a spontaneous delivery of less than 24 hours' duration. In a certain number of cases, however, unexpected complications arise during delivery which require urgent measures in order to save the fetus and/or the mother from serious harm or death. If pregnancy has been complicated by uncontrolled morbid conditions in the mother, the chances of misfortune during labor and delivery are increased, and even more so by the fact that complications of pregnancy are commonly associated with immaturity, as was discussed in Chapter VI. Abnormal labor and delivery may affect the fetus through inadequate uterine function, injury, intrauterine hypoxia, infection, and induced toxicity.

Hospital care during labor and delivery by qualified personnel is a complement to proper prenatal care and, even when the latter has been lacking, it can reduce the possibilities of irreversible damage and fatal complications.

Place of birth was specified for more than 90 per cent of the children who died in infancy in 19 out of 24 areas in the 15 projects (Table 177). La Paz had the lowest percentage (70.0), followed by Cali (81.7).

In the tables that follow in this chapter the assumption has been made that deaths for which data were not specified are distributed in the same way as those with data specified. However, this may have resulted in slightly high percentages for births and deaths in hospitals in a few areas, such as La Paz and Cali, where searches for non-registered deaths were conducted in hospitals but a high proportion of deliveries and many deaths did not occur in hospitals.

Of the infants with place of birth known, in all projects combined, 78.9 per cent of all those who died had been born in hospitals and the rest (21.1 per cent) had been

TABLE 177. Infant Deaths with Place of Birth Specified in 24 Areas of 15 Projects.

Area	Total infant deaths	Place of birth specified	
		No.	%
Total	27,602	25,153	91.1
ARGENTINA			
Chaco Province			
Resistencia	747	733	98.1
Rural departments	663	649	97.9
San Juan Province			
San Juan (city)	295	289	98.0
Suburban departments	696	690	99.1
Rural departments	909	896	98.6
BOLIVIA			
La Paz	2,685	1,880	70.0
Viacha	105	93	88.6
BRAZIL			
Recife	2,773	2,438	87.9
Ribeirão Prêto			
Ribeirão Prêto (city)	400	389	97.2
Franca	364	341	93.7
Communities	195	190	97.4
São Paulo	3,788	3,525	93.1
CANADA			
Sherbrooke	310	305	98.4
CHILE			
Santiago	2,207	2,038	92.3
Comunas	197	183	92.9
COLOMBIA			
Cali	1,153	942	81.7
Cartagena	856	771	90.1
Medellín	924	792	85.7
EL SALVADOR			
San Salvador	2,094	2,049	97.9
Rural *municipios*	648	630	97.2
JAMAICA			
Metropolitan Kingston	1,478	1,427	96.5
St. Andrew, rural	111	110	99.1
MEXICO			
Monterrey	3,220	3,018	93.7
UNITED STATES			
California project	784	775	98.9

born at home (Table 178). Of the total number, 45 per cent were known to have been delivered by physicians in hospitals and 25 per cent by midwives in hospitals (Figure 151).

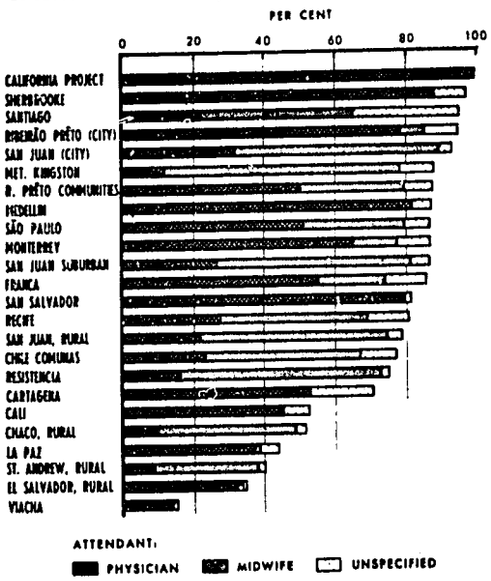
In the California project 99.2 per cent of deceased infants with place of birth stated had been born in hospitals, and in nearly all (98.2 per cent) the birth was known to have been attended by a physician. In Sherbrooke as well, practically all (97.7 per cent) had been born in hospitals. In the Latin American projects there were three cities in which more than 90 per cent

TABLE 178. Place of Birth of Children Dying in First Year of Life, and Type of Attendant at Birth in Hospital, in 24 Areas of 15 Projects.

Area	Total infants	Born in hospital[a]								Born at home[a,b]		Place of birth unspecified
		Total		Physician		Midwife		Unspecified				
		No.	%	No.	%	No.	%	No.	%	No.	%	
Total	27,602	19,842	78.9	11,309	45.0	6,300	25.0	2,233	8.9	5,311	21.1	2,449
ARGENTINA												
Chaco Province												
Resistencia	747	552	75.3	114	15.6	423	57.7	15	2.0	181	24.7	14
Rural departments	663	334	51.5	61	9.4	254	39.1	19	2.9	315	48.5	14
San Juan Province												
San Juan (city)	295	269	93.1	91	31.5	165	57.1	13	4.5	20	6.9	6
Suburban departments	696	598	86.7	182	26.4	379	54.9	37	5.4	92	13.3	6
Rural departments	909	707	78.9	189	21.1	484	54.0	34	3.8	189	21.1	13
BOLIVIA												
La Paz	2,685	828	44.0	696	37.0	29	1.5	103	5.5	1,052	56.0	805
Viacha	105	14	15.1	11	11.8	2	2.2	1	1.1	79	84.9	12
BRAZIL												
Recife	2,773	1,965	80.6	645	26.5	1,036	42.5	284	11.6	474	19.4	335
Ribeirão Prêto												
Ribeirão Prêto (city)	400	370	95.1	303	77.9	26	6.7	41	10.5	19	4.9	11
Franca	364	293	85.9	188	55.1	64	18.8	41	12.0	48	14.1	23
Communities	195	167	87.9	95	50.0	56	29.5	16	8.4	23	12.1	5
São Paulo	3,788	3,064	86.9	1,781	50.5	1,024	29.0	259	7.3	461	13.1	263
CANADA												
Sherbrooke	310	298	97.7	270	88.5	—	—	28	9.2	7	2.3	5
CHILE												
Santiago	2,207	1,943	95.3	452	22.2	885	43.4	606	29.7	95	4.7	169
Comunas	197	141	77.0	42	23.0	80	43.7	19	10.4	42	23.0	14
COLOMBIA												
Cali	1,153	486	51.6	413	43.8	13	1.4	60	6.4	456	48.4	211
Cartagena	856	544	70.6	401	52.0	1	0.1	142	18.4	227	29.4	85
Medellín	924	693	87.5	649	81.9	2	0.3	42	5.3	99	12.5	132
EL SALVADOR												
San Salvador	2,094	1,672	81.6	1,633	79.7	2	0.1	37	1.8	377	18.4	45
Rural *municipios*	648	214	34.0	212	33.7	1	0.2	1	0.2	416	66.0	18
JAMAICA												
Metropolitan Kingston	1,478	1,257	88.1	158	11.1	962	67.4	137	9.6	170	11.9	51
St. Andrew, rural	111	44	40.0	9	8.2	33	30.0	2	1.8	66	60.0	1
MEXICO												
Monterrey	3,220	2,620	86.8	1,953	64.7	379	12.6	288	9.5	398	13.2	202
UNITED STATES												
California project	784	769	99.2	761	98.2	—	—	8	1.0	6	0.8	9

[a] Percentage based on deaths with place of birth specified.
[b] Includes infants born on way to hospital.

FIG. 151. Percentage of Infants Dying in First Year of Life Who Were Born in Hospital, by Type of Attendant at Birth, in 24 Areas of 15 Projects.



of the infants had been born in hospitals—San Juan (city) with 93.1 per cent, Ribeirão Prêto (city) 95.1 per cent, and Santiago 95.3 per cent. The lowest percentages, 15.1 and 34.0, were found in Viacha and the rural *municipios* of El Salvador. As expected, suburban and rural populations had lower proportions of deliveries in hospitals than the neighboring cities.

In several areas trained midwives performed the deliveries in hospitals. In fact, in five areas (the three in San Juan Province, Resistencia in Chaco Province, and Metropolitan Kingston) they performed over half the deliveries. As for deliveries at home, rarely were they attended by physicians; some were attended by trained midwives, but many in the Latin American projects were attended by untrained midwives or by a family member or neighbor.

HOSPITALIZATION FOR UNDERLYING CAUSE OF DEATH

The percentages of deceased children under 5 years of age who were hospitalized at some time for treatment of the underlying cause of death are presented for two age groups: under 28 days and 28 days through 4 years (Table 179 and Figures 152 and 153). They are based on deaths for which data on hospitalization were known.

Of the infants who died in the neonatal period in all 15 projects combined, 66.9 per cent remained in the hospital from birth to death; 18.5 per cent were hospitalized at some time for the cause leading to death; and 14.6 per cent received no hospital care. It is interesting to note that 94.6 per cent of the neonatal deaths in the two Northern American projects were of infants who remained in hospital from birth to death, while only 65.0 per cent were in that category in the Latin American projects. This is due in part to the high proportion of neonatal deaths occurring in the first day of life in the Northern American projects (59.2 per cent). In the Latin American areas the highest percentages of infants dying in the neonatal period who remained in hospital from birth to death were 82.1 in Ribeirão Prêto (city) and 81.6

TABLE 179. Percentage of Deceased Children[a] Under 5 Years Hospitalized for Underlying Cause of Death, in Two Age Groups, in 24 Areas of 15 Projects.

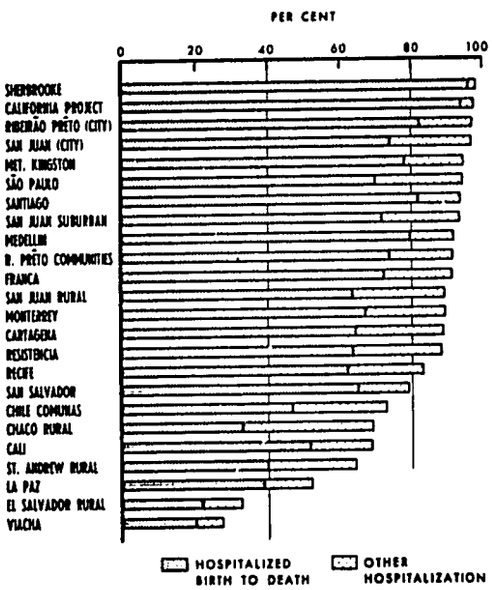
Area	Neonatal			28 days-4 years
	Total hospitalized	In hospital birth to death	Other hospitalization	Hospitalized
Total	85.4	66.9	18.5	56.9
Northern America	98.0	94.6	3.4	52.7
Latin America	84.5	65.0	19.6	57.0
ARGENTINA				
Chaco Province				
Resistencia	88.3	63.1	25.2	72.1
Rural departments	69.2	32.9	36.2	66.7
San Juan Province				
San Juan (city)	97.1	74.3	22.8	83.1
Suburban departments	93.7	71.8	21.9	79.1
Rural departments	88.9	63.1	25.9	74.2
BOLIVIA				
La Paz	52.1	38.5	13.7	19.1
Viacha	26.8	19.5	7.3	8.2
BRAZIL				
Recife	83.4	62.1	21.3	64.2
Ribeirão Prêto				
Ribeirão Prêto (city)	97.3	82.1	15.2	81.5
Franca	91.0	72.3	18.6	68.2
Communities	91.3	73.1	18.3	85.1
São Paulo	94.3	69.6	24.7	83.7
CANADA				
Sherbrooke	98.3	96.5	1.7	61.0
CHILE				
Santiago	93.8	81.6	12.2	57.4
Comunas	72.7	47.0	25.8	51.8
COLOMBIA				
Cali	68.9	51.8	17.1	46.5
Cartagena	88.8	64.0	24.8	68.1
Medellín	91.4	79.0	12.4	62.2
EL SALVADOR				
San Salvador	79.4	64.3	15.1	43.7
Rural *municipios*	32.6	21.6	11.1	13.6
JAMAICA				
Metropolitan Kingston	94.7	78.2	16.5	65.3
St. Andrew, rural	64.2	39.6	24.5	43.8
MEXICO				
Monterrey	88.8	67.1	21.7	71.5
UNITED STATES				
California project	97.9	93.9	4.0	49.1

[a] Based on deaths with hospitalization known.

in Santiago. Viacha in Bolivia and the rural *municipios* of El Salvador had the highest percentages of those never hospitalized for the underlying cause (73.2 and 67.4, respectively). La Paz followed with 47.9 per cent. The lack of hospitalization in these early deaths in some areas, together with the low percentages of mothers receiving prenatal care, indicate the urgent need to extend basic services to these sectors of the population.

In the age group 28 days-4 years the

FIG. 152. Percentage of Infants Dying in Neonatal Period Who Were Hospitalized for Underlying Cause of Death in 24 Areas of 15 Projects.



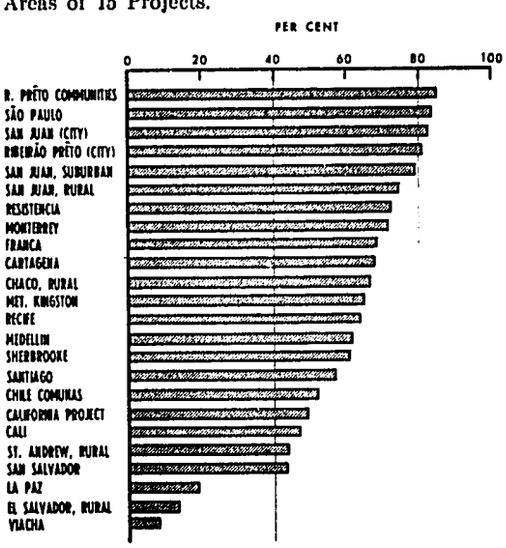
lowered the percentages of hospitalizations of children from 28 days through 4 years of age.

Length of time hospitalized is another indicator of the medical attention given to these children. In the neonatal period the duration of hospitalization depended principally on the proportion of deaths occurring in the first day or first few days of life. Appendix 5 provides detailed information on deaths by age.

For children dying in the postneonatal period and at 1–4 years, the median numbers of days hospitalized were obtained for the 15 projects. In Sherbrooke the medians were high (29 days for postneonatal deaths and 10 days for those at 1–4 years), owing in part to the long hospitalization of children suffering from congenital anomalies. In the California project the medians were 12 and 13 days, respectively. In the 13

situation was found to be quite different. In fact, the overall percentages of children hospitalized for underlying cause were fairly similar for the Northern and the Latin American projects, 52.7 and 57.0, respectively. The low percentages in certain areas of the Latin American projects may be due to lack of medical care resources and also lack of awareness of the seriousness of illness until too late. In reviewing the questionnaires it was noted that many times the family would state that as they were taking the sick child to the hospital, the child died on the way. In areas with low mortality, as in the Northern American projects, the high proportions of deaths due to external causes and sudden death decreased the chances for hospitalization. The high rates in a few other projects for sudden death in the postneonatal period likewise

FIG. 153. Percentage of Children Under 5 Years of Age Dying After Neonatal Period Who Were Hospitalized for Underlying Cause of Death in 24 Areas of 15 Projects.



Latin American projects they varied from one to eight days, as follows:

	Post-neonatal	*1–4 years*
Argentina		
Chaco Province	4	3
San Juan Province	4	1
Bolivia project	2	2
Brazil		
Recife	2	1
Ribeirão Prêto	5	4
São Paulo	8	3
Chile project	6	2
Colombia		
Cali	2	3
Cartagena	4	3
Medellín	5	3
El Salvador project	1	1
Jamaica		
Kingston-St. Andrew	4	2
Mexico		
Monterrey	3	2

The differences in these medians may be due in part to variations in availability of hospital services, awareness of the need for hospital care, and nature of the diseases causing death. The very short duration of hospitalization in these two age periods in certain projects could be interpreted as due to failure to seek medical treatment until a late date because of inability to recognize the severity of illness.

PLACE OF DEATH

Place of death is the last of the parameters used to measure the extent of medical services rendered to deceased children. Under normal circumstances, it is sound to assume that the proportion of deaths of children occurring in hospitals provides an indication of availability of health services. Moreover, high percentages of children dying in hospitals a few hours after admission could be taken as an indication of inadequate utilization of hospital services and/or lack of recognition of severity of illness, except in those cases in which sudden death or an injury was the underlying cause.

In the Latin American projects 60.4 per cent of all deceased children under 5 years of age (with place of death stated) died in hospitals, compared with 79.9 per cent in the Northern American projects (Table 180 and Figure 154). In the latter, 97.5 per cent of all neonatal deaths occurred in hospitals, compared with 82.1 per cent in the Latin American projects. In the postneonatal period, however, the opposite was found: fewer infants died in hospitals in the Northern American projects (44.4 per cent) than in the Latin American ones (50.8 per cent), but because of small numbers in the Northern American projects the difference is not significant. Sudden death was the cause assigned in 14.6 per cent of the postneonatal deaths in the latter projects and these deaths occurred at home.

In the age group 1–4 years, 59.4 per cent of the deaths occurred in hospitals in the Northern American projects compared with 43.8 per cent in the Latin American ones. In this age group 42.9 per cent of the deaths were due to external causes in Northern American projects, which accounted for many deaths in the column termed "other" in Table 180. Although many deaths due to external causes oc-

TABLE 180. Place of Death and Duration of Hospitalization of Children Under 5 Years, by Age Group, in 13 Latin American and Two Northern American Projects.

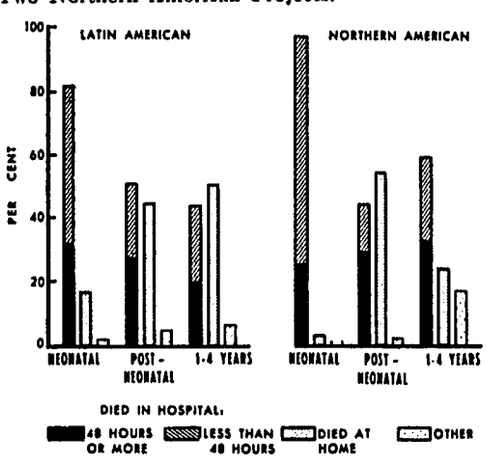
Age group	13 Latin American projects							Two Northern American projects					
	Total children	Hospital			Home	Other	Not stated	Total children	Hospital			Home	Other
		Total	48 hours or more	Less than 48 hours					Total	48 hours or more	Less than 48 hours		
	Number of deaths												
Under 5 years....	33,826	19,967	8,975	10,992	11,941	1,156	762	1,269	1,014	341	673	221	34
Neonatal.....	11,875	9,608	3,714	5,894	1,934	160	173	799	779	199	580	20	—
Postneonatal...	14,633	7,267	3,888	3,379	6,439	596	331	295	131	85	46	159	5
1–4 years.....	7,318	3,092	1,373	1,719	3,568	400	258	175	104	57	47	42	29
	Per cent[a]												
Under 5 years....	100.0	60.4	27.1	33.2	36.1	3.5		100.0	79.9	26.9	53.0	17 4	2.7
Neonatal.....	100.0	82.1	31.7	50.4	16.5	1.4		100.0	97.5	24.9	72.6	2.5	—
Postneonatal...	100.0	50.8	27.2	23.6	45.0	4.2		100.0	44.4	28.8	15.6	53.9	1.7
1–4 years.....	100.0	43.8	19.4	24.3	50.5	5.7		100.0	59.4	32.6	26.9	24.0	16.6

[a] Based on deaths with place of death specified.

curred in Latin American projects the mortality was principally due to other causes.

In Table 181, the data on place of death are given for 24 areas of the 15 projects in the two age groups, neonatal and 28 days-4 years. In the neonatal period more than 80 per cent of the deaths occurred in hospitals in the 15 projects combined. Place of death usually was the same as place of birth for those dying in the first day of life. In the Sherbrooke and California projects more than 90 per cent of all neonatal deaths occurred among infants who remained in hospital from birth until death, and more than 70 per cent died within the first 48 hours after admission.

FIG. 154. Place of Death of Children Under 5 Years, by Age Group, in 13 Latin American and Two Northern American Projects.



Since mortality in the Latin American projects was not concentrated in the first day or first few days of life, the duration of hospitalization differed markedly from that in the Northern American areas, and there were distinct differences also among projects. For example, in San Juan Province, in both the suburban departments and the city of San Juan more than 90 per cent of neonatal deaths occurred in hospitals but only

TABLE 181. Place of Death[a] and Duration of Hospitalization of Children Under 5 Years, in Two Age Groups, in 24 Areas of 15 Projects.

	Neonatal											28 days–4 years									
	Total deaths	Hospital					Home		Other		Not stated	Total deaths	Hospital				Home		Other		Not stated
		Total		48 hours or more		Less than 48 hours							Total		48 hours or more		Less than 48 hours				
		No.	%	No.	%	No.	%	No.	%	No.	%		No.	%	No.	%	No.	%	No.	%	
Total	12,674	10,387	83.1	3,913	31.3	6,474	51.8	1,951	15.6	160	1.3	173	22,421	10,591	48.5	5,403	24.7	5,191	23.8	10,208	46.8	1,030	4.7	559
ARGENTINA																								
Chaco Province																								
Resistencia	327	273	83.7	87	26.7	186	57.1	47	14.4	6	1.8	1	537	326	60.8	188	35.1	138	25.7	178	33.2	32	6.0	1
Rural departments	241	155	64.3	53	22.0	102	42.3	71	30.7	12	5.0	-	596	327	55.0	157	26.4	170	28.6	215	36.1	53	8.9	1
San Juan Province																								
San Juan (city)	172	161	94.2	72	42.1	89	52.0	6	3.5	4	2.3	1	154	115	74.7	61	39.6	54	35.1	29	18.8	10	6.5	—
Suburban departments	353	329	93.7	149	42.5	180	51.3	15	4.3	7	2.0	2	427	311	72.8	153	35.8	158	37.0	83	19.4	33	7.7	—
Rural departments	381	329	86.8	165	43.5	164	43.3	38	10.0	12	3.2	2	669	436	65.5	210	31.5	226	33.9	173	26.0	57	8.6	3
BOLIVIA																								
La Paz	1,049	498	50.6	186	18.9	312	31.7	476	48.3	11	1.1	64	3,066	535	18.6	216	7.5	319	11.1	2,255	78.6	79	2.8	197
Viacha	42	9	21.4	6	14.3	3	7.1	33	78.6	-	-	-	119	7	6.9	2	2.0	5	4.9	94	92.2	1	1.0	17
BRAZIL																								
Recife	1,073	791	74.3	254	23.8	537	50.4	271	25.4	3	0.3	8	2,562	1,082	42.7	443	17.5	639	25.2	1,417	55.9	35	1.4	28
Ribeirão Prêto																								
Ribeirão Prêto (city)	223	217	97.3	74	33.2	143	64.1	6	2.7	-	—	—	241	182	76.2	115	48.2	67	28.0	46	19.2	11	4.6	2
Franca	188	168	89.4	63	33.5	105	55.9	20	10.6	--	—	—	246	155	64.0	71	29.3	84	34.7	79	32.6	8	3.3	4
Communities	104	93	89.4	31	29.8	62	59.6	9	8.7	2	1.9	--	124	92	74.2	43	34.7	49	39.5	27	21.8	5	4.0	—
São Paulo	1,958	1,842	94.3	807	41.3	1,035	53.0	92	4.7	19	1.0	5	2,354	1,820	77.9	1,186	50.6	640	27.3	394	16.8	123	5.2	11
CANADA																								
Sherbrooke	229	225	98.3	52	22.7	173	75.5	4	1.7	--	-	-	142	82	57.7	56	39.4	26	18.3	40	28.2	20	14.1	—
CHILE																								
Santiago	1,094	1,012	92.7	384	35.2	628	57.5	68	6.2	12	1.1	2	1,395	725	52.3	378	27.3	347	25.0	526	38.0	135	9.7	9
Comunas	66	45	68.2	14	21.2	31	47.0	18	27.3	3	4.5	--	159	70	44.0	42	26.4	28	17.6	77	48.4	12	7.5	—
COLUMBIA																								
Cali	536	348	68.8	115	22.7	233	46.0	142	28.1	16	3.2	30	1,091	380	40.8	167	17.9	213	22.9	490	52.6	62	6.7	159
Cartagena	401	343	86.2	127	31.9	216	54.3	49	12.3	6	1.5	3	854	521	62.4	273	32.7	248	29.7	274	32.8	40	4.8	19
Medellín	383	343	90.0	115	30.2	228	59.8	36	9.4	2	0.5	2	965	480	50.6	235	24.8	245	25.8	423	44.6	46	4.8	16
EL SALVADOR																								
San Salvador	722	544	75.7	190	26.4	354	49.2	171	23.8	4	0.6	3	2,016	601	30.0	229	11.4	372	18.5	1,374	68.5	31	1.5	10
Rural *municipios*	195	56	28.7	21	10.8	35	17.9	134	68.7	5	2.6	--	887	72	8.1	33	3.7	39	4.4	783	88.6	29	3.3	3
JAMAICA																								
Metropolitan Kingston	937	878	93.9	419	44.8	459	49.1	48	5.1	9	1.0	2	817	462	57.0	230	28.4	232	28.6	294	36.3	55	6.8	6
St. Andrew, rural	53	34	64.2	19	35.8	15	28.3	15	28.3	4	7.5	—	96	35	36.5	22	22.9	13	13.5	53	55.2	8	8.3	—
MEXICO																								
Monterrey	1,377	1,140	85.8	363	27.3	777	58.5	166	12.5	23	1.7	48	2,576	1,619	65.5	807	32.6	812	32.8	723	29.2	131	5.3	103
UNITED STATES																								
California project	570	554	97.2	147	25.8	407	71.4	16	2.8	—	—	—	328	153	46.6	86	26.2	67	20.4	161	49.1	14	4.3	—

[a] Percentages based on deaths with place of death specified.

51.3 and 52.0 per cent, respectively, occurred less than 48 hours after admission, compared with over 70 per cent in the Sherbrooke and California projects.

For children dying at 28 days through 4 years of age, there were wide variations in the Latin American projects in both the percentages hospitalized and the length of stay. In the rural areas of the Bolivia and El Salvador projects the very low percentages of those dying in hospitals, 6.9 and 8.1, reflected the limited extent of medical attention in hospital for the fatal illnesses of these children.

Analyses of patterns of mortality by age and causes together with various other factors closely related to excessive mortality in some of the projects point to the need for providing comprehensive health services on a continuous basis. The study of multiple causes demonstrates that although excessive mortality in children in developing areas is due mainly to acute morbid conditions as underlying causes, important contributory causes such as low birth weight and nutritional deficiency may have their origin in factors or causes acting over long periods of time. This relationship should be taken into consideration when planning health services. Prenatal care should start at the

very earliest stage of pregnancy, and a sufficient number of visits should be planned to ensure that the expectant mother receives proper surveillance of her state of health and nutrition as well as education on safeguarding the health of her child after birth. Such prenatal measures will help to assure that the birth, attended by qualified personnel, will take place under conditions offering the best possible security to both mother and infant. Follow-up services after birth, with continuing emphasis placed on prevention of infectious diseases and malnutrition, prompt treatment of illness, and attainment of a desirable reproductive pattern in the mother, should constitute the minimum services to safeguard the health of mother and child.

Chapter XVI

Environmental Conditions

In addition to the various factors influencing the level of mortality in childhood that have been considered in previous chapters, another important group of environmental factors deserves analysis. These include conditions in the child's surroundings such as housing, water supplies, and sanitary facilities.

In Chapter XIV education of the mother was shown to be a useful overall indicator of socioeconomic conditions. That analysis revealed that there were differences in socioeconomic conditions among families in two groups: (1) those of infants dying in the neonatal period and (2) those of infants dying in the postneonatal period. The families of the first group are probably fairly representative of the situation in the general population of the areas concerned, as many deaths occur soon after birth and are due to factors related to pregnancy and delivery. However, even in this period environmental conditions affect mortality and become of increasing importance with age. The variation in death rates in Latin American areas was much less in this neonatal period than in the postneonatal period, when the causes stemmed principally from environmental factors and the infectious diseases were responsible for a high proportion of deaths. Also, excessive mortality from nutritional deficiency in the postneonatal period was probably the result of unfavorable socioeconomic conditions that deprived the children of sufficient nutritive food for proper growth and development and left them susceptible to repeated infections.

In this chapter the two aforementioned groups of families are taken as a basis for bringing out the differences in environmental conditions. Mortality in the postneonatal period is then analyzed in relation to environmental conditions affecting the families.

Availability of drinking water has been recognized as an important determinant of morbidity and mortality due to diarrheal disease (Watt *et al.*, 1953; Hollister *et al.*, 1955). The Investigation has shown that the supply of piped water available to families of deceased infants varied widely among the cities and was almost completely lacking in a few cities and in several of the rural areas.

Water supply is the principal environmental condition analyzed in this chapter; however, data on sanitary facilities and size of house, which are also important factors, are considered as well.

Schliessmann *et al.* (1958), on investigating the associations between environmental conditions and incidence of diarrheal disease, found that the effect of socioeconomic factors such as income, family size, education of housewife, and crowding was secondary in importance to the effect of the

presence or absence of sanitary facilities. These authors based their analysis on the location of the water supply and toilet facility, that is, inside or outside the house, as has been done also in this Investigation. They found the incidence of diarrheal disease to be lowest when the dwelling had water and a flush toilet inside the house.

In Chapter IX it was made clear that mortality could not be reduced to low levels without reduction of nutritional deficiency. The data in this chapter indicate that provision of water is another essential component of a sound program leading to reduction in death rates. As both factors, nutritional deficiency and infection, are due to unfavorable socioeconomic conditions, their roles cannot be separated; infectious agents from the environment attack the most susceptible infants and children, those weakened by nutritional deficiency. Thus both the host and the agent are involved in this complicated pattern of mortality and both must be taken into account when planning services to improve a population's state of health.

WATER SUPPLIES

During the interviews in the homes of deceased children, information was obtained on the type of water supply available to the family: water piped inside the house, or piped water available outside or nearby through a communal facility. One of the goals laid down in the Charter of Punta del Este (Organization of American States, 1961) was to supply potable water and sewage disposal services to at least 70 per cent of the urban and 50 per cent of the rural population during the decade. At the III Special Meeting of Ministers of Health of the Americas, held in 1972 (PAHO, 1973), new goals were approved for the decade of the 1970's: to provide water service with house connections for 80 per cent of the urban population and water for 50 per cent of the rural population; and to install sewerage systems for 70 per cent of the urban population and such systems or other sanitary facilities for 50 per cent of the rural population. The findings of the Investigation can be viewed in relation to these goals (which are for countries) so that they may serve as a basis for future planning.

Table 182 presents the basic data in regard to piped water available to families of infants dying in the two age groups (neonatal and postneonatal) in 22 areas of 14 projects (the California project is not included as home interviews were not conducted). Figure 155 shows (in the left section) the percentages of households in the first group (neonatal) served with piped water. In nine cities more than 80 per cent of these households had piped water available, namely:

Santiago	96.2	Cartagena	89.9
Medellín	95.1	San Juan (city)	87.9
Sherbrooke	94.6	Monterrey	83.0
Cali	92.9	Ribeirão Prêto (city)	81.2
Kingston-St. Andrew	91.5		

In four of these cities the percentages ranged from 81.2 to 89.9, and in the other five they were above 90.

In the rural areas the percentages of households with piped water were very low, and they were low also in several of

TABLE 182. Availability of Piped Water in Families of Infants[a] Dying in Neonatal and Postneonatal Periods in 22 Areas of 14 Projects.

Area	Neonatal period									Postneonatal period								
	Total houses	Piped water						Other source or unknown		Total houses	Piped water						Other source or unknown	
		Total		Inside house		Outside					Total		Inside house		Outside			
		No.	%	No.	%	No.	%	No.	%		No.	%	No.	%	No.	%	No.	%
Total	9,502	6,062	63.8	3,328	35.0	2,734	28.8	3,440	36.2	12,409	6,692	53.9	2,863	23.1	3,829	30.9	5,717	46.1
ARGENTINA																		
Chaco Province																		
Resistencia	304	69	22.7	48	15.8	21	6.9	235	77.3	409	41	10.0	20	4.9	21	5.1	368	90.0
Rural departments	235	16	6.8	8	3.4	8	3.4	219	93.2	410	9	2.2	3	0.7	6	1.5	401	97.8
San Juan Province																		
San Juan (city)	149	131	87.9	104	69.8	27	18.1	18	12.1	107	86	80.4	59	55.1	27	25.2	21	19.6
Suburban departments	311	123	39.2	73	23.2	50	15.9	191	60.8	324	103	31.8	46	14.2	57	17.6	221	68.2
Rural departments	346	35	10.1	22	6.4	13	3.8	311	89.9	509	49	9.6	20	3.9	29	5.7	460	90.4
BOLIVIA																		
La Paz	637	471	73.9	177	27.8	294	46.2	166	26.1	1,064	703	66.1	248	23.3	455	42.8	361	33.9
Viacha	38	26	68.4	14	36.8	12	31.6	12	31.6	55	28	50.9	18	32.7	10	18.2	27	49.1
BRAZIL																		
Recife	893	203	22.7	106	11.9	97	10.9	690	77.3	1,463	164	11.2	45	3.1	119	8.1	1,299	88.8
Ribeirão Prêto																		
Ribeirão Prêto (city)	202	164	81.2	126	62.4	38	18.8	38	18.8	160	96	60.0	54	33.8	42	26.2	64	40.0
Franca	162	74	45.7	48	29.6	26	16.0	88	54.3	143	43	30.1	26	18.2	17	11.9	100	69.9
Communities	94	74	78.7	43	45.7	31	33.0	20	21.3	83	68	81.9	27	32.5	41	49.4	15	18.1
São Paulo	1,714	981	57.2	753	43.9	228	13.3	733	42.8	1,555	713	45.9	495	31.8	218	14.0	842	54.1
CANADA																		
Sherbrooke	203	192	94.6	191	94.1	1	0.5	11	5.4	73	68	93.2	67	91.8	1	1.4	5	6.8
CHILE																		
Santiago	586	564	96.2	440	75.1	124	21.2	22	3.8	888	822	92.6	599	67.5	223	25.1	66	7.4
Comunas	57	29	50.9	7	12.3	22	38.6	28	49.1	113	69	61.1	17	15.0	52	46.0	44	38.9
COLOMBIA																		
Cali	382	355	92.9	247	64.7	108	28.3	27	7.1	444	416	93.7	238	53.6	178	40.1	28	6.3
Cartagena	208	187	89.9	91	43.8	96	46.2	21	10.1	356	324	91.0	101	28.4	223	62.6	32	9.0
Medellín	263	250	95.1	216	82.1	34	12.9	13	4.9	398	350	87.9	284	71.4	66	16.6	48	12.1
EL SALVADOR																		
San Salvador	690	481	69.7	109	15.8	372	53.9	209	30.3	1,338	837	62.6	125	9.3	712	53.2	501	37.4
Rural *municipios*	185	35	18.9	—	—	35	18.9	150	81.1	440	79	18.0	4	0.9	75	17.0	361	82.0
JAMAICA																		
Kingston-St. Andrew	882	807	91.5	187	21.2	620	70.3	75	8.5	549	465	84.7	75	13.7	390	71.0	84	15.3
MEXICO																		
Monterrey	958	795	83.0	318	33.2	477	49.8	163	17.0	1,528	1,159	75.9	292	19.1	867	56.7	369	24.1

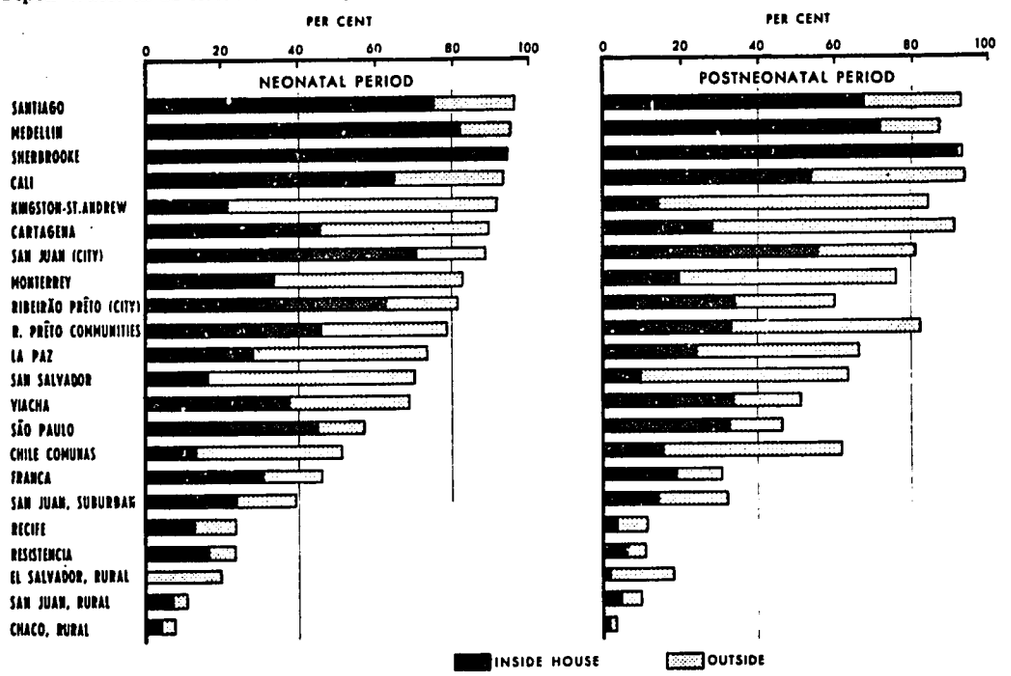
[a] In families in which home interviews were conducted and information was provided.

the cities and suburban areas. The nine areas with the lowest percentages (less than 60) of families in the first group (neonatal) served with piped water were the following:

São Paulo	57.2	Resistencia	22.7
Chile, *comunas*	50.9	El Salvador, rural *municipios*	18.9
Franca	45.7	San Juan Province, rural	10.1
San Juan Province, suburban	39.2	Chaco Province, rural	6.8
Recife	22.7		

As can be seen, the variation in availability of water supplies was great in the areas of the 14 projects for which information was obtained. The completeness of home interviewing varied, and it is probable that some of the families living in unfavorable conditions were those that could not be located (for lack of address). Appendix

FIG. 155. Percentage of Families of Infants Dying in Neonatal and Postneonatal Periods Served with Piped Water in 22 Areas of 14 Projects.



4 gives the percentages of families of deceased children in which interviews were conducted in the areas of 14 projects. The failure to find homes may affect the findings in the Colombian cities and in the Bolivia project.

Figure 155 shows also the percentages of homes with piped water inside the house. In Santiago, for example, 75.1 per cent of the families in the first group (neonatal) had piped water inside and an additional 21.2 per cent had it outside the house or available from a neighborhood source. Considerable variation was noted in regard to water service inside the house. For instance, in Kingston-St. Andrew piped water was often provided for the house but the taps were outside, near the kitchen, and often in the yard for use also in watering the grass and garden. Actually in this project 70.3 per cent of the homes of infants deceased in the neonatal period were served by water outside the building, although the water was readily available.

As can be seen in Figure 155 (right section) the percentages in regard to families of infants dying in the postneonatal period were lower in 18 areas, compared with those in the neonatal group. Two of the small areas (Ribeirão Prêto communities and *comunas* in the Chile project) as well as two cities in Colombia varied from the general pattern of lower percentages for these families.

In cities where more than 90 per cent of families in the first group (neonatal) had piped water supplies, the differences be-

tween the two groups were small or disappeared:

	Neonatal period	*Postneonatal period*
Santiago	96.2	92.6
Cali	92.9	93.7
Sherbrooke	94.6	93.2

When water was available for only low proportions of families, however, the differences were clear, as in the three following cities:

	Neonatal period	*Postneonatal period*
São Paulo	57.2	45.9
Recife	22.7	11.2
Resistencia	22.7	10.0

In Resistencia and Recife the percentages for the second group were only about half those for the first.

The data for the Latin American areas have been combined in Table 183 to give an overall view of the situation. In the 13 cities 69.4 per cent of the homes of infants dying in the neonatal period had piped water supplies. In contrast, in the eight other areas only 28.8 per cent had piped water. These percentages may be related to the goals of the Charter of Punta del Este. Although in these 13 cities combined the goal of 70 per cent was practically reached, for the other areas combined the percentage was only 28.8, or 57.6 per cent of the goal. These areas near cities were probably much better served with water supplies than the remote rural areas. In the 13 cities combined only 37.1 per cent of the homes of these infants dying in the neonatal period had water supplies inside the house. Thus, the new goal of providing water services with house connections for 80 per cent of the urban population and water for 50 per cent of the rural population in the decade of the 1970's poses a great challenge.

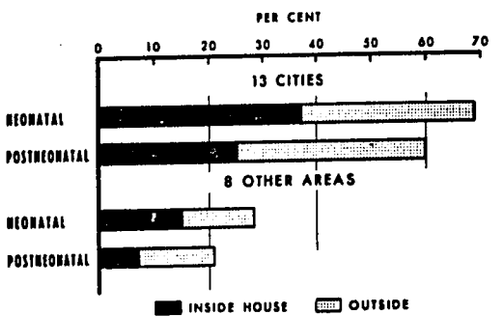
Table 183 shows also the findings for homes of infants deceased in the postneonatal period. In the 13 cities combined only 60.2 per cent had piped water supplies (in contrast to 69.4 for the neonatal group), a significantly lower percentage. In the eight other areas the proportion was 28.8 per cent (compared with 21.6). Therefore, this is clear evidence that families of infants dying in the postneonatal period had less favorable conditions in regard to piped water supplies. The differences between families in the two groups are apparent for many of the areas shown in Figure 155 and for the areas combined in Figure 156.

TABLE 183. Availability of Piped Water in Families of Infants[a] Dying in Neonatal and Postneonatal Periods in 21 Areas of 13 Latin American Projects.

Areas	Neonatal period					Postneonatal period				
	Total houses	Piped water				Total houses	Piped water			
		Total		Inside house			Total		Inside house	
		No.	%	No.	%		No.	%	No.	%
Total	9,299	5,870	63.1	3,137	33.7	12,336	6,624	53.7	2,796	22.7
13 cities combined	7,868	5,458	69.4	2,922	37.1	10,259	6,176	60.2	2,635	25.7
8 other areas combined	1,431	412	28.8	215	15.0	2,077	448	21.6	161	7.8

[a] In families in which home interviews were conducted and information was provided.

FIG. 156. Percentage of Families of Infants Dying in Neonatal and Postneonatal Periods Served with Piped Water in 13 Latin American Cities and Eight Other Areas Combined, in 13 Projects.



Among families of infants in the postneonatal group the proportions with piped water inside the house were much lower. For example, in the eight other areas combined the percentage was 7.8, compared with 15.0 for the neonatal group, and in the 13 cities, 25.7 compared with 37.1. There is no doubt that environmental conditions as measured by availability of piped water were much less favorable in this second group of families than in the first.

Postneonatal death rates in relation to water supplies in families of infants dying in that age period are presented in Table 184 and Figure 157. For eight areas in which piped water was available to at least 80.0 per cent of the families, the postneonatal death rate varied from a low of 4.8 per 1,000 live births (Sherbrooke) to 29.2 (Cali). In the 14 areas with lower percentages for water supplies, the death rates were in excess of 30 with one exception (Ribeirão Prêto city), and they ranged from 42.9 to 83.9 in the five areas with less than 30 per cent of the families served with piped water. These data are presented in Figure 158, which shows the negative correlation of postneonatal death rates and percentage of houses with piped water; the correlation coefficient was −0.688. With the exclusion of the two areas with exceedingly high death rates in this age period (Viacha and rural El Salvador), the coefficient was higher, namely, −0.755. These two rural areas have unusually serious problems of which lack of water supply is one. Thus, these inverse relationships indicate clearly that lack of water service has a direct relationship to excessive postneonatal mortality and is an important measure of unfavorable environmental conditions.

The relationship was even closer (correlation coefficient of −0.834) when water inside the house was used as a measure and three areas (Viacha, rural El Salvador, and Kingston-St. Andrew) were excluded (Figure 159). Kingston-St. Andrew was excluded because of incomparability of the

TABLE 184. Availability of Piped Water in Families of Infants Dying in Postneonatal Period, and Postneonatal Mortality[a] in 22 Areas of 14 Projects.

Area	Percentage of houses with piped water		Postneonatal death rate
	Total	Inside	
Cali	93.7	53.6	29.2
Sherbrooke	93.2	91.8	4.8
Santiago	92.6	67.5	27.7
Cartagena	91.0	28.4	25.4
Medellín	87.9	71.4	27.9
Kingston-St. Andrew	84.7	13.7	14.6
Ribeirão Prêto, communities	81.9	32.5	23.7
San Juan (city)	80.4	55.1	21.1
Monterrey	75.9	19.1	34.8
La Paz	66.1	23.3	44.5
San Salvador	62.6	9.3	53.6
Chile, *comunas*	61.1	15.0	38.5
Ribeirão Prêto (city)	60.0	33.8	19.0
Viacha	50.9	32.7	74.1
São Paulo	45.9	31.8	31.5
San Juan, suburban	31.8	14.2	43.3
Franca	30.1	18.2	34.6
El Salvador, rural	18.0	0.9	83.9
Recife	11.2	3.1	55.9
Resistencia	10.0	4.9	42.9
San Juan, rural	9.6	3.9	54.9
Chaco, rural	2.2	0.7	54.1

[a] Rates per 1,000 live births.

FIG. 157. Percentage of Families of Infants Dying in Postneonatal Period Served with Piped Water, and Postneonatal Mortality in 22 Areas of 14 Projects.

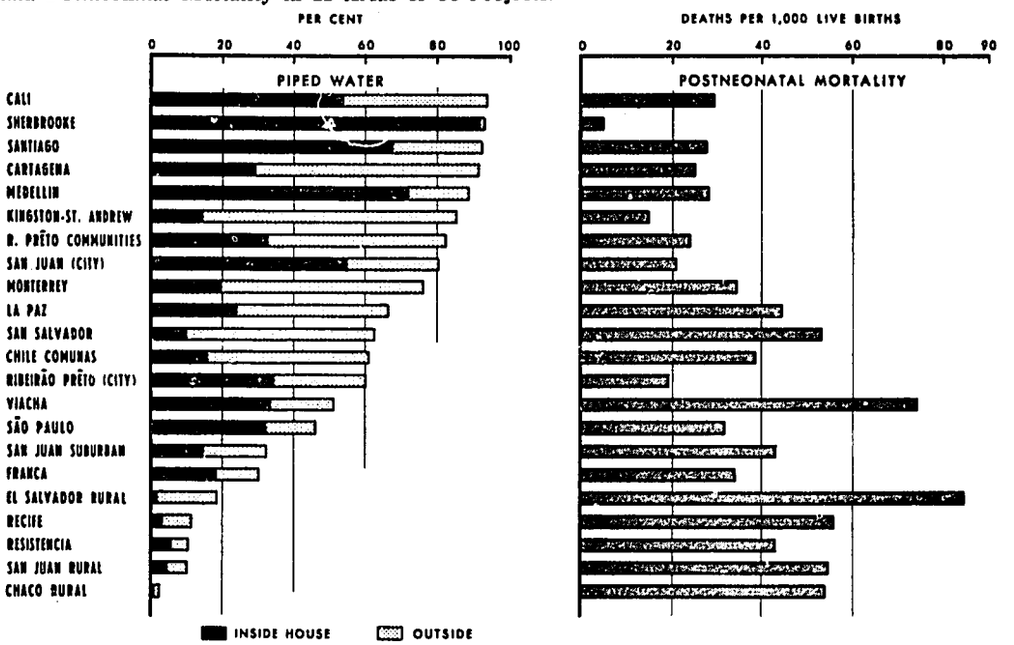


FIG. 158. Postneonatal Mortality and Percentage of Families of Infants Dying in Postneonatal Period Served with Piped Water in 22 Areas of 14 Projects.

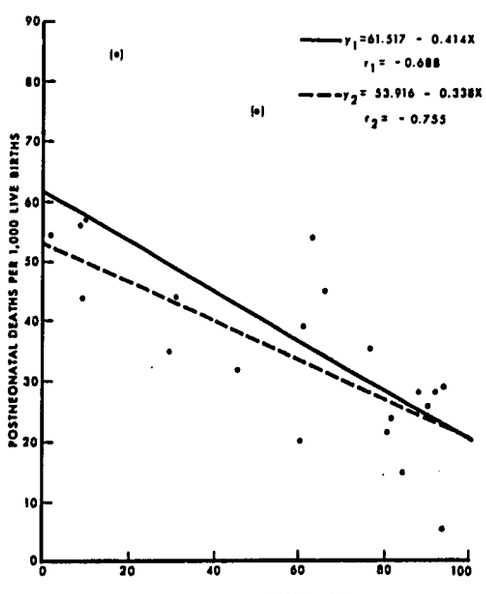
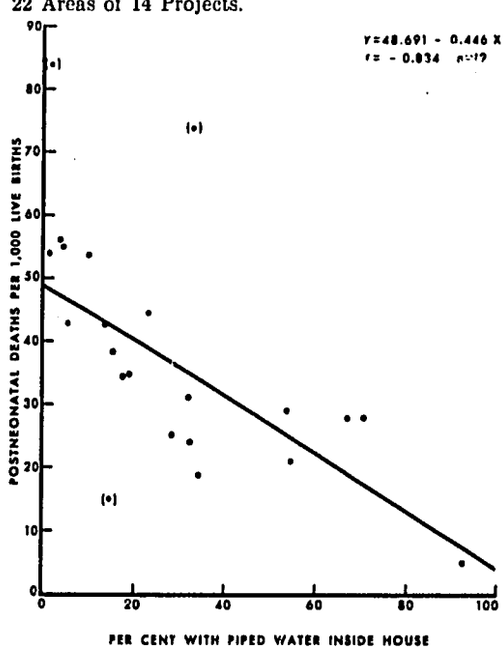


FIG. 159. Postneonatal Mortality and Percentage of Families of Infants Dying in Postneonatal Period Served with Water Piped Inside House, in 22 Areas of 14 Projects.



data; as was pointed out earlier, though water was often just outside the kitchen in this project, it was readily available and the situation was therefore much more favorable than when the source was a facility serving several families.

SANITARY FACILITIES

Data on the type of toilet facility used by the family (flush toilet inside house, common facility for a group of families, or other facility such as pit privy) were also obtained during the home visits by the interviewers. The data on these facilities are presented together with those on piped water in Table 185, for 13 cities and eight other areas of the 13 Latin American projects combined, in households of infants dying in the neonatal and the postneonatal periods. Here again it can be seen that conditions were less favorable for families of infants who died in the postneonatal period.

The most satisfactory conditions (piped water inside house and flush toilet) were found in 31.3 per cent of the households of infants in the neonatal group in the 13 cities combined, but they were found in only 19.5 per cent of households of the other group of infants in these cities. In the eight other areas the percentages for both groups were low, 11.8 and 5.1, respectively.

The percentages of households with neither piped water nor toilet facilities in-

TABLE 185. Piped Water and Sanitary Facilities in Families of Infants[a] Dying in Neonatal and Postneonatal Periods in 13 Cities and Eight Other Areas of 13 Latin American Projects Combined.

Piped water and sanitary facilities	13 Latin American projects				13 cities				8 other areas			
	Neonatal period		Postneonatal period		Neonatal period		Postneonatal period		Neonatal period		Postneonatal period	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Total	9,299	99.9	12,336	100.0	7,868	99.9	10,259	100.0	1,431	100.0	2,077	100.0
Piped water inside house	3,137	33.7	2,796	22.7	2,922	37.1	2,635	25.7	215	15.0	161	7.8
With flush toilet	2,632	28.3	2,107	17.1	2,463	31.3	2,001	19.5	169	11.8	106	5.1
With other toilet facilities	423	4.5	549	4.5	398	5.1	519	5.1	25	1.7	30	1.4
No toilet facilities	82	0.9	140	1.1	61	0.8	115	1.1	21	1.5	25	1.2
Piped water outside house	2,733	29.4	3,828	31.0	2,536	32.2	3,541	34.5	197	13.8	287	13.8
With toilet facilities	2,401	25.8	3,221	26.1	2,249	28.6	3,012	29.4	152	10.6	209	10.1
No toilet facilities	332	3.6	607	4.9	287	3.6	529	5.2	45	3.1	78	3.8
Without piped water	3,429	36.9	5,712	46.3	2,410	30.6	4,083	39.8	1,019	71.2	1,629	78.4
With toilet facilities	2,132	22.9	3,278	26.6	1,674	21.3	2,549	24.8	458	32.0	729	35.1
No toilet facilities	1,297	13.9	2,434	19.7	736	9.4	1,534	15.0	561	39.2	900	43.3

[a] In families in which home interviews were conducted and information was provided.

creased from 9.4 for the neonatal group to 15.0 for the postneonatal group in the 13 cities, and in the eight other areas they were 39.2 and 43.3 respectively. These differences can be seen in Figure 160. The detailed data for the 22 areas of 14 projects are presented in Table 186.

As with most of the data presented, the variations among areas were great. Almost all households were supplied with water and toilet facilities in Sherbrooke (91.8 per cent), Cali (91.7) and Santiago (89.5), while in three areas at least 50 per cent of the homes of infants dying in the postneonatal period had neither of these facilities. There is no doubt that environmental conditions as measured by availabilty of water supplies and sanitary installations were deficient or lacking in high proportions of the families of infants in the postneonatal group. These data serve to show the extent of deficiencies in water and sewage facilities and the amount of effort needed to bring many areas to the level of those attained by a few, such as Santiago, where infant mortality has been markedly reduced in recent years.

In Chapter XIV it was shown that much higher proportions of the deceased children of mothers with secondary or university education died in the neonatal period than children whose mothers had no education (Figure 143), and that in several cities in Latin America more than 60 per cent of the deaths of children of the better educated mothers occurred in the neonatal period. This concentration of deaths of children under 5 years of age in the neonatal period indicates a favorable situation, for in projects with low death rates (as in Sherbrooke and California) over 60 per cent of the deaths of children under 5 years of age occurred in the neonatal period.

A similar situation was found upon subdividing the families according to availability of water supplies and sanitary facilities. Table 187 shows the proportions of deaths of children under 5 years that occurred in the neonatal period in two groups of families: (1) those with piped water inside the house and flush toilets, and (2) those with neither of these facilities.

In five areas more than 60 per cent of the deaths occurred in the neonatal period in families in the first group, while the per-

FIG. 160. Piped Water and Sanitary Facilities in Families of Infants Dying in Neonatal and Postneonatal Periods in 13 Cities and Eight Other Areas of 13 Latin American Projects Combined.

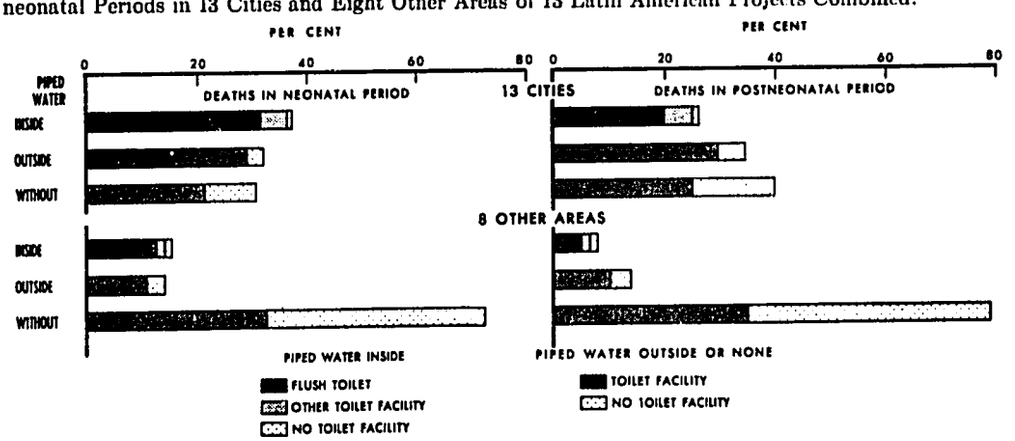


TABLE 186. Piped Water Supplies and Sanitary Facilities in Families[a] of Deceased Infants in Two Age Groups in 22 Areas of 14 Projects.

Area	Total houses	Piped water inside						Piped water outside				Without piped water			
		Flush toilet		Other toilet facility		No toilet facility		Toilet facility		No toilet facility		Toilet facility		No toilet facility	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
	Neonatal period														
Total	9,502	2,821	29.7	423	4.5	84	0.9	2,402	25.3	332	3.5	2,141	22.5	1,299	13.7
ARGENTINA															
Chaco Province															
Resistencia	304	35	11.5	13	4.3	—	—	21	6.9	—	—	196	64.5	39	12.8
Rural departments	235	6	2.6	2	0.9	—	—	7	3.0	1	0.4	165	70.2	54	23.0
San Juan Province															
San Juan (city)	149	85	57.0	15	10.1	4	2.7	19	12.8	8	5.4	6	4.0	12	8.1
Suburban departments	314	56	17.8	10	3.2	7	2.2	37	11.8	13	4.1	62	19.7	129	41.1
Rural departments	346	16	4.6	4	1.2	2	0.6	4	1.2	9	2.6	81	23.4	230	66.5
BOLIVIA															
La Paz	637	133	20.9	15	2.4	29	4.6	177	27.8	117	18.4	26	4.1	140	22.0
Viacha	38	2	5.3	—	—	12	31.6	—	—	12	31.6	—	—	12	31.6
BRAZIL															
Recife	893	66	7.4	40	4.5	—	—	91	10.2	6	0.7	467	52.3	223	25.0
Ribeirão Prêto															
Ribeirão Prêto (city)	202	119	58.9	7	3.5	—	—	36	17.8	2	1.0	27	13.4	11	5.4
Franca	162	45	27.8	3	1.9	—	—	26	16.0	—	—	78	48.1	10	6.2
Communities	94	40	42.6	3	3.2	—	—	31	33.0	—	—	17	18.1	3	3.2
São Paulo	1,714	607	35.4	140	8.2	6	0.4	214	12.5	14	0.8	603	35.2	130	7.6
CANADA															
Sherbrooke	203	189	93.1	—	—	2	1.0	1	0.5	—	—	9	4.4	2	1.0
CHILE															
Santiago	586	367	62.6	71	12.1	2	0.3	115	19.6	9	1.5	10	1.7	12	2.0
Comunas	57	4	7.0	3	5.3	—	—	21	36.8	1	1.8	17	29.8	11	19.3
COLOMBIA															
Cali	382	218	57.1	27	7.1	2	0.5	103	27.0	5	1.3	11	2.9	16	4.2
Cartagena	208	60	28.8	21	10.1	10	4.8	39	18.8	57	27.4	2	1.0	19	9.1
Medellín	263	196	74.5	15	5.7	5	1.9	22	8.4	12	4.6	5	1.9	8	3.0
EL SALVADOR															
San Salvador	690	97	14.1	12	1.7	—	—	349	50.6	23	3.3	139	20.1	70	10.1
Rural *municipios*	185	—	—	—	—	—	—	26	14.1	9	4.9	38	20.5	112	60.5
JAMAICA															
Kingston-St. Andrew	882	178	20.2	9	1.0	—	—	602	68.3	18	2.0	67	7.6	8	0.9
MEXICO															
Monterrey	958	302	31.5	13	1.4	3	0.3	461	48.1	16	1.7	115	12.0	48	5.0
	Postneonatal period														
Total	12,409	2,174	17.5	549	4.4	140	1.1	3,221	26.0	608	4.9	3,282	26.4	2,435	19.6
ARGENTINA															
Chaco Province															
Resistencia	409	12	2.9	7	1.7	1	0.2	19	4.6	2	0.5	280	68.5	88	21.5
Rural departments	410	2	0.5	1	0.2	—	—	4	1.0	2	0.5	308	75.1	93	22.7
San Juan Province															
San Juan (city)	107	44	41.1	10	9.3	5	4.7	19	17.8	8	7.5	9	8.4	12	11.2
Suburban departments	324	33	10.2	9	2.8	4	1.2	35	10.8	22	6.8	59	18.2	162	50.0
Rural departments	509	7	1.4	7	1.4	6	1.2	19	3.7	10	2.0	113	22.2	347	68.2
BOLIVIA															
La Paz	1,064	180	16.9	24	2.3	44	4.1	236	22.2	219	20.6	59	5.5	302	28.4
Viacha	55	3	5.5	1	1.8	14	25.5	—	—	10	18.2	—	—	27	49.1
BRAZIL															
Recife	1,463	24	1.6	20	1.4	1	0.1	100	6.8	19	1.3	758	51.8	541	37.0
Ribeirão Prêto															
Ribeirão Prêto (city)	160	51	31.9	3	1.9	—	—	39	24.4	3	1.9	49	30.6	15	9.4
Franca	143	21	14.7	5	3.5	—	—	8	5.6	9	6.3	86	60.1	14	9.8
Communities	83	25	30.1	2	2.4	—	—	36	43.4	5	6.0	9	10.8	6	7.2
São Paulo	1,555	369	23.7	117	7.5	9	0.6	203	13.1	15	1.0	691	44.4	151	9.7
CANADA															
Sherbrooke	73	67	91.8	—	—	—	—	—	—	1	1.4	4	5.5	1	1.4
CHILE															
Santiago	888	438	49.3	151	17.0	10	1.1	206	23.2	17	1.9	36	4.1	30	3.4
Comunas	113	13	11.5	4	3.5	—	—	47	41.6	5	4.4	25	22.1	19	16.8
COLOMBIA															
Cali	444	202	45.5	35	7.9	1	0.2	170	38.3	8	1.8	14	3.2	14	3.2
Cartagena	356	36	10.1	36	10.1	29	8.1	94	26.4	129	36.2	7	2.0	25	7.0
Medellín	398	229	57.5	45	11.3	10	2.5	52	13.1	14	3.5	20	5.0	28	7.0
EL SALVADOR															
San Salvador	1,338	84	6.3	40	3.0	1	0.1	661	49.4	51	3.8	298	22.3	203	15.2
Rural *municipios*	440	2	0.5	1	0.2	1	0.2	60	13.6	15	3.4	129	29.3	232	52.7
JAMAICA															
Kingston-St. Andrew	549	73	13.3	2	0.4	—	—	371	67.6	19	3.5	75	13.7	9	1.6
MEXICO															
Monterrey	1,528	259	17.0	29	1.9	4	0.3	842	55.1	25	1.6	253	16.6	116	7.6

[a] In families in which home interviews were conducted and information was provided.

centages were much lower in families lacking those facilities, namely:

	With water inside, and flush toilet	*No facility*
Resistencia	68.6	23.4
Franca	65.2	31.2
Ribeirão Prêto (city)	65.0	32.4
Recife	62.9	21.3
San Juan Province, rural	61.5	33.8

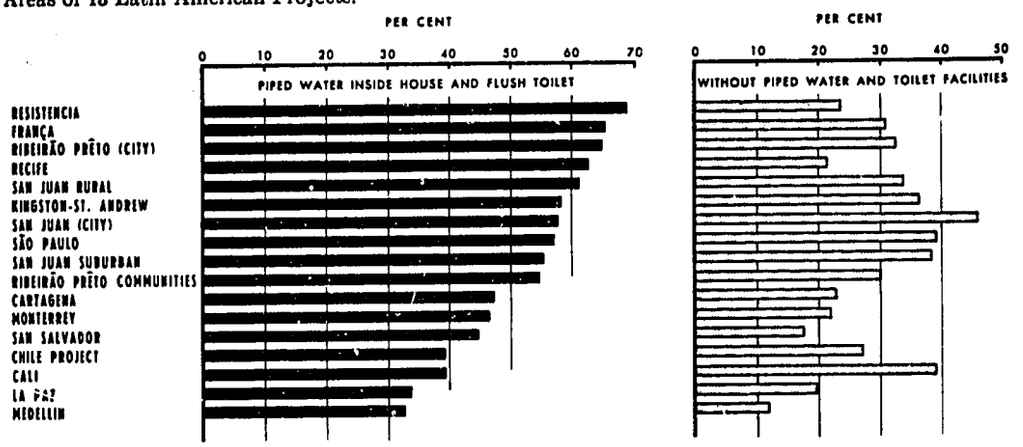
As can be seen, the relatively high proportions of deaths occurring in the neonatal period in families with these facilities available (indicating favorable socioeconomic conditions) were in sharp contrast to the low proportions (from 21.3 to 33.8 per cent) in families deprived of such facilities. The differences in these percentages are shown in Figure 161 for 17 areas with sufficient

TABLE 187. Percentage of Deaths of Children Under 5 Years of Age Occurring in Neonatal Period in Families with Piped Water Inside House and Flush Toilets, and in Those without These Facilities, in 21 Areas of 14 Projects.

Area	With piped water inside house and flush toilet			Without piped water and toilet facility		
	Deaths under 5 years	Neonatal deaths		Deaths under 5 years	Neonatal deaths	
		No.	%		No.	%
Total	5,933	2,821	47.5	5,185	1,299	25.1
Total Latin American areas	5,631	2,632	46.7	5,181	1,297	25.0
ARGENTINA						
Chaco Province						
Resistencia	51	35	68.6	167	39	23.4
Rural departments	9	6	#	196	54	27.6
San Juan Province						
San Juan (city)	147	85	57.8	26	12	46.2
Suburban departments	101	56	55.4	335	129	38.5
Rural departments	26	16	61.5	681	230	33.8
BOLIVIA						
La Paz	393	133	33.8	717	140	19.5
Viacha	7	2	#	59	12	20.3
BRAZIL						
Recife	105	66	62.9	1,045	223	21.3
Ribeirão Prêto						
Ribeirão Prêto (city)	183	119	65.0	34	11	32.4
Franca	69	45	65.2	32	10	31.2
Communities	73	40	54.8	10	3	30.0
São Paulo	1,057	607	57.4	332	130	39.2
CANADA						
Sherbrooke	302	189	62.6	4	2	#
CHILE project	949	371	39.1	84	23	27.4
COLOMBIA						
Cali	560	218	38.9	41	16	39.0
Cartagena	126	60	47.6	85	19	22.4
Medellín	600	196	32.7	67	8	11.9
EL SALVADOR						
San Salvador	217	97	44.7	397	70	17.6
Rural *municipios*	2	—	—	630	112	17.8
JAMAICA						
Kingston-St. Andrew	306	178	58.2	22	8	36.4
MEXICO						
Monterrey	650	302	46.5	221	48	21.7

[a] In families in which home interviews were conducted and information was provided.
Percentage not calculated for base of less than 10.

FIG. 161. Percentage of Deaths of Children Under 5 Years of Age Occurring in Neonatal Period in Families with Piped Water Inside House and Flush Toilets, and in Those without These Facilities, in 17 Areas of 13 Latin American Projects.



numbers for calculation of percentages. The data show that the second group of families experience excessive losses in the later periods of childhood, when mortality is more directly affected by the environment and many deaths could be prevented. This unfavorable mortality experience in families with inadequate water supply and sanitary facilities affords strong support for the recommendations on environmental sanitation programs formulated by the Special Meeting of Ministers of Health in 1972.

HOUSING

Size of family, number of rooms in house, and persons per room showed differences in the same two groups of families used in the previous analysis: those of children dying in the neonatal period and in the postneonatal period, with the first group probably being fairly representative of the situation in the general population of the area.

The average size of families of infants dying in the neonatal period varied in the Latin American areas from 3.7 persons in La Paz and Viacha to 6.3 in Cartagena; and for families of those dying in postneonatal period the variation was from 3.5 in Viacha to 6.6 in Cartagena and Medellín (Table 188). (For calculating size of family, the deceased infants studied in the Investigation were not considered members of the household.) In 18 areas the average size was slightly larger for the postneonatal group than for the neonatal, in two areas it was the same, and in two it was less. For the 14 projects combined the average size was 4.9 members for the neonatal group and 5.3 for the postneonatal group. The families were small in Sherbrooke, with 3.6 persons on the average in the first group and 4.1 in the second.

Table 189 gives the number of rooms in

TABLE 188. Average Size of Families of Infants[a] Dying in Neonatal and Postneonatal Periods in 22 Areas of 14 Projects.

Area	Neonatal period		Postneonatal period	
	No. of families	Average members	No. of families	Average members
Total	9,482	4.9	12,343	5.3
ARGENTINA				
Chaco Province				
Resistencia	304	5.1	409	5.3
Rural departments	235	5.3	410	5.4
San Juan Province				
San Juan (city)	149	5.1	107	4.9
Suburban departments	314	5.5	323	5.5
Rural departments	346	5.5	509	5.9
BOLIVIA				
La Paz	634	3.7	1,045	3.7
Viacha	38	3.7	55	3.5
BRAZIL				
Recife	893	5.6	1,463	5.9
Ribeirão Prêto				
Ribeirão Prêto (city)	202	5.0	160	5.1
Franca	162	4.9	143	5.0
Communities	94	5.2	83	5.7
São Paulo	1,703	4.0	1,524	4.4
CANADA				
Sherbrooke	203	3.6	73	4.1
CHILE				
Santiago	583	4.5	887	4.8
Comunas	57	5.5	112	5.6
COLOMBIA				
Cali	382	4.6	443	4.8
Cartagena	208	6.3	355	6.6
Medellín	263	6.0	396	6.6
EL SALVADOR				
San Salvador	689	5.0	1,338	5.4
Rural *municipios*	185	6.0	440	6.2
JAMAICA				
Kingston-St. Andrew	882	4.2	544	4.7
MEXICO				
Monterrey	956	6.0	1,524	6.1

[a] In families in which home interviews were conducted and information was provided.

households of deceased infants in the two age groups, for 22 areas of 14 projects. For these areas combined, 30.2 per cent of families in the neonatal group lived in one-room households, 26.1 per cent in two-room, 17.4 per cent in three-room, and 26.4 per cent in houses with at least four rooms. The corresponding percentages for families in the postneonatal group were 39.0, 27.6, 15.4, and 18.0. The data showed, therefore, that housing was less favorable for the second group than for the first (roughly representing the general population) and also that the differences in size of dwellings in these widely separated areas were great. In Sherbrooke 86.0 and 87.5 per cent of households in these two groups, respectively, had at least four rooms. In Recife, Ribeirão Prêto communities, and Medellín over 50 per cent of households in the neonatal group had

TABLE 189. Number of Rooms in Households of Infants[a] Dying in Neonatal and Postneonatal Periods in 22 Areas of 14 Projects.

Area	Neonatal period									Postneonatal period								
	Total houses	Number				Per cent				Total houses	Number				Per cent			
		1	2	3	4 and over	1	2	3	4 and over		1	2	3	4 and over	1	2	3	4 and over
Total	9,297	2,804	2,424	1,619	2,450	30.2	26.1	17.4	26.4	12,115	4,726	3,342	1,865	2,182	39.0	27.6	15.4	18.0
ARGENTINA																		
Chaco Province																		
Resistencia	298	111	105	41	41	37.2	35.2	13.8	13.8	399	176	151	53	19	44.1	37.8	13.3	4.8
Rural departments	233	96	80	30	18	41.2	34.3	16.7	7.7	403	186	146	43	28	46.2	36.2	10.7	6.9
San Juan Province																		
San Juan (city)	147	16	33	31	67	10.9	22.4	21.1	45.6	104	20	22	16	46	19.2	21.2	15.4	44.2
Suburban departments	311	50	68	83	110	16.1	21.9	26.7	35.4	322	71	94	70	87	22.0	29.2	21.7	27.0
Rural departments	343	55	89	106	93	16.0	25.9	30.9	27.1	502	77	130	160	135	15.3	25.9	31.9	26.9
BOLIVIA																		
La Paz	608	301	150	65	92	49.5	24.7	10.7	15.1	991	573	221	92	105	57.8	22.3	9.3	10.6
Vincha	35	17	11	2	5	48.6	31.4	5.7	14.3	53	26	15	5	7	49.1	28.3	9.4	13.2
BRAZIL																		
Recife	885	58	156	200	471	6.6	17.6	22.6	53.2	1,458	147	337	351	623	10.1	23.1	24.1	42.7
Ribeirão Prêto																		
Ribeirão Prêto (city)	199	17	43	48	91	8.5	21.6	24.1	45.7	159	29	50	45	35	18.2	31.4	28.3	22.0
Franca	159	15	36	51	57	9.4	22.6	32.1	35.8	140	17	41	42	40	12.1	29.3	30.0	28.6
Communities	93	9	15	15	54	9.7	16.1	16.1	58.1	82	7	23	20	32	8.5	28.0	24.4	39.0
São Paulo	1,672	256	667	428	321	15.3	39.9	25.6	19.2	1,518	360	659	301	198	23.7	43.4	19.8	13.0
CANADA																		
Sherbrooke	200	2	6	20	172	1.0	3.0	10.0	86.0	72	1	1	7	63	1.4	1.4	9.7	87.5
CHILE																		
Santiago	569	113	131	73	252	19.9	23.0	12.8	44.3	859	264	211	131	253	30.7	24.6	15.3	29.5
Comunas	56	14	22	14	6	25.0	39.3	25.0	10.7	110	27	38	20	25	24.5	34.5	18.2	22.7
COLOMBIA																		
Cali	361	129	53	45	134	35.7	14.7	12.5	37.1	424	180	104	61	79	42.5	24.5	14.4	18.6
Cartagena	203	54	65	38	46	26.6	32.0	18.7	22.7	353	136	135	50	32	38.5	38.2	14.2	9.1
Medellín	260	40	48	37	135	15.4	18.5	14.2	51.9	388	92	68	79	149	23.7	17.5	20.4	38.4
EL SALVADOR																		
San Salvador	680	510	68	40	62	75.0	10.0	5.9	9.1	1,321	1,115	91	55	60	84.4	6.9	4.2	4.5
Rural *municipios*	184	165	14	4	1	89.7	7.6	2.2	0.5	430	382	34	11	3	88.8	7.9	2.6	0.7
JAMAICA																		
Kingston-St. Andrew	877	586	160	56	75	66.8	18.2	6.4	8.6	542	369	93	45	35	68.8	17.2	8.3	6.5
MEXICO																		
Monterrey	924	190	404	183	147	20.6	43.7	19.8	15.9	1,485	471	678	208	128	31.7	45.7	14.0	8.6

[a] In families in which home interviews were conducted and information was provided.

four or more rooms. At the other extreme, in San Salvador and rural *municipios* of El Salvador 75.0 and 89.7 per cent of these families lived in one room. In general families of infants dying in the neonatal period appeared to have homes with more rooms than those of infants dying in the postneonatal period. Since the data were collected according to standard definitions, there appear to be distinct differences between the two groups of families with respect to housing, even in areas where mortality was excessive, as in Recife and San Salvador.

Just as number of rooms in household varied widely, number of persons per room showed great variation in these areas (Table 190). For families of infants dying in the postneonatal period, the areas with the

TABLE 190. Number of Persons per Room in Households of Infants[a] Dying in Neonatal and Postneonatal Periods in 22 Areas of 14 Projects.

Area	Neonatal period											Postneonatal period										
	Total families	Number					Per cent					Total families	Number					Per cent				
		Less than 1	1	2	3	4 and over	Less than 1	1	2	3	4 and over		Less than 1	1	2	3	4 and over	Less than 1	1	2	3	4 and over
Total	9,220	1,144	2,847	2,207	1,201	1,821	12.4	30.9	23.9	13.0	19.8	12,043	722	3,058	2,851	1,923	3,489	6.0	25.4	23.7	16.0	29.0
ARGENTINA																						
Chaco Province																						
Resistencia	298	18	77	66	46	91	6.0	25.8	22.1	15.4	30.5	398	3	59	116	93	127	0.8	14.8	29.1	23.4	31.9
Rural departments	233	12	35	67	46	73	5.2	15.0	28.8	19.7	31.3	403	15	63	84	90	151	3.7	15.6	20.8	22.3	37.5
San Juan Province																						
San Juan (city)	145	23	82	16	14	10	15.9	56.6	11.0	9.7	6.9	103	16	43	23	9	12	15.5	41.7	22.3	8.7	11.7
Suburban departments	309	43	110	81	30	45	13.9	35.6	26.2	9.7	14.6	321	23	108	72	58	60	7.2	33.6	22.4	18.1	18.7
Rural departments	343	40	110	94	54	45	11.7	32.1	27.4	15.7	13.1	500	36	164	150	67	83	7.2	32.8	30.0	13.4	16.6
BOLIVIA																						
La Paz	602	69	149	176	83	125	11.5	24.8	29.2	13.8	20.8	978	57	230	302	172	217	5.8	23.5	30.9	17.6	22.2
Viacha	35	1	11	14	6	3	2.9	31.4	40.0	17.1	8.6	53	3	18	18	7	7	5.7	34.0	34.0	13.2	13.2
BRAZIL																						
Recife	878	156	417	198	65	42	17.8	47.5	22.6	7.4	4.8	1,456	122	652	405	140	137	8.4	44.8	27.8	9.6	9.4
Ribeirão Prêto																						
Ribeirão Prêto (city)	197	37	91	38	17	14	18.8	46.2	19.3	8.6	7.1	159	10	63	39	21	26	6.3	39.6	24.5	13.2	16.4
Franca	158	24	75	36	13	10	15.2	47.5	22.8	8.2	6.3	139	16	60	38	13	12	11.5	43.2	27.3	9.4	8.6
Communities	90	22	44	14	5	5	24.4	48.9	15.6	5.6	5.6	80	12	31	16	12	9	15.0	38.8	20.0	15.0	11.2
São Paulo	1,658	292	690	386	155	145	17.6	41.6	23.3	9.3	8.7	1,503	126	520	409	218	230	8.4	34.6	27.2	14.5	15.3
CANADA																						
Sherbrooke	190	34	93	60	3	—	17.9	48.9	31.6	1.6	—	67	43	22	1	1	—	64.2	32.8	1.5	1.5	—
CHILE																						
Santiago	561	126	214	117	61	43	22.5	38.1	20.9	10.9	7.7	850	87	279	244	124	116	10.2	32.8	28.7	14.6	13.6
Comunas	56	2	11	23	11	9	3.6	19.6	41.1	19.6	16.1	109	4	31	30	23	21	3.7	28.4	27.5	21.1	19.3
COLOMBIA																						
Cali	356	76	87	81	42	70	21.3	24.4	22.8	11.8	19.7	417	37	95	103	93	89	8.9	22.8	24.7	22.3	21.3
Cartagena	201	10	55	45	38	53	5.0	27.4	22.4	18.9	26.4	352	7	53	62	71	159	2.0	15.1	17.6	20.2	45.2
Medellín	254	52	75	61	27	39	20.5	29.5	24.0	10.6	15.4	383	38	107	95	53	90	9.9	27.9	24.8	13.8	23.5
EL SALVADOR																						
San Salvador	677	20	73	131	114	339	3.0	10.8	19.4	16.8	50.1	1,318	16	88	103	203	818	1.2	6.7	14.6	15.4	62.1
Rural *municipios*	181	—	3	24	19	138	—	1.6	13.0	10.3	75.0	430	—	8	42	69	311	—	1.9	9.8	16.0	72.3
JAMAICA																						
Kingston-St. Andrew	874	28	137	255	192	262	3.2	15.7	29.2	22.0	30.0	540	5	82	118	108	227	0.9	15.2	21.9	20.0	42.0
MEXICO																						
Monterrey	921	69	208	224	160	260	7.5	22.6	24.3	17.4	28.2	1,484	46	282	291	278	587	3.1	19.0	19.6	18.7	39.6

[a] In families in which home interviews were conducted and information was provided.

highest percentages of households with four or more persons per room were as follows:

El Salvador, rural *municipios*	72.3
San Salvador	62.1
Cartagena	45.2
Kingston-St. Andrew	42.0
Monterrey	39.6
Chaco Province, rural	37.5

The following had the lowest percentages:

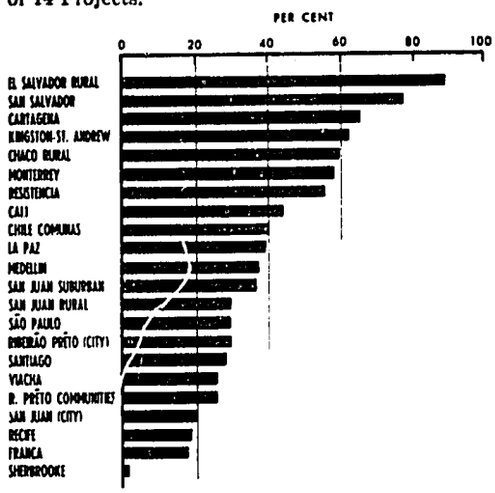
San Juan (city)	11.7
Ribeirão Prêto communities	11.2
Recife	9.4
Franca	8.6

In Sherbrooke none of the families had as many as four persons per room.

These percentages did not appear to be closely related to mortality. In Figure 162 the percentages with three or more persons per room among families of infants dying in the postneonatal period are shown in descending order. Kingston-St. Andrew, which had a relatively favorable death rate in the postneonatal period, was fourth in order. In contrast, Recife, with an excessive postneonatal death rate, had one of the lowest percentages (19.0) of families with at least three persons per room.

While there appeared to be no consistent relationship of these findings to postneonatal mortality, more families of infants dying in the postneonatal period had households with three or more persons per room than did families of infants in the neonatal

FIG. 162. Percentage of Households with Three or More Persons per Room among Families of Infants Dying in Postneonatal Period in 22 Areas of 14 Projects.



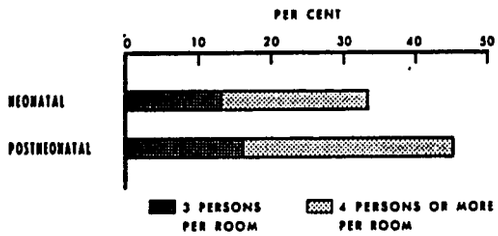
group (Table 191 and Figure 163). The percentages for the two groups—postneonatal and neonatal—were 29.1 and 20.2 for four or more persons per room and 16.0 and 13.3 for three persons per room, thereby indicating greater crowding in families with postneonatal deaths than in those with neonatal deaths.

* * *

TABLE 191. Percentage Distribution of Persons per Room in Families of Infants Dying in Neonatal and Postneonatal Periods in 13 Latin American Projects Combined.

Persons per room	Neonatal period	Postneonatal period
Less than 1	12.3	5.7
1	30.5	25.4
2	23.8	23.8
3	13.3	16.0
4 or more	20.2	29.1

FIG. 163. Percentage of Households with at Least Three Persons per Room among Families of Infants Dying in Neonatal and Postneonatal Periods in 13 Latin American Projects Combined.



These findings, as well as those presented earlier in this chapter, indicate that environmental conditions were less favorable for the families of infants dying in the postneonatal period. Significant inverse correlations were obtained between percentage of families of such infants served with piped water and postneonatal death rates.

Concentration of mortality under 5 years in the neonatal period was noted in families with piped water inside the house and flush toilets. In fact, in five of the Latin American areas more than 60 per cent of the deaths of children under 5 years in such families occurred in the neonatal period—a favorable relationship such as that found in areas with low death rates in infancy and early childhood. In contrast, in families without water and toilet facilities high proportions of the deaths occurred in the age periods when unfavorable environmental conditions combined with susceptibility to infectious agents result in high death rates. The provision of water supplies and sanitary facilities to much higher proportions of families in many urban and rural areas is essential for bringing about major reductions in postneonatal mortality.

Chapter XVII

Changes in Assignments of Causes of Death

In this Investigation an important contribution to knowledge of causes leading to death in childhood was made by the additional clinical and pathological data obtained from hospital, clinical, and autopsy records and from interviews in the homes of deceased children. An analysis can now be made in order to appraise the value of this additional information for the correct assignment of underlying causes and to formulate practical recommendations for improving mortality statistics, so they may serve as the basis for planning health programs and evaluating progress as well as for research into the etiology and epidemiology of disease.

The changes in assignments of causes of death resulting from the additional information obtained are made clear by a comparison of the final assignments with those derived from data on the death certificates. In eight of the projects (Chaco and San Juan Provinces, Bolivia, Recife, São Paulo, Sherbrooke, Chile, and Kingston-St. Andrew) a copy of the death certificate was attached to the completed questionnaire* for each death, and in six others (Ribeirão Prêto, Cali, Cartagena, Medellín, Monterrey, and California) the data were transferred from the certificate to a section (page 9) of the questionnaire. In the El Salvador project such additional information was not available for the complete series of deaths. Therefore, the following account of changes in assignments of underlying causes is given for 14 projects.

* The questionnaire is reproduced in Appendix 1.

PROCEDURES FOR CLASSIFYING CAUSES OF DEATH

Procedures for the classification of underlying causes as well as associated causes, both those contributing to and those considered consequences of the events leading to death, were established in the initial planning phase of the Investigation. A Planning Conference specifically devoted to problems of medical histories and certification was held in October 1968 to lay down these procedures. It was agreed that complete and comparable information from clinical histories, autopsy protocols, and home interviews would have to be recorded routinely on the questionnaires. Such complete information for the assignment of multiple causes was considered essential for the success of the Investigation, as well as for future activities of the principal collab-

orators to improve medical certification in their respective areas.

Each principal collaborator was responsible for reviewing all the information obtained and for entering, on the final page of the questionnaire, a summary of the assignments made by the local staff of underlying and associated causes in each death. The principal collaborators organized and carried out this work in various ways. In the Bolivia project, for example, a group of specialists comprising a pathologist, a pediatrician, the medical interviewers, and the principal collaborator reviewed the completed questionnaires and assigned causes at staff conferences held once a week. These meetings were similar to the clinical pathology conferences often held routinely as part of the teaching program in university hospitals.

The information provided on the international form of medical certificate of cause of death* was used in classifying the underlying cause in accordance with the Rules for Classification set forth in the *International Classification of Diseases*, Eighth Revision (WHO, 1967, pp. 415–436). In accordance with the general rule, the condition entered on the lowest used line of Part I of the form would be the underlying cause selected, unless it was highly improbable that this condition could have given rise to all the conditions entered on the lines above it. This selection of underlying cause frequently could differ from the original local classification as a result of lack of knowledge of the international rules or failure to apply them at the local level. Such differences, which could be analyzed locally in each project, are not considered in this report.

After the underlying cause was selected on the basis of the information appearing on the death certificate, all of the clinical and pathological information as well as the reports of medical interviews in the home were taken into account in order to make the final assignment.

Standard procedures for the final assignment of underlying and associated causes were established in the Washington Office of the Pan American Health Organization. One of the physicians† who had reviewed more than 20,000 questionnaires in the first Inter-American Investigation of Mortality (of adults) helped to develop the procedures for assigning associated causes and also reviewed several thousand questionnaires on which underlying and associated causes were classified. The review of these questionnaires and classifications proved more complicated and time-consuming than in the first Investigation, principally because of the difficulty of determining associated causes involved in the fatal outcome. Two principal collaborators and three other medical officers from the field staff of projects also assisted in this review and assignment of causes. To ensure consistency, all assignments were reviewed in the Washington Office.

*In Bolivia, where the international form was not used, the underlying cause from the death certificate was determined on the basis of the logical sequence of events.

†Dr. Darío Curiel of Caracas, Venezuela.

INFORMATION AVAILABLE FOR ASSIGNMENTS

In the 14 projects included in this analysis, there were 31,275 deaths, or 89.1 per cent of the total of 35,095 deaths of children under 5 years of age studied in the Investigation (Table 192). Clinical and other information in addition to death certificate

TABLE 192. Information Available for Final Assignment of Causes of Death of Children Under 5 Years, by Age Group, in 14 Projects Combined.

Age group	Total deaths[a]		Clinical or other information and death certificate		Death certificate only		Clinical or other information only	
	No.	%	No.	%	No.	%	No.	%
Under 5 years	31,275	100.0	27,082	86.6	2,001	6.4	2,192	7.0
Neonatal	11,757	99.9	9,714	82.6	558	4.7	1,485	12.6
Postneonatal	13,103	100.0	11,767	89.8	911	7.0	425	3.2
1–4 years	6,415	100.0	5,601	87.3	532	8.3	282	4.4

[a] Excluding deaths in El Salvador project.

was available for comparison of the classifications of 27,082 deaths, or 86.6 per cent of the 31,275. For the remainder only one type of information was found: for 2,001, the death certificate only; and for 2,192 deaths, other information only, the latter being deaths that were not registered or for which no certificates were found. Data from both sources of information were available for higher proportions of the deaths occurring in the postneonatal period (89.8 per cent) and at 1-4 years of age (87.3) than of neonatal deaths (82.6). Deaths in the neonatal age group comprised 35.9 per cent of the total included in this comparative study of assignments.

Table 193 shows the types of information available for these assignments in each

TABLE 193. Information Available for Final Assignment of Causes of Death of Children Under 5 Years of Age in 14 Projects.

Project	Total deaths		Clinical or other information and death certificate		Death certificate only		Clinical or other information only	
	No.	%	No.	%	No.	%	No.	%
Total	31,275	100.0	27,082	86.6	2,001	6.4	2,192	7.0
ARGENTINA								
Chaco Province	1,701	100.0	1,490	87.6	126	7.4	85	5.0
San Juan Province	2,156	100.0	1,898	88.0	36	1.7	222	10.3
BOLIVIA project	4,276	100.0	3,180	74.4	565	13.2	531	12.4
BRAZIL								
Recife	3,635	100.0	3,310	91.1	223	6.1	102	2.8
Ribeirão Prêto	1,126	100.0	1,103	98.0	5	0.4	18	1.6
São Paulo	4,312	100.0	4,242	98.4	44	1.0	26	0.6
CANADA								
Sherbrooke	371	100.0	314	84.6	7	1.9	50	13.5
CHILE project	2,714	100.0	2,242	82.6	127	4.7	345	12.7
COLOMBIA								
Cali	1,627	99.9	1,367	84.0	191	11.7	69	4.2
Cartagena	1,255	100.0	956	76.2	45	3.6	254	20.2
Medellín	1,348	100.0	1,104	81.9	180	13.4	64	4.7
JAMAICA								
Kingston-St. Andrew	1,903	100.0	1,630	85.7	56	2.9	217	11.4
MEXICO								
Monterrey	3,953	100.0	3,348	84.7	396	10.0	209	5.3
UNITED STATES								
California project	898	100.0	898	100.0	—	—	—	—

of the 14 projects. In the California project clinical or other records as well as death certificates were available for all deaths; in São Paulo and Ribeirão Prêto both were available for 98.4 and 98.0 per cent of the total respectively. In only two projects, Bolivia and Cartagena, was this percentage less than 80. In Cartagena, however, death certificates were the single source for only 45 deaths (3.6 per cent) while clinical and pathological records were the source for nearly all of the remaining 254 (20.2 per cent); except for one death known to have a certificate that was not available, the rest of these (253) were deaths that were not registered. Although for these deaths the hospital records were well completed, they do not contribute to this present analysis.

In this study of the changes in assignments, the data relate only to 27,082 deaths for which death certificates as well as clinical or other information were available in the 14 projects.

AGREEMENT WITH UNDERLYING CAUSE FROM DEATH CERTIFICATE

For slightly more than one half the deaths (52.5 per cent) the final assignment of underlying cause was in agreement with the underlying cause derived from the death certificate (Table 194). This concordance of assignment represents general agreement with a category within the same group—e.g., nutritional deficiency unqualified (269), with one of the categories in group 260–269—as well as specific agreement with the same three-digit category—e.g., protein malnutrition (267). For a disease such as measles there was only specific agreement with a three-digit category (055).

In 8,119 deaths, or nearly a third of the total, the underlying cause assigned on the death certificate was considered an associated cause on final assignment. In the remaining 4,741 deaths (17.5 per cent) there was no agreement of the underlying cause on the death certificate with either the

TABLE 194. Agreement of Underlying Causes Based on Death Certificates with the Final Assignments in Children Under 5 Years, by Age Group, in 14 Projects Combined.

Age group	Total deaths[a]		Agreement with underlying cause		Agreement with associated cause		No agreement	
	No.	%	No.	%	No.	%	No.	%
Under 5 years	27,082	100.0	14,222	52.5	8,119	30.0	4,741	17.5
Neonatal	9,714	100.0	4,003	41.2	3,671	37.8	2,040	21.0
Postneonatal	11,767	100.0	6,964	59.2	2,953	25.1	1,850	15.7
1–4 years	5,601	100.0	3,255	58.1	1,495	26.7	851	15.2

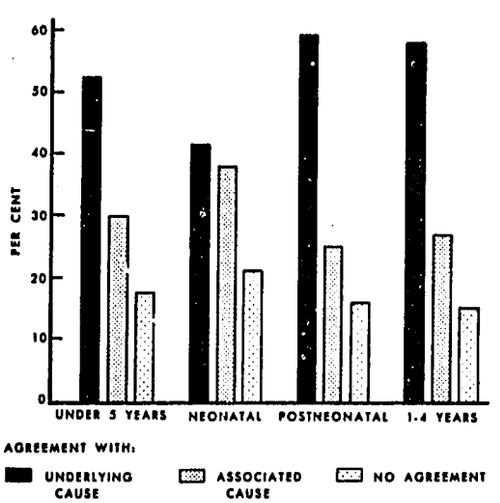
[a] Includes only deaths with information available from death certificates and from other sources.

underlying or an associated cause on final assignment.

Agreement was greater for the postneonatal deaths and those at 1–4 years of age (59.2 and 58.1, respectively) than for neonatal deaths (41.2 per cent). This was to be expected, since infectious diseases and external causes occurring after the neonatal period are more readily recognized and diagnosed than certain of the perinatal causes. The problems encountered in classifying the perinatal causes are discussed later in this chapter.

The agreement of assignments, by age group, is shown in Figure 164. The first bar in each group is the critical one, measuring the amount of agreement that the final assignment of underlying cause on the basis of all available information would have with the underlying cause derived from the death certificate after coding in accordance with international rules. The percentages for neonatal deaths (41.2) and those in the other two age groups combined (58.8) indicate that statistics on underlying causes of death are not satisfactory enough at the present time to give a true and realistic picture of causes as the basis for health planning. Actually, these data from death certificates are probably superior to those for a country as a whole, as the quality of such information in rural areas is even poorer. For sound health planning, it is essential to improve the quality of medical certification as well as the completeness of registration, or else to obtain data for planning from other sources, such as through sampling surveys or through specific research programs.

FIG. 164. Agreement of Underlying Causes Based on Death Certificates with the Final Assignments in Children Under 5 Years, by Age Group, in 14 Projects Combined.



In the individual projects (Table 195 and Figure 165) the general agreement of underlying cause on death certificate with that on final assignment for all the deaths under 5 years of age varied from 46.3 per cent in Chaco Province to 64.3 per cent in Sherbrooke. In eight projects 50.2 per cent or more of the underlying causes were in general agreement and in the remaining six projects less than half.

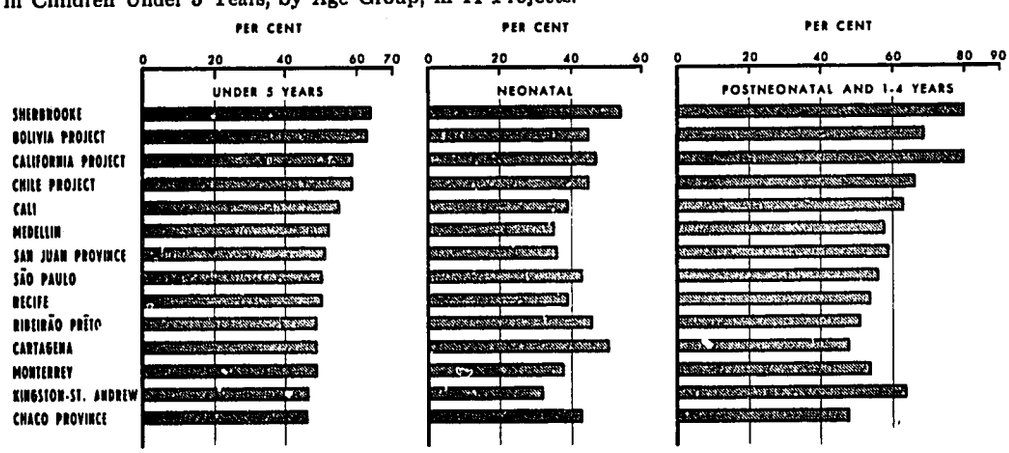
In only eight projects was there as much as 40 per cent agreement for deaths in the neonatal period, while in the postneonatal and 1–4 year age group six projects had at least 60 per cent agreement (California, Sherbrooke, Bolivia, Chile, Kingston-St. Andrew, and Cali).

These percentages indicate lack of understanding of the value of correctly stating underlying cause on the death certificate. The agreement of underlying cause on the certificate with associated cause assigned in the Investigation indicated that many times one of the consequences (such as pneumonia) was given on the certificate instead of the underlying cause. Hospitals should set up clinical-pathological conferences and institute procedures for providing the certifying physicians with all available

TABLE 195. Agreement of Underlying Causes Based on Death Certificates with the Final Assignments in Children Under 5 Years, by Age Group, in 14 Projects.

Project	Under 5 years			Neonatal			Postneonatal and 1–4 years		
	Total deaths	Agreement		Total deaths	Agreement		Total deaths	Agreement	
		No.	%		No.	%		No.	%
Total	27,082	14,222	52.5	9,714	4,003	41.2	17,368	10,219	58.8
ARGENTINA									
Chaco Province	1,490	690	46.3	460	196	42.6	1,030	494	48.0
San Juan Province	1,898	961	50.6	732	267	36.5	1,166	694	59.5
BOLIVIA project	3,180	2,010	63.2	729	326	44.7	2,451	1,684	68.7
BRAZIL									
Recife	3,310	1,642	49.6	943	370	39.2	2,367	1,272	53.7
Ribeirão Prêto	1,103	542	49.1	505	235	46.5	598	307	51.3
São Paulo	4,242	2,130	50.2	1,909	816	42.7	2,333	1,314	56.3
CANADA									
Sherbrooke	314	202	64.3	188	101	53.7	126	101	80.2
CHILE project	2,242	1,324	59.1	790	358	45.3	1,452	966	66.5
COLOMBIA									
Cali	1,367	755	55.2	435	168	38.6	932	587	63.0
Cartagena	956	469	49.1	193	99	51.3	763	370	48.5
Medellín	1,104	570	51.6	310	110	35.5	794	460	57.9
JAMAICA									
Kingston-St. Andrew	1,630	759	46.6	884	280	31.7	746	479	64.2
MEXICO									
Monterrey	3,348	1,635	48.8	1,066	407	38.2	2,282	1,228	53.8
UNITED STATES									
California project	898	533	59.4	570	270	47.4	328	263	80.2

FIG. 165. Agreement of Underlying Causes Based on Death Certificates with the Final Assignments in Children Under 5 Years, by Age Group, in 14 Projects.



data obtained in order to ensure that underlying causes are stated on death certificates. Here is a challenge for medical educators, who are ideally placed to contribute toward improvement in the quality of medical certification.

CHANGES ON FINAL ASSIGNMENT, BY CAUSES

Analysis of the changes on final assignment, by causes, shows that important health problems were uncovered by using the clinical information available in hospitals and from autopsy records and by questioning the families to learn of the events leading to death. Five groups of causes are presented in Table 196: infective and parasitic diseases, nutritional deficiency, certain perinatal causes, congenital anomalies, and all other causes, for the 14 projects combined.

Of the five groups, the major shifts were in the group of infective and parasitic diseases, with 2,084 more deaths included in these categories on final assignment than on the basis of death certificates—a 23-percent increase. A small increase of 6 per cent was noted in the group of certain perinatal causes, and an increase of 15 per cent in congenital anomalies. The shifts to these three groups with increases were from nutritional deficiency and from the group of other causes, in which there were large decreases of 34 and 23 per cent, respectively.

The changes in causes within each of the groups are considered in the sections that follow.

TABLE 196. Five Groups of Underlying Causes Based on Death Certificates and on Final Assignments, with Ratios,[a] in Children Under 5 Years of Age in 14 Projects Combined.

Cause group	Death certificate	Final assignment	Ratio
Total deaths[b]	27,082	27,082	1.00
Infective and parasitic diseases ... 000–136	9,055	11,139	1.23
Nutritional deficiency ... 260–269	1,336	881	0.66
Certain perinatal causes ... 760–778	5,879	6,231	1.06
Congenital anomalies ... 740–759	1,378	1,590	1.15
All other causes	9,434	7,241	0.77

[a] Ratio of deaths on final assignment to those from death certificates.
[b] Includes only deaths with information available from death certificates and from other sources.

INFECTIVE AND PARASITIC DISEASES

Data for five specific diseases and two groups of the infective and parasitic diseases are given for the 14 projects combined and for each project in Table 197. The ratios of numbers of deaths on final assignment to those on the basis of death certificates are given also; the ratio of 1.23 for the group of infective and parasitic diseases indicates an increase on final assignment of 23 per cent. The ratios for the group of infectious diseases as a whole were largest for Ribeirão Prêto (1.70) and Chaco Province (1.55), followed by São Paulo, San Juan Province, and Monterrey. These high ratios indicate a lack of statement of the underlying causes on the death certificates,

TABLE 197. Deaths Assigned to Infective and Parasitic Diseases as Underlying Causes Based on Death Certificates and on Final Assignments, with Ratios,[a] in Children Under 5 Years of Age in 14 Projects.

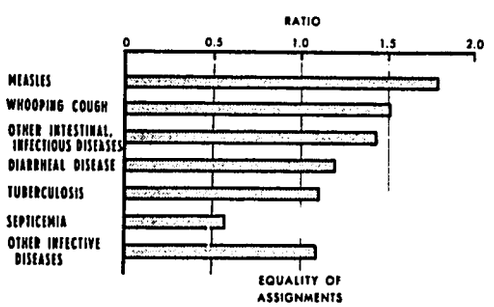
Project	Deaths		Ratio	Deaths		Ratio	Deaths		Ratio	Deaths		Ratio
	Certificate	Final		Certificate	Final		Certificate	Final		Certificate	Final	
	Infective and parasitic diseases (000-136)			Diarrheal disease (009)			Other intestinal infectious diseases (000-008)			Tuberculosis (010-019)		
Total[b]	9,055	11,139	1.23	6,208	7,455	1.20	318	457	1.44	266	292	1.10
ARGENTINA												
Chaco Province	457	710	1.55	340	555	1.63	1	2	#	34	36	1.06
San Juan Province	499	676	1.35	325	486	1.50	2	3	#	6	11	1.83
BOLIVIA project	1,219	1,508	1.24	642	893	1.39	24	10	0.42	61	52	0.85
BRAZIL												
Recife	1,670	1,776	1.06	1,226	1,155	0.94	119	17	0.14	31	59	1.90
Ribeirão Prêto	248	422	1.70	190	332	1.75	8	5	#	3	2	#
São Paulo	1,140	1,623	1.42	863	1,198	1.39	10	69	6.90	25	26	1.04
CANADA												
Sherbrooke	6	6	#	3	3	#	—	—	—	—	—	—
CHILE project	675	675	1.00	434	501	1.15	22	47	2.14	8	8	#
COLOMBIA												
Cali	576	591	1.03	429	407	0.95	5	21	4.20	19	17	0.89
Cartagena	439	482	1.10	292	272	0.93	14	36	2.57	8	8	#
Medellín	441	491	1.11	325	339	1.04	13	27	2.08	13	12	0.92
JAMAICA												
Kingston-St. Andrew	403	487	1.21	329	346	1.05	3	11	3.67	1	3	#
MEXICO												
Monterrey	1,239	1,644	1.33	803	956	1.19	97	209	2.15	57	58	1.02
UNITED STATES												
California project	43	48	1.12	7	12	1.71	—	—	—	—	—	—
	Whooping cough (033)			Septicemia (038)			Measles (055)			Other infective and parasitic diseases (rest of 000-136)		
Total[b]	149	227	1.52	573	322	0.56	984	1,777	1.81	557	609	1.09
ARGENTINA												
Chaco Province	19	18	0.95	10	7	0.70	18	50	2.78	35	42	1.20
San Juan Province	14	20	1.43	55	22	0.40	65	93	1.43	32	41	1.28
BOLIVIA project	45	38	0.84	17	18	1.06	403	476	1.18	27	21	0.78
BRAZIL												
Recife	3	28	9.33	36	21	0.58	143	381	2.66	112	115	1.03
Ribeirão Prêto	1	7	#	5	6	#	26	46	1.77	15	24	1.60
São Paulo	19	35	1.84	68	38	0.56	91	156	1.71	64	101	1.58
CANADA												
Sherbrooke	—	—	—	—	—	—	—	1	#	3	2	#
CHILE project	6	7	#	157	56	0.36	11	21	1.91	37	35	0.95
COLOMBIA												
Cali	7	12	1.71	25	13	0.52	45	77	1.71	46	44	0.96
Cartagena	10	17	1.70	23	14	0.61	44	99	2.25	48	36	0.75
Medellín	2	3	#	27	5	0.19	28	81	2.89	33	24	0.73
JAMAICA												
Kingston-St. Andrew	14	17	1.21	14	57	4.07	6	7	#	36	46	1.28
MEXICO												
Monterrey	8	24	3.00	118	53	0.45	104	288	2.77	52	56	1.08
UNITED STATES												
California project	1	1	#	18	12	0.67	—	1	#	17	22	1.29

[a] Ratio of deaths on final assignment to those assigned from death certificates.
[b] Includes only deaths with information available from death certificates and from other sources.
Ratio not computed for less than 10 deaths by each assignment

in this case infectious diseases. All projects except those in Chile and Sherbrooke had some net understatement of infectious diseases.

The ratios of final assignment to death certificate assignment are shown in Figure 166 for five infectious diseases and two groups of the remaining infectious diseases. The largest increase was noted for measles (81 per cent). The increase for whooping cough of 52 per cent indicated that this communicable disease of childhood was understated as well. Increases were noted also for diarrheal disease and other intestinal infectious diseases. Of the 573 deaths assigned to septicemia from death certificates, a reduction was made to 322 on the basis of additional information on a more specific underlying cause.

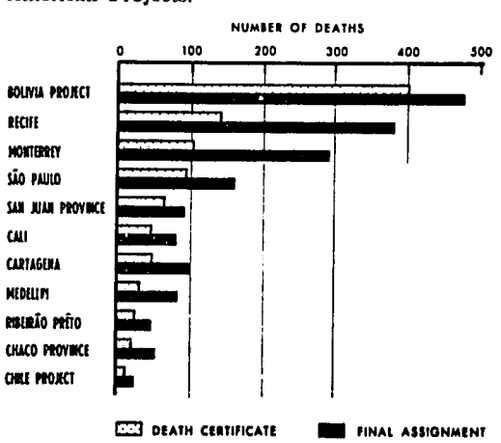
FIG. 166. Ratio of Final Assignments to Death Certificate Assignments for Infective and Parasitic Diseases as Underlying Causes in Children Under 5 Years of Age in 14 Projects Combined.



With respect to measles, the assignments increased from 984 deaths on the basis of death certificates to 1,777 on final assignment. Using the death certificates alone, only 55.4 per cent of these deaths found due to measles could have been classified as measles. This indicates a serious lack of information regarding this preventable disease. In several projects the number of measles deaths was more than doubled by the additional information; the ratios of number on final assignment to that on death certificate were 2.78 in Chaco Province, 2.66 in Recife, 2.25 in Cartagena, 2.89 in Medellín, and 2.77 in Monterrey. For these five projects the number of deaths that could have been classified as measles on the basis of death certificate was 337, while the additional information revealed 899. Therefore, the Investigation has uncovered the size of this serious problem, against which action has already been recommended by the Ministers of Health of the Americas (Pan American Health Organization, 1969). However, if the effects of the actions taken are to be properly evaluated, death certificates should in the future include this important underlying cause whenever known.

Figure 167 shows the numbers of deaths from measles derived from death certificates on final assignment for 11 of the 14 projects. Data for Kingston-St. Andrew and the two Northern American projects are not shown because of the small numbers of deaths involved.

FIG. 167. Measles as Underlying Cause Based on Death Certificates and on Final Assignments in Children Under 5 Years of Age in 11 Latin American Projects.



Although the Bolivia project appears to have the largest number of measles deaths known by death certificate, actually the term *escarlatina* (equivalent to scarlet fever in English) was frequently used by physicians and witnesses to signify measles. In the early months of the Investigation this misuse of the term was detected and so the deaths stated to be due to *sarampión* (measles) and *escarlatina* were combined to give the total on death certificates as shown in Table 197. It can thus be seen that, because of this terminology difficulty, the seriousness of the measles problem had not been known in Bolivia. Even in Chile, where a preventive program against measles had been successfully conducted, an increase was noted from 11 to 21 deaths on the basis of the additional information.

For the 1,777 deaths due to measles on final assignment, the underlying causes derived from death certificates are given in Table 198 and Figure 168. Another infectious disease was stated for 365 deaths (20.5 per cent), including 288 in which diarrheal disease was the reported cause. Pneumonia or influenza was the cause given for 287 or 16.2 per cent. In Chapter VIII it was shown that pneumonia and diarrheal disease were frequently found to be intermediate or terminal complications (consequences) of measles. Confusion of underlying cause with terminal condition, often called the direct cause of death by the certifying physician, is common. The percentage distribution of these other underlying causes stated on death certificates for the 1,777 deaths due to measles, in which at least one additional source of information was used for the final assignment, is shown in Figure 168. While significant numbers of these deaths were assigned to complications such as pneumonia or influenza (16.2 per cent) very few (4.4 per cent) were assigned to nutritional deficiency, a common contributory cause also responsible for those complications.

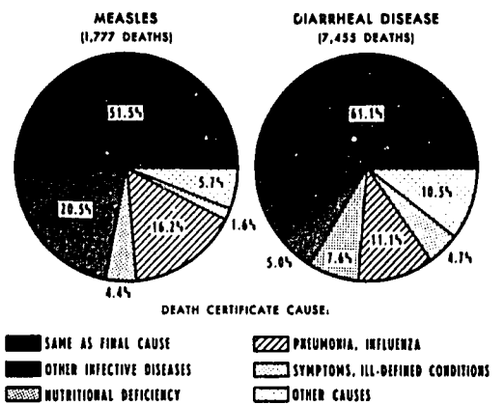
The second communicable disease with a marked increase on final assignment—52 per cent—was whooping cough. Though

TABLE 198. Final Assignments of Deaths of Children Under 5 Years of Age from Measles and Diarrheal Disease. Compared with Underlying Causes Stated on Death Certificates in 14 Projects Combined.

Death certificate cause	Final assignment			
	Measles (055)		Diarrheal disease (009)	
	No.	%	No.	%
Total deaths[a]	1,777	100.0	7,455	100.0
Same as final assignment	915	51.5	4,557	61.1
Other infective and parasitic diseases ..... Rest of 000–136	365[b]	20.5	374	5.0
Nutritional deficiency 260–269	79	4.4	570	7.6
Pneumonia and influenza 470–486	287	16.2	824	11.1
Other diseases of respiratory system 460–466, 490–519	52	2.9	147	2.0
Immaturity 777	1	0.1	135	1.8
Symptoms, ill-defined conditions 780–792, 795, 796	29	1.6	348	4.7
All other causes	49	2.8	500	6.7

[a] Includes only deaths with information available from death certificates and from other sources.
[b] Includes 288 deaths (16.2%) assigned to diarrheal disease by death certificate.

FIG. 168. Final Assignments of Deaths of Children Under 5 Years of Age from Measles and Diarrheal Disease, Compared with Underlying Causes Stated on Death Certificates in 14 Projects Combined.



the numbers were small for many of the projects, it is evident that the underlying cause of these deaths is frequently not given on death certificates. In Recife only three deaths from whooping cough could have been known from the certificates, while 28 were found on final assignment. The increase from 8 to 24 in Monterrey also points to lack of information on this communicable disease of childhood.

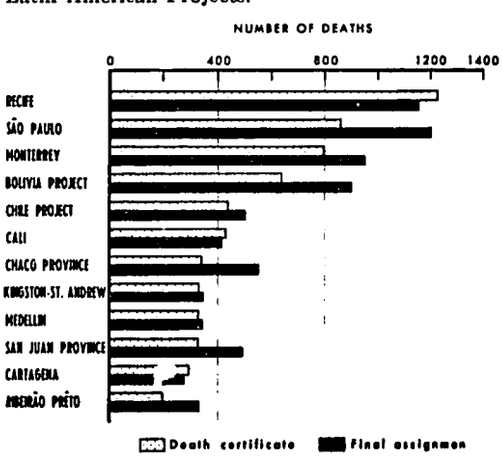
On the whole, tuberculosis was usually certified, only 10 per cent more deaths from this cause having been found on final assignment for the 14 projects combined. However, in Recife the number of deaths nearly doubled, 59 on final assignment compared with 31 on the basis of death certificates.

Diarrheal disease presents a puzzling problem. It was unexpected to find 20 per cent more deaths on final assignment than on the basis of death certificates, in spite of the fact that the final assignment disclosed that many deaths from other causes had been attributed to diarrheal disease on the certificates. In Recife, Cali, and Cartagena the numbers were larger from the death certificates, but in all other projects the reverse was noted (Figure 169). The failure to state this common and easily recognizable disease on official records is an indication of serious deficiencies in the certification of causes of death.

Of the total of 7,455 diarrheal disease deaths found on final assignment (Table 198 and Figure 168), 824 had been certified as pneumonia or influenza (11.1 per cent) and 570 as nutritional deficiency (7.6 per cent).

Septicemia was certified as underlying cause of 573 deaths while on final assignment only 322 deaths (56 per cent) were so classified (Table 197). The septicemia was often considered a consequence of other infectious conditions such as diarrheal disease, diseases of respiratory system or of skin and subcutaneous tissue, certain perinatal causes of mortality, and others. In very few deaths was septicemia considered a contributory condition.

FIG. 169. Diarrheal Disease as Underlying Cause Based on Death Certificates and on Final Assignments in Children Under 5 Years of Age in 12 Latin American Projects.



NUTRITIONAL DEFICIENCY

More deaths were attributed to this important group on death certificates than on final assignment—1,336 compared with 881 (Table 199). This reduction was due principally to the rules and procedures followed in the Investigation whereby the infectious disease was considered as underlying cause and the nutritional deficiency as contributory cause. Thus, if measles or diarrheal disease initiated the chain of events leading to death they were assigned as underlying cause. Marked differences were noted among the projects, with large increases occurring in Recife and Cali.

On the basis of death certificates, 1,336 deaths were assigned to nutritional deficiency and only in one fifth of these (262 deaths) were the specific types stated, namely, protein malnutrition (category 267) with 96 deaths and nutritional marasmus (category 268) with 166 deaths. Differentiation between types of nutritional de-

TABLE 199. Deaths Assigned to Nutritional Deficiency as Underlying Cause Based on Death Certificates and on Final Assignments, with Ratios,[a] in Children Under 5 Years of Age in 14 Projects.

Project	Deaths		Ratio	Deaths		Ratio	Deaths		Ratio	Deaths		Ratio
	Certificate	Final		Certificate	Final		Certificate	Final		Certificate	Final	
	Nutritional deficiency (260-269)			Protein malnutrition (267)			Nutritional marasmus (268)			Other nutritional deficiency (260-266, 269)		
Total[b]	1,336	881	0.66	96	504	5.25	166	344	2.07	1,074	33	0.03
ARGENTINA												
Chaco Province	161	43	0.27	7	16	2.29	19	19	1.00	135	8	0.06
San Juan Province	140	63	0.45	1	8	#	21	52	2.48	118	3	0.03
BOLIVIA project	149	53	0.36	18	26	1.44	18	26	1.44	113	1	0.01
BRAZIL												
Recife	94	137	1.46	37	100	2.70	6	36	6.00	51	1	0.02
Ribeirão Prêto	64	25	0.39	6	15	2.50	10	10	1.00	48	—	*
São Paulo	237	99	0.42	12	29	2.42	60	59	0.98	165	11	0.07
CANADA												
Sherbrooke	—	—	—	—	—	—	—	—	—	—	—	—
CHILE project	53	51	0.96	4	11	2.75	9	39	4.33	40	1	0.02
COLOMBIA												
Cali	78	116	1.49	1	84	84.00	6	30	5.00	71	2	0.03
Cartagena	88	107	1.22	3	88	29.33	2	15	7.50	83	4	0.05
Medellín	63	59	0.94	—	44	*	4	15	3.75	59	—	*
JAMAICA												
Kingston-St. Andrew	62	56	0.90	4	34	8.50	4	21	5.25	54	1	0.02
MEXICO												
Monterrey	147	72	0.49	3	49	16.33	7	22	3.14	137	1	0.01
UNITED STATES												
California project	—	—	—	—	—	—	—	—	—	—	—	—

[a] Ratio of deaths on final assignment to those assigned from death certificates.
[b] Includes only deaths with information available from death certificates and from other sources.
Ratio not computed for less than 10 deaths by each assignment.
* More than 10 deaths by one assignment, none by the other.

TABLE 200. Final Assignments of Deaths of Children Under 5 Years of Age from Two Types of Nutritional Deficiency, Compared with Underlying Causes Stated on Death Certificates in 14 Projects Combined.

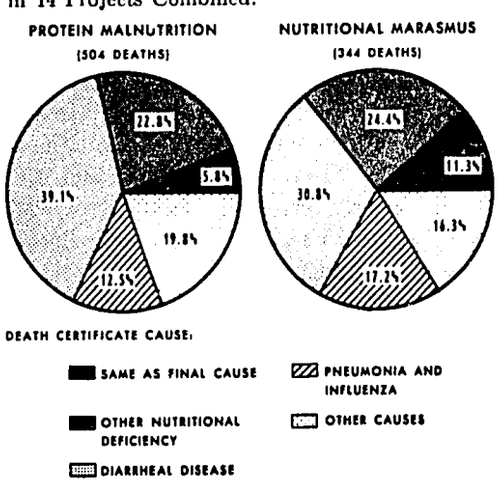
Death certificate cause	Final assignment			
	Protein malnutrition (267)		Nutritional marasmus (268)	
	No.	%	No.	%
Total deaths[a]	504	100.0	344	100.0
Protein malnutrition 267	29	5.8	6	1.7
Nutritional marasmus 268	5	1.0	39	11.3
Other nutritional deficiency 260–266, 269	110	21.8	78	22.7
Diarrheal disease 009	197	39.1	106	30.8
Pneumonia and influenza 470–486	63	12.5	59	17.2
All other causes	100	19.8	56	16.3

[a] Includes only deaths with information available from death certificates and from other sources.

ficiency is important for preventive action according to severity of condition and age affected.

Within the group of nutritional deficiency, the final assignments to protein malnutrition were more than five times the number assigned from death certificates (504 and 96, respectively). Likewise, for nutritional marasmus, the increase was from 166 to 344 deaths. Table 200 and Figure 170 show the causes stated on death certificates for these deaths from protein malnutrition and nutritional marasmus. More than 50 per cent of all the deaths found due to protein malnutrition as underlying cause had been classed as diarrheal disease or in the group of pneumonias and influenza, and 22.8 per cent had been classed as other forms of nutritional deficiency. The deaths from nutritional marasmus had been assigned to diarrheal disease or pneumonia in 48.0 per cent of the cases and to other nutritional deficiency in 24.4 per cent. It is worth noting again that in the Investigation nutritional deficiency of all types was usually found to be an associated cause, and that only through the multiple-cause approach was it possible to measure the real magnitude of this most serious health problem in Latin America.

FIG. 170. Final Assignments of Deaths of Children Under 5 Years of Age from Protein Malnutrition and Nutritional Marasmus, Compared with Underlying Causes Stated on Death Certificates in 14 Projects Combined.



CERTAIN PERINATAL CAUSES

This broad group of causes of death presents many and varied problems (Table 201). Though the size of the group as a whole differed only slightly on final assignment from that derived from death certificates, there was great variation in the specificity within the group (Figure 171). These shifts in assignment may have deep implications in terms of recognition and definition of priority problems for planning and teaching purposes. For example, 611 deaths were assigned in the Investigation to maternal conditions but only 100 were so classified on death certificates. This represents a sixfold increase, and in some projects the ratio was even higher. In the Bolivia project, Kingston-St. Andrew, and São Paulo deaths from maternal conditions as underlying causes increased, respectively, from 1, 9, and 10 on death certificates to 37, 110, and 105 on final assignment. Knowledge of the sequence of events, including mother's condition before and during pregnancy and circumstances surrounding birth, is essential for assigning the multiple causes and for ensuring the survival and health of the product of gestation. Such relationships have been analyzed in Chapter VI.

There was a sixfold increase also in the final assignments of deaths due to difficult labor, for the 14 projects combined. In certain projects the increases were dramatic, as in Bolivia, Monterrey, Recife, and São Paulo, where the final assignments were from 12.0 to 25.3 times the numbers known from death certificates.

Other complications of pregnancy and childbirth showed a tenfold increase on final assignment as underlying causes, the most remarkable case being that of Kingston-St. Andrew, where one such death was recorded on the death certificate compared with 174 assigned in the Investigation using additional sources of information.

Deaths attributed to conditions of placenta and cord on final assignment were more than four times the number known from death certificates. As in the case of all the other perinatal causes mentioned, information on these conditions must be made available in order to institute preventive measures.

In contrast to these changes in the positive direction in the assignment of underlying causes, shifts in the opposite direction were observed in other groups or categories, such as birth injury without mention of cause (category 772), anoxic and hypoxic conditions (776), immaturity (777), and other conditions of newborn (778). All these conditions represent consequences of more specific causes and therefore do not constitute satisfactory underlying causes. Their diagnoses, however, are of great importance since they provide a description of the extent of damage to the child, in addition to that resulting from more specific causes susceptible of prevention. If assignments to these less specific causes and conditions have been decreased as underlying causes, their "recovery" can be obtained through the study of multiple causes, as was shown in Chapter VI.

Immaturity (category 777) presents a major problem. In the 1965 Revision of the *International Classification of Diseases* (WHO, 1967), the notes for use in primary mortality coding (page 432) include the following statement:

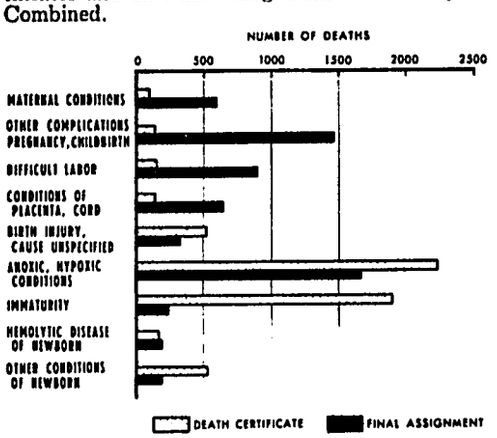
> "777 *Immaturity, unqualified*
> 778.1 *Post-maturity*
> 779.0 *Maceration*
> Not to be used if any other cause of perinatal mortality is reported."

TABLE 201. Infant Deaths from Certain Perinatal Causes as Underlying Causes Based on Death Certificates and on Final Assignments, with Ratios,[a] in 14 Projects.

Project	Deaths: Certificate	Deaths: Final	Ratio	Deaths: Certificate	Deaths: Final	Ratio	Deaths: Certificate	Deaths: Final	Ratio	Deaths: Certificate	Deaths: Final	Ratio	Deaths: Certificate	Deaths: Final	Ratio
	Total perinatal causes[c] (760–778)			Maternal conditions[c] (760–763)			Difficult labor (764–768)			Other complications pregnancy, childbirth (769)			Conditions of placenta, cord (770, 771)		
Total[b]	5,879	6,231	1.06	100	611	6.11	143	897	6.27	139	1,473	10.60	140	648	4.63
ARGENTINA															
Chaco Province	296	305	1.03	4	20	5.00	19	49	2.58	12	71	5.92	5	21	4.20
San Juan Province	442	458	1.04	4	32	8.00	20	103	5.15	20	108	5.40	14	39	2.79
BOLIVIA project	347	355	1.02	1	37	37.00	3	76	25.33	4	53	13.25	1	36	36.00
BRAZIL															
Recife	624	639	1.02	3	27	9.00	5	81	16.20	5	122	24.40	5	57	11.40
Ribeirão Prêto	361	359	0.99	7	19	2.71	15	48	3.20	1	80	80.00	7	23	3.29
São Paulo	1,072	1,119	1.04	10	105	10.50	14	168	12.00	33	247	7.48	15	96	6.40
CANADA															
Sherbrooke	124	123	0.99	3	18	6.00	4	11	2.75	10	38	3.80	8	18	2.25
CHILE project	429	506	1.18	20	37	1.85	12	69	5.75	15	126	8.40	12	60	5.00
COLOMBIA															
Cali	281	301	1.07	8	43	5.38	8	52	6.50	12	67	5.58	3	16	5.33
Cartagena	113	114	1.01	5	15	3.00	7	20	2.86	2	15	7.50	8	21	2.62
Medellín	222	248	1.12	9	33	3.67	15	32	2.13	4	68	17.00	8	35	4.38
JAMAICA															
Kingston-St. Andrew	596	640	1.08	9	110	12.22	8	54	6.75	1	174	174.00	6	30	5.00
MEXICO															
Monterrey	539	631	1.17	7	63	9.00	6	107	17.83	4	175	43.75	14	93	6.64
UNITED STATES															
California project	433	427	0.99	10	52	5.20	7	27	3.86	16	129	8.06	34	103	3.03
	Birth injury, cause unspecified[c] (772)			Hemolytic disease of newborn (774, 775)			Anoxic, hypoxic conditions (776)			Immaturity (777)			Other conditions of newborn (778)		
Total[b]	521	321	0.62	159	185	1.16	2,223	1,675	0.75	1,010	229	0.12	544	192	0.35
ARGENTINA															
Chaco Province	37	21	0.57	11	11	1.00	53	68	1.28	125	35	0.28	30	9	0.30
San Juan Province	38	29	0.76	13	18	1.38	127	96	0.76	152	8	0.05	54	25	0.46
BOLIVIA project	18	8	0.44	6	7	#	112	116	1.04	141	8	0.06	61	14	0.23
BRAZIL															
Recife	49	46	0.94	5	8	#	226	220	0.97	215	43	0.20	111	35	0.32
Ribeirão Prêto	32	14	0.44	3	4	#	163	163	1.00	107	3	0.03	26	5	0.19
São Paulo	58	52	0.90	20	26	1.30	487	352	0.72	357	41	0.11	78	32	0.41
CANADA															
Sherbrooke	9	5	#	8	10	1.25	41	19	0.46	37	3	0.08	4	1	#
CHILE project	70	35	0.50	29	40	1.38	201	120	0.60	38	5	0.13	32	14	0.44
COLOMBIA															
Cali	14	8	0.57	17	10	0.59	144	96	0.67	65	5	0.08	10	4	0.40
Cartagena	11	8	0.73	4	6	#	43	22	0.51	12	1	0.08	21	6	0.29
Medellín	40	19	0.48	9	8	#	85	43	0.51	34	2	0.06	18	8	0.44
JAMAICA															
Kingston-St. Andrew	40	27	0.68	11	16	1.45	115	162	1.41	366	45	0.12	40	28	0.70
MEXICO															
Monterrey	71	34	0.48	19	16	0.84	195	125	0.64	182	11	0.06	41	7	0.17
UNITED STATES															
California project	34	15	0.44	4	5	#	231	73	0.32	79	19	0.24	18	4	0.22

[a] Ratio of deaths on final assignment to those assigned from death certificates.
[b] Includes only deaths with information available from death certificates and from other sources.
[c] Includes five deaths in 1–4 year age group: three from maternal conditions by final assignment, one from that cause group on death certificate, and one from unspecified birth injury on death certificate.
Ratio not computed for less than 10 deaths by each assignment.

FIG. 171. Infant Deaths from Certain Perinatal Causes as Underlying Causes Based on Death Certificates and on Final Assignments in 14 Projects Combined.



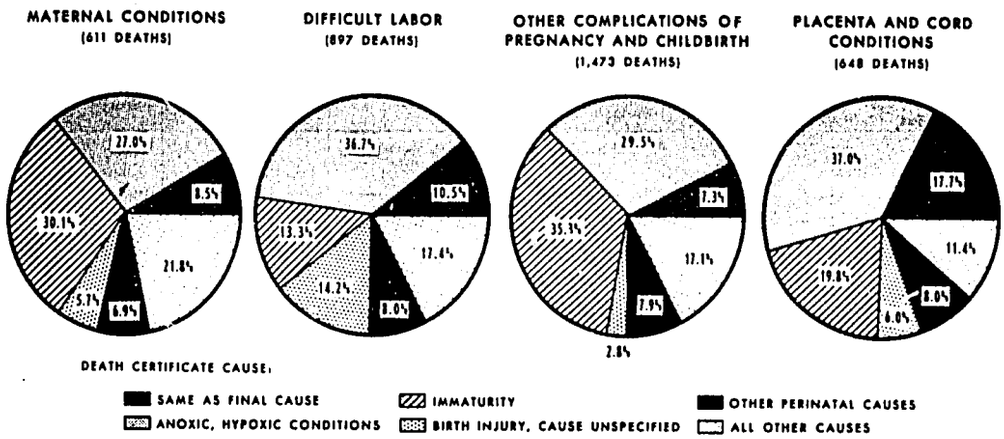
On 1,910 death certificates immaturity was the only cause given and thus the coding was made to category 777. However, for 1,681 of these deaths information available from clinical or other records was used to make a specific assignment. Unfortunately many physicians fail to realize the value of stating the specific cause, for example, maternal condition such as placenta previa, toxemia, etc. As can be seen in Table 202, of the deaths attributed only to immaturity on death certificates, 184 were assigned to a maternal conditon (categories 760–763), 119 to difficult labor (764–768), 520 to other complications of pregnancy and childbirth (769), and 128 to conditions of placenta and cord (770, 771). The percentage distributions of deaths from these four important causes, showing the assignments originally made from death certificates, are presented in Figure 172. These data show clearly the lack of sufficient information on these important causes of infant mortality—knowledge that is essential as a basis for prevention of these conditions.

TABLE 202. Final Assignments of Infant Deaths from Certain Perinatal Causes, Compared with Underlying Causes Stated on Death Certificates in 14 Projects Combined.

Death certificate cause	Final assignment							
	Maternal conditions[b] (760–763)		Difficult labor (764–768)		Other complications pregnancy, childbirth (769)		Conditions of placenta, cord (770, 771)	
	No.	%	No.	%	No.	%	No.	%
Total deaths[a]	611	100.0	897	100.1	1,473	99.9	648	99.9
Same as final assignment	52	8.5	94	10.5	108	7.3	115	17.7
Birth injury, cause unspecified 772	35	5.7	127	14.2	41	2.8	39	6.0
Anoxic, hypoxic conditions 776	165	27.0	329	36.7	435	29.5	240	37.0
Immaturity 777	184	30.1	119	13.3	520	35.3	128	19.8
Other perinatal causes Rest of 760–778	42	6.9	72	8.0	117	7.9	52	8.0
Pneumonia and influenza 470–486	55	9.0	59	6.6	111	7.5	31	4.8
All other causes	78	12.8	97	10.8	141	9.6	43	6.6

[a] Includes only deaths with information available from death certificates and from other sources.
[b] Includes three deaths in 1–4 year age group.

FIG. 172. Final Assignments of Infant Deaths from Certain Perinatal Causes, Compared with Underlying Causes Stated on Death Certificates in 14 Projects Combined.



CONGENITAL ANOMALIES

The increase in number of deaths due to congenital anomalies of all types was small, 15 per cent (Table 203). The largest increase was noted in Recife, where 61 deaths were assigned to anomalies on the basis of death certificates and 108 on final assignment. In Medellín and in Kingston-St. Andrew there were increases of 33 and 26 per cent.

For anomalies of the nervous and the digestive systems the increases for all projects combined were 40 and 71 per cent, respectively. In Monterrey, where anomalies of the nervous system were found to be unusually frequent, the number rose from 56 to 79, or 41 per cent. In addition there were six deceased infants without death certificates who were known to have had serious anomalies of the nervous system, and six others for whom death certificates but no clinical information or data from home interviews were available. Thus, from the death certificates alone, only 62 of the 91 deaths due to these anomalies would have been known.

Shifts within the broad group of congenital anomalies in some areas were in part due to greater specificity in the assignment. For instance, in the California project deaths from congenital anomalies affecting multiple systems (category 759), other than Down's disease (759.3), had 18 assignments on the death certificates and only eight in the final assignments in the Investigation.

An increase was noted in anomalies of the digestive system in all projects combined, from 191 on the basis of death certificates to 327 on final assignment. Increases were observed in each of the projects.

TABLE 203. Deaths Assigned to Congenital Anomalies as Underlying Causes Based on Death Certificates and on Final Assignments, with Ratios,[a] in Children Under 5 Years of Age in 14 Projects.

Project	Deaths		Ratio	Deaths		Ratio	Deaths		Ratio	Deaths		Ratio	Deaths		Ratio
	Certificate	Final		Certificate	Final		Certificate	Final		Certificate	Final		Certificate	Final	
	Congenital anomalies (740-759)			Nervous system (740-743)			Heart, circulatory system (746, 747)			Digestive system (749-751)			Other anomalies (rest of 740-759)		
Total[b]	1,378	1,590	1.15	272	380	1.40	648	610	0.94	191	327	1.71	267	273	1.02
ARGENTINA															
Chaco Province	42	50	1.19	8	9	#	22	18	0.82	3	11	3.67	9	12	1.33
San Juan Province	95	93	0.98	18	22	1.22	46	32	0.70	13	31	2.38	18	8	0.44
BOLIVIA project	34	37	1.09	2	5	#	15	11	0.73	13	19	1.46	4	2	#
BRAZIL															
Recife	61	108	1.77	14	31	2.21	35	41	1.17	7	23	3.29	5	13	2.60
Ribeirão Prêto	68	76	1.12	9	12	1.33	27	28	1.04	16	21	1.31	16	15	0.94
São Paulo	222	237	1.07	41	58	1.41	123	111	0.90	23	44	1.91	35	24	0.69
CANADA															
Sherbrooke	80	90	1.12	30	33	1.10	30	32	1.07	6	9	#	14	16	1.14
CHILE project	155	174	1.12	25	36	1.44	74	62	0.84	24	34	1.42	32	42	1.31
COLOMBIA															
Cali	65	61	0.94	7	12	1.71	39	33	0.85	11	14	1.27	8	2	#
Cartagena	46	57	1.24	7	0	#	24	20	0.83	10	14	1.40	5	14	2.80
Medellin	60	80	1.33	6	11	1.83	32	28	0.88	10	21	2.10	12	20	1.67
JAMAICA															
Kingston-St. Andrew	111	140	1.26	17	24	1.41	41	56	1.37	16	26	1.62	37	34	0.92
MEXICO															
Monterrey	184	219	1.19	56	79	1.41	74	73	0.99	29	44	1.52	25	23	0.92
UNITED STATES															
California project	155	168	1.08	32	39	1.22	66	65	0.98	10	16	1.60	47	48	1.02

[a] Ratio of deaths on final assignment to those assigned from death certificates.
[b] Includes only deaths with information available from death certificates and from other sources.
Ratio not computed for less than 10 deaths by each assignment.

OTHER CAUSES

Five groups of causes and one specific category are given in Table 204 to show the changes on final assignment. In three of these groups—diseases of respiratory system, other defined diseases, and symptoms and ill-defined conditions—there were large reductions. Whereas 5,846 deaths were attributed to respiratory diseases on death certificates, only 4,546 or 78 per cent were so assigned on the basis of clinical and other information available. In many of these the respiratory disease was the terminal event.

For the deaths certified as due to ill-defined conditions, specific underlying causes could usually be determined on the basis of additional evidence obtained. For all but 14 per cent of the 851 deaths in these categories, a specific cause was assigned. In Chaco Province, São Paulo, and Monterrey, the 142, 149 and 171 deaths attributed to these conditions on death certificates were reduced to 25, 11 and 9, respectively, on final assignment.

Deaths from the "sudden death syn-

TABLE 204. Deaths Assigned to Certain Underlying Causes Based on Death Certificates and on Final Assignments, with Ratios,[a] in Children Under 5 Years of Age in 14 Projects.

Project	Deaths		Ratio	Deaths		Ratio	Deaths		Ratio	Deaths		Ratio	Deaths		Ratio	Deaths		Ratio
	Certificate	Final		Certificate	Final		Certificate	Final		Certificate	Final		Certificate	Final		Certificate	Final	
	Diseases of nervous system, sense organs (310-315, 320-389)			Diseases of respiratory system (460-519)			Other defined diseases[c]			Sudden death (795)			Symptoms and other ill-defined conditions (780-792, 796)			External causes (E800-E989)		
Total[b]	884	860	0.97	5,846	4,546	0.78	1,100	769	0.70	59	233	3.95	851	118	0.14	694	715	1.03
ARGENTINA																		
Chaco Province	58	39	0.67	257	237	0.92	44	37	0.84	4	8	#	142	25	0.15	29	36	1.24
San Juan Province	85	66	0.78	428	397	0.93	83	49	0.59	3	22	7.33	48	5	0.10	75	69	0.92
BOLIVIA project	45	35	0.78	1,149	1,073	0.93	99	37	0.37	4	13	3.25	80	5	0.06	54	64	1.19
BRAZIL																		
Recife	71	81	1.14	616	403	0.65	86	80	0.93	—	5	#	61	40	0.66	27	41	1.52
Ribeirão Prêto	38	36	0.95	197	120	0.61	49	36	0.73	—	5	#	52	5	0.10	26	19	0.73
São Paulo	182	217	1.19	1,017	697	0.69	163	146	0.90	—	18	*	149	11	0.07	60	75	1.25
CANADA																		
Sherbrooke	0	6	#	25	26	1.04	27	25	0.93	1	0	#	4	—	#	38	32	0.84
CHILE project	102	112	1.10	564	481	0.85	101	76	0.75	30	46	1.53	21	6	0.29	112	115	1.03
COLOMBIA																		
Cali	44	44	1.00	229	166	0.72	47	40	0.85	2	13	6.50	6	2	#	39	33	0.85
Cartagena	28	23	0.82	128	101	0.79	76	36	0.47	1	0	#	12	—	*	25	27	1.08
Medellín	32	36	1.12	170	94	0.55	50	35	0.70	3	16	5.33	18	1	0.06	45	44	0.98
JAMAICA																		
Kingston-St. Andrew	47	53	1.13	210	130	0.62	92	68	0.71	—	13	*	82	6	0.07	27	31	1.15
MEXICO																		
Monterrey	117	87	0.74	738	539	0.73	141	65	0.46	2	22	11.00	171	9	0.05	70	60	0.86
UNITED STATES																		
California project	26	25	0.96	118	82	0.69	42	39	0.93	0	37	4.11	5	3	#	67	69	1.03

[a] Ratio of deaths on final assignment to those assigned from death certificates.
[b] Includes only deaths with information available from death certificates and from other sources.
[c] Diseases not included elsewhere in Tables 197, 199, 201, 203, and 204.
Ratio not computed for less than 10 deaths by each assignment.
* More than 10 deaths by one assignment; none by the other.

drome" (category 795) increased from 59 to 233. In São Paulo, for example, 18 deaths were assigned to this syndrome whereas none had been so stated on death certificates.. In the Chile project the deaths attributed to this syndrome increased from 30 to 46, and in California from 9 to 37. Accurate measurement of this important problem is essential in order to provide guidelines for studies of causes and means of prevention.

On the whole, there was little change in the external causes and diseases of the nervous system as assigned from the death certificates. However, the data for the individual projects reveal an increase in Recife for external causes, from 27 to 41 deaths.

* * *

In summary, the fact that the underlying causes assigned in the Investigation were in general agreement with only 52.5 per cent of those derived from death certificates (coded in accordance with international rules and procedures) indicates major shortcomings in certain aspects of current official mortality statistics that affect their usefulness for health planning. This is in addition to other deficiencies in the quality of these statistics described earlier, such as lack of registration of deaths in early life. For a common communicable disease of childhood such as measles, only 55.4 per cent of the deaths could have been known from death certificates, and in several projects the numbers of measles deaths were more than doubled in the final assignment using additional information. The distinction between terminal condition and underlying cause

needs to be made clear to certifying physicians.

Specific types of nutritional deficiency—protein malnutrition and nutritional marasmus—are not being recognized sufficiently by the medical certifiers, as a fivefold increase was noted for the more severe form: protein malnutrition, or kwashiorkor.

The maternal conditions and conditions of placenta and cord as well as other important perinatal causes also are being missed.

The Investigation has uncovered many problems connected with the statement of underlying cause on death certificates. These findings should serve to bring to the attention of certifying physicians the important contribution they can make to the improvement of mortality statistics. Teaching through clinical-pathological conferences would be beneficial. Thus, complete certification of multiple causes of death becomes a problem of medical education.

Chapter XVIII

Highlights and Recommendations

The Inter-American Investigation of Mortality in Childhood, in which 35,095 deaths of children under 5 years of age were studied in 15 different projects, has uncovered and measured health problems for which solutions must be sought. This hemispheric research project has demonstrated the great value of geographic studies of mortality with comparisons of the findings in widely separated areas. The patterns in each of the areas studied appear to be distinct; no two projects had the same type or size of problems. Therefore, the findings in each area make a unique contribution to knowledge of conditions in the locality, state, province, and country in which the project was situated, while at the same time adding to the understanding of health problems of the Hemisphere and of the world.

Highlights of the Investigation are given in this chapter, along with recommendations concerning action that could be taken at the local, national, and international levels for the improvement of health in childhood, which in essence means improvement of the health of families, communities, and nations.

HIGHLIGHTS

Fifteen concise statements of the findings of the Investigation are given as highlights. Although nutritional deficiency is considered the outstanding problem and is stated first, the order of the others does not necessarily reflect their relative importance. Many of the problems are closely interrelated, and their analysis makes clear the need for a comprehensive approach in health planning in order to attain the overall objective of maternal and child health programs, that is, optimum growth and development of children as an indispensable requirement for the well-being of societies.

First. Nutritional deficiency was the most serious health problem uncovered in the Investigation, as measured by its involvement in mortality. This condition is coupled with low weight at birth, and the two conditions combined are endangering the survival and hampering the growth and development of infants and young children and probably of future mothers. Through the study of mortality by multiple causes, 57.0 per cent of the children who died under 5 years of age were found to have had immaturity or nutritional deficiency as either the underlying or an associated cause of

death. In several areas two-thirds of the deceased children had such evidence of increased susceptibility to disease.

Immaturity indicates a deficit in growth and development of the infant at birth, and low birth weights are believed to be attributable at least in part to the poor nutritional state of the mothers. Breaking this vicious cycle is mandatory. Mothers must be provided with sufficient food of good quality so that they will be able to produce healthy children.

Immaturity and nutritional deficiency were found to be even more serious in rural areas than in the neighboring cities, the magnitude of these problems in the rural sector of Latin America having been uncovered for the first time in the Investigation.

The impact of nutritional deficiency and low birth weight at a stage when the infant normally undergoes rapid growth and development should be considered not only in terms of mortality but also and principally in terms of the effects on the future health of the survivors.

Second. For the first time mortality from nutritional deficiency has been analyzed by age at death and by type of deficiency, and a geographic description has been provided for urban and rural populations in 13 projects in widely separated areas of Latin America.

The peak of mortality from nutritional deficiency was in infancy, as early as the third and fourth months of life, but the patterns differed markedly in the 13 projects. In six projects mortality was excessive early in life, in the first few months; in six others high rates extended into the second year; and in the rural areas of the El Salvador project mortality from this cause continued during the first five years of life. Mortality from protein malnutrition increased to its peak in children 12–17 months of age, while nutritional marasmus caused high rates in infants from 2–6 months old.

Third. Only through the study of multiple causes was it possible to measure the magnitude of health problems in infancy and childhood. Analyses of associated as well as underlying causes of death were necessary in order to uncover important interrelationships such as the synergistic action of infectious diseases and nutritional deficiency, and the effects of complications of pregnancy and childbirth on products of gestation as measured by weight and condition of the newborn.

To implement the recommendation made after the first Inter-American Investigation of Mortality in adults (1962–1964), this Investigation has sought to study the epidemiology of diseases, not by isolated entities but by analyzing combinations of pathological states. Modern data processing methods, including tabulation by computer, have proved valuable in carrying out these analyses of multiple causes. Use of such tabulations and analyses should be extended widely for the study of vital statistics in cities and other selected areas where satisfactory data can be obtained in developing countries, as well as in highly developed countries of the world.

Fourth. Official mortality statistics fail to reveal the real magnitude of health problems. In the Investigation registration of neonatal deaths was found to be so incomplete that it is certain that mortality in this period of life has not been sufficiently known. For the 15 projects combined, 13.2 per cent of the neonatal deaths had not been registered; in one project half had not been registered, and in two others more than one-fourth. The outcome of each pregnancy

should be ascertained and recorded, that is, whether a live birth or a fetal death, in accordance with the definitions established by the World Health Organization. Complete data on weight at birth for all live births, including infants who die in the neonatal period, are essential for analyses of neonatal mortality and for an understanding of the role of immaturity as an associated cause of death.

Only 52.5 per cent of the death certificates were in general agreement with the underlying causes that were assigned in the Investigation on the basis of additional clinical and pathological information obtained from hospital and autopsy records and during interviews conducted in the homes of deceased children. Even for a common communicable disease of childhood such as measles, mortality could have been known from the death certificates for only 55.4 per cent of the 1,777 deaths attributed to this disease on final assignment, using data from at least one additional source.

Health planning based on such incomplete data cannot be realistic. The next steps, therefore, should be directed toward further improvement of the completeness and quality of vital statistics, hospital statistics, and medical certification of death.

Fifth. The role of the infectious diseases as underlying causes of death has been clarified, with diarrheal disease being found as the principal cause and measles second in importance. The death rate from infectious diseases was shown to be 23 per cent higher than could have been known from the official death certificates. Failure to include the infectious diseases on death certificates, even when evidence of them is available on clinical records, has restricted knowledge of the size of these health problems in many areas. In the case of measles, for example, mortality in five projects was found to be more than double that recorded on death certificates. Prior to the Investigation immunization programs against this important disease of childhood had been undertaken in only one of the Latin American countries included in this study, namely Chile, as was evident from the data collected on vaccinations.

The synergistic action of infectious diseases and nutritional deficiency, as demonstrated in the Investigation, should be taken into account when planning health programs, so that measures for prevention of such deficiency as well as immunization against infectious diseases and other measures may be properly coordinated.

Sixth. The relationships of abnormal conditions in the mother before and during childbirth, complications of pregnancy and immaturity, and their effects on the product of conception have been measured for the first time. This analysis was made possible by the study of multiple causes. Maternal conditions and difficult labor as underlying causes of death were increased sixfold by the additional information collected in the Investigation; other complications of pregnancy and childbirth were increased more than tenfold, and conditions of placenta and cord combined over four times. Surprisingly high proportions of deaths in the neonatal period were of newborn infants of low birth weight.

Seventh. The Investigation has uncovered excessive frequencies of deaths from congenital anomalies of the nervous system in three projects. In the two Latin American projects—El Salvador and Monterrey, Mexico—research into the causation of spina bifida is essential in order to determine if some type of nutritional deficiency or a toxic or environmental factor is

involved. Since some deaths from spina bifida and other anomalies of the nervous system occur before birth and thus are fetal deaths, only a limited part of this problem may have been uncovered in the Investigation. In these projects the principal collaborators and their staffs made certain that deaths of all such products with evidence of life were included in the Investigation. Moreover, damage other than that causing death (fetal deaths and infant deaths) should be explored in the surviving children.

In the Sherbrooke project in Canada anencephalus was found to have excessive frequency, and the causes should be sought. Although the frequency of spina bifida also was high in Sherbrooke, this was due in part to the fact that this condition was found at times in combination with anencephalus.

Eighth. Marked variations in patterns of mortality were noted for certain other causes and groups of causes such as diseases of the nervous and respiratory systems, malignant neoplasms, external causes, and the sudden death syndrome. Mortality from malignant neoplasms in childhood was greater than that revealed by mortality statistics of the respective countries and thus the groundwork is being laid for studies on causation of these conditions. Sudden death was found more frequently among infants of young mothers (less than 20 years of age) than among those of older mothers. In this way, the study of patterns of such diseases by geographic area provides bases for planning health programs as well as clues for further research.

Ninth. Child mortality in rural areas of the projects included in the Investigation was much higher than in the neighboring cities, thereby reflecting the seriousness of health problems in those sectors. These rural areas studied in the Investigation, because of their closeness to the urban medical centers, cannot be considered typical of the large rural populations of Latin America where mortality in childhood is probably at least twice as high as in the cities.

The variation in mortality was greatest for children in the second year of life, the highest rate (in a rural area) being more than 50 times the lowest (in suburban California). To reduce mortality in childhood, major attention must be given to rural areas in Latin American countries. Because of lack of registration of deaths, as well as the deficient quality of certification, the extent and seriousness of health problems in most rural areas in Latin America remains obscure.

Tenth. Excessive reproductive wastage has been revealed through the study of mortality in products of previous pregnancies of the mothers of deceased children included in the Investigation. In two projects with high death rates, Recife and El Salvador, more than 30 per cent of the products of previous pregnancies were found to have died.

In projects with high birth rates, high proportions of the deceased infants studied in the Investigation were of fifth or higher birth orders (e.g., 50.7 per cent in Recife and 48.6 per cent in Monterrey). Death rates were found to be excessive in infants of fifth or higher birth orders in the two Latin American projects that had data available on live births; those rates were 90.0 and 90.6 deaths per 1,000 live births in the Monterrey and Chile projects, in contrast to 40.5 and 39.4 for first births. In

recent years when a sharp decline in the birth rate occurred in the Province of Santiago in Chile, a shift was noted from high birth orders to lower birth orders in which infant mortality is less.

Information on the distributions of live births by age and parity of mothers was limited; the data by age were available for only five of the Latin American projects, and by parity, for only two projects. Such data are essential for conducting analyses that will lead to a fuller understanding of patterns of reproduction and of neonatal and infant mortality. Planning for healthy and intelligent children is a vital and integral part of health planning. For such planning, basic data are indispensable.

Eleventh. Breast feeding for one month or longer had been provided for only 52.5 per cent of the infants who died in the postneonatal period; also, only 18.4 per cent of those dying at 6–11 months of age had been breast fed for six months or longer. In two projects in Brazil and in El Salvador the proportions of infants breast fed for a month or longer were very low: 26.8 per cent in Recife, 35.5 per cent in São Paulo, and 37.9 per cent in El Salvador. In breast fed infants lower proportions of the deaths were due to diarrheal disease and nutritional deficiency than in those never breast fed.

Prior to this Investigation, breast feeding was believed to be the usual method of feeding infants in early life in Latin America. Therefore, the markedly different patterns found were unexpected.

Infants in these societies who are never breast fed fail to receive a life-giving food that both protects against infection and disease and provides the nutrients necessary for growth and development.

Twelfth. An inverse correlation was found between infant mortality and prenatal care of mothers. The variation in proportions of mothers of deceased infants receiving such care was great, from 16.9 to 96.7 per cent. In five areas (three of them rural) less than half of the mothers had received any medical attention in the prenatal period. In contrast, there were nine areas in which more than 80 per cent had made at least one visit for prenatal care. The provision of this service for all mothers is a necessity.

Thirteenth. The level of education of the mother was shown to be a valuable indicator of socioeconomic status, as has been demonstrated also in studies of differential mortality in the United States. Education of mother is a measure of many socioeconomic variables. Mothers with little or no education usually are of families with low income, poor housing, deficient water supply and sanitary facilities, and without adequate prenatal and other medical services. This measure is therefore an appropriate one for use in health planning and in future research.

There are certain segments of the population in the Latin American projects, as revealed by the data in Chapters XIV–XVI, in which conditions are probably relatively as favorable as in highly developed countries. In these segments the proportions of the deaths of children under 5 years of age which occurred in the neonatal period were as high as in the Northern American projects (over 60 per cent in both). However, very large proportions of families of deceased children in the Latin American projects lived under such unfavorable conditions that high percentages of the deaths occurred in the postneonatal period and at

1–4 years of age, the periods in which mortality can be reduced drastically by known methods. These populations are at the greatest risk of disease and death and must be provided with at least the minimum health facilities and services.

Fourteenth. The availability of piped water supplies varied markedly in the Latin American areas. In four areas 90 per cent or more of families in which neonatal deaths occurred had piped water inside the house or available from a communal facility, while in five (two cities and three rural areas) less than one-fourth had water service available. For the 13 Latin American cities combined, 69.4 per cent of such families had piped water (37.1 per cent inside house) but in the eight other areas only 28.8 per cent had that service (15.0 per cent inside house). These findings in families of infants dying in the neonatal period, which are probably quite similar to those in the general populations of the same areas, can be considered in relation to the new goals set by the Special Meeting of Ministers of Health of the Americas for the decade of the 1970's (PAHO, 1973)—namely, to provide water services with house connections for 80 per cent of the urban population and water for 50 per cent of the rural population. It can be seen that attainment of these goals poses a great challenge.

Of the families of infants who died in the postneonatal period, lower percentages were supplied with piped water (60.2 in cities and 21.6 in the eight other areas), findings which indicated that environmental conditions as measured by this parameter were much less favorable than in families in which neonatal deaths occurred. A negative correlation was established between postneonatal death rates and the percentages of homes with piped water among families of infants dying in the postneonatal period. The inverse relation was even clearer when death rates were correlated with percentages of homes with piped water inside the house.

Provision of water supplies (and sanitary facilities) to much higher proportions of families in many urban and rural areas is essential if major reductions in mortality are to be achieved.

Fifteenth. Coordinated, community-centered research has clearly been demonstrated to be a sound method of uncovering health problems and providing data needed for the establishment of effective programs. The Ministers of Health of the Andean Region (Colombia, Ministry of Public Health, 1971) expressed their recommendation on this point as follows (in translation):

> If we really desire to invest resources effectively, we need to measure and evaluate the known problems and to uncover those that remain hidden or whose magnitude is unknown. Operational research acquires the utmost importance, both for assessing the coverage and productivity of existing systems and for laying the bases for new designs and methods of work. To achieve this end, it is important that our countries not remain in isolation but combine their efforts for the conduct of joint research programs such as the "investigation of mortality in children under 5 years of age," just completed by the Pan American Health Organization in cooperation with various countries—among them Bolivia, Chile, and Colombia, members of the (Andean) group.

The overall significance of this research project, therefore, is its value for the establishment of a new policy, by the Organization and other international agencies, to support and conduct, in cooperation with the countries, community-centered research as an essential part of health programs.

MATERNAL AND CHILD HEALTH AND NUTRITION

The Investigation has provided the most exact measurement possible of the magnitude of problems underlying child mortality in 15 projects in the Hemisphere. The evidence presented indicates the urgent need for action to find solutions for the main problems uncovered. A multidisciplinary and intersectoral approach should be introduced to develop programs that will make optimum use of resources to deal with the most serious of the multiple conditions and factors found to be responsible for mortality and morbidity. The degree of risk at the level of community, family, and individual must be taken into account in setting the order of priorities.

A top priority is the promotion and attainment of an optimum state of nutrition for pregnant and nursing women and for the products of conception. Prevention of low weight at birth (immaturity) and of nutritional deficiency is considered a much more effective and less expensive endeavor than care of the immature infant and extended treatment of the malnourished child. These two conditions of high vulnerability are main contributors to excessive mortality and to permanent deficits in growth and development. The highest priority, therefore, is to assure the mother adequate medical care and good nutrition so that she will have healthy and intelligent children.

Parents should be provided with guidance and assistance so that they may attain optimal reproductive patterns in respect to age of mother and intergestational intervals. This must be considered a top priority within programs of family health in order to safeguard the physical condition and intelligence of children and hence the well-being of societies.

Breast feeding of sufficient duration and the timely addition of adequate foods to the diet of the weaning child should be encouraged as essential life-giving measures in developing areas. The use of these protective measures to guard against malnutrition and gastrointestinal infections should go hand in hand with other basic actions to reduce the magnitude of what has been shown to cause the most serious health problems in developing areas: the complex of nutritional deficiency-infection. Among these measures, extension of immunization programs, including vaccination against measles in all countries, and provision of piped water supplies appear to be mandatory.

All these basic activities should be carried out as part of an integrated maternal and child health program and within a general plan of health and social progress. In such a program the various phases of the infant's development (intra- and extra-uterine) should be viewed as a continuum, so as to take into account the interrelationships of causes and factors that have been discussed throughout this report.

Methods for increasing the efficiency of each component of the program and for recognizing and measuring high risk must be developed, along with measures for extending services to groups of population that require them most. Certain basic principles of health administration recommended by the principal collaborators (PAHO, 1972-c)—such as regionalization of health services, integration of preventive and curative aspects on a functional and programmed basis to provide continuous

care to mother and child, as well as maximum utilization of auxiliary personnel—may be effective in many areas of Latin America in coping with the massive needs.

The findings presented in the preceding chapters should be of assistance to health authorities for the establishment of priorities. Use could be made of the data related to characteristic patterns of disease, specific factors involved in mortality, and basic indicators, as means of determining levels of risk and utilizing resources to best advantage for dealing with the problems uncovered.

EDUCATION IN THE HEALTH SCIENCES

The universities and in particular the schools of medicine and public health, working through the principal collaborators and their staffs, made highly significant contributions to the conduct of this Investigation, and to the results set forth in this report. Such important participation by universities in community-centered research should be continued in the future, in order to uncover health problems and plan for their solution at the local, national, and international levels. Since the success of this endeavor is dependent on the preparation of the health team through educational programs directed toward the development and well-being of communities, teaching and research activities should be combined to prepare the manpower that will be needed for the task. Students of the health sciences and all types of personnel of health agencies should be made aware of the importance of securing basic data of high quality for the planning, execution, and evaluation of health programs as well as for teaching programs. The term health sciences is used in the broad sense, to include medicine, nursing, midwifery, dentistry, social work, and all types of activities performed by public health personnel.

Closer working relationships should be established between universities—which are most valuable instruments of change—and the health agencies. To this end the following recommendations are made.

First. Students at all levels in the various health disciplines should become acquainted with the status and problems of health in the community. They should also be made aware of their responsibility for recording and making use of the facts, as the basis for a clear definition of problems and the introduction of measures leading to their solution.

Second. The planning and conduct of research and practical studies by universities in the community should involve the staffs and facilities of the health services, and mechanisms for coordination between the two groups should be developed so that new information may be utilized to plan and carry out concrete actions for the benefit of the population.

Third. The experience of this Investigation could assist toward a better definition of methods for teaching the disciplines related to maternal and child health. Indeed, the findings should facilitate the selection of priority areas for study and above all serve to demonstrate the complexity of the factors determining the state of health of community, family, and individual. This com-

plexity makes clear the need to introduce the multiple-cause approach in the study of factors involved in morbidity and mortality. The adoption of such methods in teaching will encourage team effort in the task of defining and solving health problems.

Integration, or as a minimum, close coordination of obstetrics and pediatrics, with a strong component of preventive aspects, should be established in teaching and training programs so as to provide basic knowledge of all the multiple factors affecting the health of mother and child.

Concerted efforts to attain high quality in delivery of health services should be the aim of teaching and training, just as they should be also of clinical and community-centered research. The relationship is reciprocal in the sense that good training and teaching as well as current research are necessary for improving the quality of health services.

Continuing education in maternal and child health disciplines, using the facilities of health services as well as university resources, is essential. Problems such as those revealed by this Investigation should have precedence in the program of instruction, and efforts should be made to reach every member of the health team, including midwives as well as such empirical personnel as lay midwives or lay birth attendants, who must learn to comply with at least the minimum standards in the care of women at childbirth and of the newborn. Such personnel should be supervised, assisted, and taught the essentials of care of uncomplicated cases and the procedures for prompt referral of patients in whom a complication is found or suspected.

The efforts undertaken by the teams participating in this Investigation should be continued and carried forward, by setting up teaching programs and centers in the different schools to disseminate and encourage wide application and further development of community-centered research. All the experiences in this Investigation, including the difficulties, are useful for gaining knowledge of and working out solutions for the many problems uncovered.

DEVELOPMENT AND IMPROVEMENT OF BASIC HEALTH DATA AND STATISTICS

For geographic studies of diseases it is necessary to have available or develop basic data from different areas. There is a wealth of such data to be found in the Americas, as the areas have varied characteristics and these must be taken into account in order to obtain complete and comparable information on the epidemiology and, in particular, the causation of disease. Through the research that has been completed, this Investigation has pointed out the steps which are advisable for recording and collecting such data as well as for tabulation and analysis of the multiple causes and factors involved.

The first and most important recommendation is that the outcome of each pregnancy be recorded with as much information as possible. This should include condition of the newborn, birth weight, signs of life (such as recommended by Chase *et al.*, 1972), and if death occurs, all possible in-

formation regarding underlying and associated causes, in both mother and newborn, that may have contributed to the fatal outcome, as well as exact age at death. Search for congenital anomalies is an essential part of this first examination of the newborn.

An expert committee of the World Health Organization (WHO, 1970-b) has recommended a complete and uniform system for the registration of all live births and perinatal deaths. In such a system it is essential to distinguish clearly between those born alive and fetal deaths, in accordance with the WHO definitions. It is advisable to use a form for recording the outcome, with statement of the evidence of signs of life, and basic information such as length of gestation, age and parity of mother, infant's weight at birth, congenital anomalies, etc. Specific principles governing clinical records in the hospital as well as responsibilities for registration of vital events were formulated by the principal collaborators (PAHO, 1972-c).

These recommendations can be carried out readily in hospitals and health centers. Midwives and nurses as well as obstetricians and pediatricians can contribute to the complete recording of such vital data. To evaluate the completeness of recording of these events, analyses of series of births and deaths are advisable at many levels, first in the hospital, and then in local areas such as a community, city or county, province or state, and finally in the country. The standard of 10 deaths in the first day of life per 1,000 live births is a useful indicator for a hospital to use in evaluating the completeness of recording.

Until the coverage of the vital statistics system is complete, analyses at the levels where it is complete are advisable—for example, first for a district within a state, and later for the entire state and for the country as a whole. To increase the value of basic data, completeness of the information and quality in certification must be stressed. For calculation of death rates in a given area, essential data on infant's birth weight and on age and parity of mother must be provided for both the numerator (infant or neonatal deaths) and the denominator (live births); and the proper distinction must be made between mothers who are residents of the area and those who are non-residents. The leadership of the medical profession in establishing procedures in hospitals, health centers, and vital statistics systems is important so that the data needed for health programs and for research will become available.

As an important step to achieve comparability as well as compliance with recommendations of the World Health Organization to Member Governments, the definitions of a live birth and of a fetal death should be introduced and followed by all those with responsibilities in relation to vital events: obstetricians, pediatricians, nurses and midwives, as well as personnel employed in hospital records rooms, civil registries, and vital statistics offices.

In the section on medical certification and rules for classification in the *International Classification of Diseases* (WHO, 1967) the following statements are made: "From the standpoint of prevention of deaths, it is important to cut the chain of events or institute the cure at some point. The most effective public health objective is to prevent the precipitating cause from operating. . . . It is assumed, and rightly so, that the certifying medical practitioner is in a better position than any other individual to decide which of the morbid conditions led directly to death and to state the antecedent conditions, if any, which gave rise to this cause."

On the medical certificate of cause of death, in addition to Part I which is used for recording the underlying cause and events leading to death, Part II is provided for recording other significant conditions that unfavorably influenced the course of the morbid process and thus contributed to the fatal outcome. The Investigation has made clear the enormous importance of the associated causes, such as nutritional deficiency and immaturity, in addition to the underlying causes. Thus, completeness and correct use of medical certification and the inclusion of statements on both underlying and contributory causes are essential. The multiple-cause approach is necessary in order to establish the relationships between agent and host in mortality.

Combined efforts by clinicians and pathologists will result in better definition of the underlying cause and contributory conditions and the chain of events leading to death. Strengthening the important discipline of pediatric pathology, including clinical laboratory aspects, will enrich our knowledge of the problems affecting maternal and child health. Essentially, improvement in certification of causes of death and in basic sources of data depends on the leadership provided by the medical profession.

Computer facilities are now available for tabulations of multiple causes and cross tabulations of many factors involved in morbidity and mortality. Vision and imagination in the computer processing of vital statistics and in the utilization of such data could result in significant contributions to medical knowledge. At the international level recommendations by WHO in regard to certification, tabulation, and analysis of data on multiple causes are needed so that comparable data will become available for epidemiologic studies in the future.

EPIDEMIOLOGIC RESEARCH

The Investigation has served to uncover the seriousness of the problems of nutritional deficiency and immaturity in Latin America. It has provided an overview of other major community health problems, some of which need clarification through in-depth epidemiologic research while for others practical research is required to demonstrate the most realistic methods for solving the problems.

The policy of combining epidemiologic and community-centered research with preventive actions is the sound and logical approach. The Investigation has demonstrated clearly the great diversity of patterns of mortality in widely separated areas of the Hemisphere. In medical education programs, students should be made aware of the importance of continuing the search for greater knowledge of diseases and for clues to their etiology. The discovery in the last century of specific infectious bacterial agents was only a beginning. Much more must be learned to understand the etiology and epidemiology of many diseases.

Different types of areas—those at high altitude, and rural as well as urban localities—should be included in geographic studies of diseases. Analysis of their varied characteristics may result in unexpected

findings, uncovering facts about the causation of diseases and providing guidelines for their prevention.

The gravity and complexity of the combined effects of immaturity-nutritional deficiency are clear, and methods to break this vicious cycle must be found. However, only through longitudinal research will it be possible to demonstrate conclusively the full effects of nutritional deficiency on the future mothers and on their products. Such comparative studies on the outcome of pregnancies, taking into account biological factors in the mother such as age, nutritional state, and reproductive history as well as social and environmental factors, would be of great value for understanding differences in patterns of reproduction and for planning health programs.

The Investigation has furnished the first known data indicating that fatal congenital anomalies of the nervous system are unusually frequent in certain geographic areas in the Americas. The findings provide clues for further research into the etiology of such anomalies. Their possible relationship to nutritional deficiency suggests a new area for investigation in depth. Since such anomalies may result in fetal deaths as well as in deaths soon after birth, intensive research on these conditions is needed. Fortunately the number of deaths studied in the Investigation was sufficient to reveal the first basic data, but much more information is required. Clinical and pathological data from rural areas should contribute significant information regarding these conditions. The variations observed in mortality from congenital anomalies of the digestive system and from Down's disease are also leads for further research.

The Investigation has found mortality from malignant neoplasms in childhood to be greater than was known from official statistics. Leukemias accounted for half of these deaths. A puzzling finding was the frequency of minor anomalies in the children who died from malignant neoplasms. Documentation of a much larger series of deaths is necessary; the search into etiology must be based on the analysis of multiple causation.

Cancer research involving man and his environment, as was pointed out by Marston (1969), poses a great challenge for the epidemiologist. Possible relationships of viruses and immunity (that is, agents and host—as with many infectious diseases) and environmental factors are under study. Viruses such as those now known to cause cancer in laboratory and domestic animals may be causal agents of human cancer. New evidence from the studies by Bross *et al.* (1972) indicates an increased risk of leukemia after exposure to sick animals, and this suggests the value of geographic studies of malignant diseases, to investigate possible causal relationships between agents in the environment (animal viruses, for instance) and such diseases. To gain knowledge of the etiology of malignant neoplasms, clues can be sought by establishing the chain of events leading to their appearance. Since specific types of acute leukemia and lymphomas have relatively low frequencies, data from many different areas and countries with a wide diversity of environmental conditions will be of value.

The sudden death syndrome (with cause unknown) becomes increasingly important as death rates from infectious diseases decline. As such deaths are relatively infrequent, research such as that carried out in this Investigation is needed to obtain sufficient background information. For example, the data indicate that their frequency is greatest among infants of young

mothers—an important clue for the search for specific causes.

The complexity of the perinatal causes of mortality, that is, conditions in the mother and those of placenta and cord, has been revealed by the data collected, and the value of analysis of multiple causes and factors has been shown. More complete information is required regarding multiple causes involved in neonatal deaths as well as basic data from birth certificates for analysis of mortality according to infant's birth weight and age and parity of the mother.

Once knowledge has been gained of the magnitude and nature of causes and factors responsible for excessive reproductive wastage, as well as of their interrelationships, it becomes obligatory to find the best solutions possible for the problems uncovered. Action at the community level, using local resources, to assess and improve the nutritional state of expectant mothers and children has high priority. Imaginative operational research is urgently needed to provide the foundation for reorientation of maternal and child health programs in developing societies.

Future epidemiologic research on diseases and on methods for their prevention should be directed toward elucidating the roles of the host, the specific agent, and the environment, and all the interrelationships of the multiple factors involved. Additional geographic studies similar to the two Inter-American Investigations of Mortality, using new approaches for further exploration into multiple causes of disease and determinants of health, will contribute to the advancement of epidemiology and hence to the improvement of world health.

APPENDICES

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APPENDIX 1

STANDARD FORM OF QUESTIONNAIRE FOR DEATHS OF THE INTER-AMERICAN INVESTIGATION OF MORTALITY IN CHILDHOOD

INTER-AMERICAN INVESTIGATION OF MORTALITY IN CHILDHOOD

Confidential

Death - page 1

1. Name of child _____ 2. Serial no. _____

3. Date of birth	4. Date of death	5. Sex	6. Age at death ___ yrs. ___ mos. ___ days ___ hrs.

7. Address _____ Sector or division _____

HOUSING

8. Neighborhood _____	9. Type of housing _____	10. Number of rooms _____	11. Water: Piped water Inside ☐ Outside ☐ Other ☐	12. Toilet: Flush ☐ Other ☐ None ☐

13. HOUSEHOLD ROSTER

Ind. no.	Name	Relation to head	Date of birth*	Age	Sex	Marital status	Education: Total years	Education: Last Type	Education: Last Years	Length of residence: In community	Length of residence: Last 5 years Urban	Length of residence: Last 5 years Rural
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												

*Enter date of birth for children under 6 years.

14. OCCUPATION

Ind. no.	Name	Currently employed	Occupation	Kind of business	Time in occupation

15. DEATHS IN HOUSEHOLD IN PAST YEAR

Name of deceased	Age	Sex	Date	Home	Hosp.	Name of hospital	Other

16. PREGNANCY HISTORY OF MOTHER

Order	Date pregnancy ended	Abortion?	Stillbirth?	Live births: Name of child	Sex	Living now?	Age at death
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							

17. Pregnant now? Yes ☐ No ☐ Unknown ☐ 18. Remarks: _____

19. Source of information: Name _____ Ind. no. _____ Date _____ Interviewer _____

INTER-AMERICAN INVESTIGATION OF MORTALITY IN CHILDHOOD

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Death - page 2

Name of child _____ Serial no. _____

Date of birth	Date of death	Sex	Age at death ____ yrs. ____ mos. ____ days ____ hrs.

20. DATA ON PARENTS

Ind. no.	Name	Live here?	Date of birth	Age	Marital status	Education	Employed now?	Occupation	Business
	Father								
	Mother								

21. Was the mother of this child seen by physician, or in a clinic or hospital during pregnancy? Yes ☐ No ☐ Unknown ☐
If yes, name of physician, clinic or hospital _____ Dates _____
Reason _____
Months pregnant at first visit? _____ Number of visits _____

22. Length of pregnancy _____ months Unknown ☐

23. Were there complications during pregnancy? No ☐ Yes ☐ If yes, check below. Unknown ☐
Edema ☐ Convulsions ☐ Threatened abortion ☐ Hemorrhage ☐
Trauma ☐ Operation ☐ Specify _____
Infectious disease ☐ Specify _____

24. Where born? Home ☐ Hospital ☐ Name and address _____ Other ☐

25. Who attended birth? Doctor ☐ Midwife ☐ Other ☐ _____ Certificate no. _____

26. Was the delivery spontaneous? No ☐ Yes ☐ Unknown ☐ Were instruments used? No ☐ Yes ☐ Unknown ☐
Was anesthesia given? No ☐ Yes ☐ Was sedation given? No ☐ Yes ☐ Cesarian? No ☐ Yes ☐

27. Was the general aspect of child good at birth? No ☐ Yes ☐
If not good, what did you notice? _____

28. Birth weight _____ Unknown ☐

29. Did you breast feed the child? Yes ☐ When did you start weaning? Age ____ months Reason _____
When did you finish weaning? Age ____ months _____
No ☐ Why not? _____ Unknown ☐

30. Was other milk used? No ☐ Yes ☐ At what age? ____ months or ____ days Times per day _____
Composition: Milk _____ Water _____ Was use of milk continued? _____

31. Was other weaning food used? _____ Was weaning food continued? _____

32. Give age in months when foods were added:	JUICES: ____ mos. Times per week ____	CEREALS: ____ mos. Times per week ____	PULSES: ____ mos. Times per week ____	ROOTS, TUBERS: ____ mos. Times per week ____
LEAFY VEGETABLES: ____ mos. Times per week ____	EGGS: ____ mos. Times per week ____	POULTRY: ____ mos. Times per week ____	MEAT: ____ mos. Times per week ____	FISH: ____ mos. Times per week ____

33. At what age (in months) did child do the following: a) raise head? ____ b) seat self? ____ c) stand alone? ____
d) walk alone? ____ e) control bladder? ____ f) control bowels? ____ g) feed self? ____

34. Who cared for child most of day: Mother ☐ Grandmother ☐ Sibling (15 yrs.+) ☐ Sibling(-15 yrs.) ☐
Other relative ☐ Maid ☐ Day care ☐ Other ☐

35. Has your child been vaccinated? Yes ☐ No ☐ Unknown ☐ If yes, which vaccinations _____

36. At what age in months did child have following: a) German measles? ____ b) measles? ____ c) chickenpox? ____
d) whooping cough? ____ e) mumps? ____

37. Remarks: _____

38. Source of information: Mother ☐ Father ☐ Other ☐ _____

Date _____ Interviewer _____

INTER-AMERICAN INVESTIGATION OF MORTALITY IN CHILDHOOD

Confidential

Death - page 3

Name of child _____ Serial no. _____

Date of birth	Date of death	Sex	Age at death ___ yrs. ___ mos. ___ days ___ hrs.

39. During the past year, has this child been attended by a physician or in a clinic or hospital? Yes ☐ No ☐ Unknown ☐

Name of physician, clinic or hospital	Type*	Dates	Days in hospital	Reason	Number of visits

*Indicate whether clinic (health center or hospital) C, in-patient in hospital H, practicing physician P, emergency E.

40. Did the child receive medical attention before the past year? Yes ☐ No ☐ Unknown ☐

Name of physician, clinic or hospital	Type*	Dates	Days in hospital	Reason	Number of visits

*Indicate whether clinic (health center or hospital) C, in-patient in hospital H, practicing physician P, emergency E.

41. Disease a) How long was the child ill? _____ b) How did illness start? _____

c) What disease do you think caused the child's death? _____

42. Description of the disease by the mother _____

43. Home treatment _____

44. Prescriptions _____

45. Who prescribed? _____

46. Did the mother see signs of malnutrition? (edema, loss of weight, changes in hair or skin) _____

47. To doctor a) Was child taken to doctor? No ☐ Yes ☐ b) How many days after onset of illness? ____

c) What was condition of child? Slightly ill ☐ Moderately ill ☐ Very ill ☐

48. Where did child die? Home ☐ Hospital ☐ Name _____ Other ☐

49. Death certificate number _____

50. Source of information: Mother ☐ Father ☐ Other ☐

Date _____ Interviewer _____

INTER-AMERICAN INVESTIGATION OF MORTALITY IN CHILDHOOD

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Death - page 4

Name of child _____ Serial no. _____

Date of birth	Date of death	Sex	Age at death ___yrs. ___mos. ___days ___hrs.

DATA OBTAINED FROM HOSPITAL, CLINIC OR PHYSICIAN

51. Abnormal conditions of pregnancy	None ☐	Edema ☐	Hyper-tension ☐	Albumi-nuria ☐	Convul-sions ☐	Hyper-emesis ☐	Anemia ☐	Threatened abortion ☐	Placenta previa ☐	Other, specify

52. Conditions unrelated to pregnancy	None ☐	German measles ☐	T b c pulm. ☐	Syphi-lis ☐	Operation: reason, findings	Trauma, specify	Other, specify

53. Delivery	Spontane-ous ☐	Manipu-lation ☐	Forceps ☐	Cesarian ☐	Anesthe-sia ☐	Sedation ☐	Other, specify	54. Length of gestation	55. Single or multiple birth

DATA ON CHILD (age in completed months in first line)

	At birth									
56. Age										
57. Weight										
58. Nutritional status										

59. DATA ON NEWBORN FROM RECORD

General state: Good ☐ Fair ☐ Poor ☐

Activity: Normal ☐ Abnormal ☐

First cry ____ min. First breathing ___ min.

Movements: Normal ☐ Abnormal ☐

Muscular tone: Increased ☐ Normal ☐ Decreased ☐

Head - Size: Increased ☐ Normal ☐ Decreased ☐

Shape: Normal ☐ Abnormal ☐

Cephalohematoma ☐ Lacerations ☐

Eyes, nose, ears, mouth _____

Neck - Rigidity: Yes ☐ No ☐ Masses ☐

Chest: _____

First voiding ____ hrs. First bowel movement ____ hrs.

First feeding ____ hrs. Type _____

Acceptance ☐ Rejection ☐

Genitals: Normal ☐ Abnormal ☐

Extremities: Normal ☐ Abnormal ☐

Skin, color _____

Cyanosis: General ☐ Extremities ☐

Jaundice: Yes ☐ No ☐ Time ____

Hemorrhagic signs: Yes ☐ No ☐

Infection signs: _____

Lacerations: Yes ☐ No ☐

Edema _____

Breathing: Normal ☐ Irregular ☐

Secretion _____

Abdominal: Masses ☐ Hernia ☐

Congenital anomalies: _____

Progress: _____

60. PRINCIPAL FINDINGS IN HOSPITAL AND CLINICS, PRIOR TO ILLNESS LEADING TO DEATH

61. Source of information:	Hospital ☐	Clinic ☐	Private M. D. ☐	Other ☐	Date _____ Interviewer _____

INTER-AMERICAN INVESTIGATION OF MORTALITY IN CHILDHOOD

Confidential

Death - page 5

Name of child _____ Serial no. _____

Date of birth	Date of death	Sex	Age at death ___yrs. ___mos. ___days ___hrs.

PRESENT ILLNESS - EVENTS THAT LED TO DEATH OF THE CHILD

62. Date disease started _____ 63. How disease started _____

64. Main symptoms _____

65. Description of disease _____

PHYSICAL EXAMINATION (at admission to hospital or first outpatient or house visit)

66. Date _____ 67. Height _____ 68. Weight and arm circumference: Wt. _____ Arm circumference _____

69. Nutritional status _____

70. Relevant physical findings _____

71 Evolution and treatment _____

72. Source of information:	Hospital ☐	Clinic ☐	Private M. D. ☐	Other ☐	Date _____	Interviewer _____

INTER-AMERICAN INVESTIGATION OF MORTALITY IN CHILDHOOD

Confidential

Death - page 6

Name of child _____ Serial no. _____

Date of birth	Date of death	Sex	Age at death ___ yrs. ___ mos. ___ days ___ hrs.

DATA OBTAINED FROM HOSPITAL, OUTPATIENT SERVICE OR PHYSICIAN

73. Relevant laboratory findings _____

74. X-rays: Site _____ Date _____ Results _____

75. Other auxiliary examinations _____

76. Surgical procedures and findings _____

77. Cytology _____ 78. Biopsy _____

79. CLINICAL DIAGNOSES _____

80. Autopsy? No ☐ Yes ☐ Date _____

81. Date hospitalized	82. Date discharged	83. Where died?	Home ☐	Outpatient service ☐	Hospital less than 48 hours ☐	Hospital 48 hours or more ☐	Other ☐

84. Source of information	Hospital ☐	Clinic ☐	Private M. D. ☐	Other ☐	Date	Interviewer

DATA OBTAINED BY HOME VISIT OF MEDICAL INTERVIEWER

85. Date disease started _____ 86. How disease started _____

87. Main symptoms _____

88. Description of disease _____

INTER-AMERICAN INVESTIGATION OF MORTALITY IN CHILDHOOD

Confidential

Death - page 7

Name of child _____ Serial no. _____

Date of birth	Date of death	Sex	Age at death ____yrs. ____mos. ____days ____hrs.

DATA OBTAINED BY MEDICAL INTERVIEWER IN HOME

89. Disease	a) How long was the child ill? _____ b) How did illness start? _____ c) What do you think caused death? _____ d) Did someone else have same disease?
90. Fever	a) Did the child have fever? No ☐ Little ☐ Moderate ☐ Very high ☐ b) How long? ____ c) Did you take the temperature? No ☐ Yes ☐ d) What was it? _____
91. Respiration	a) How was the respiration? Slow ☐ Normal ☐ Rapid ☐ Difficult ☐ b) Did the sides of nose move in breathing? Yes ☐ No ☐ c) Noise? _____
92. Cough	a) Did the child cough? No ☐ Little ☐ Moderate ☐ Heavy ☐ b) Expectoration? No ☐ Little ☐ Moderate ☐ Heavy ☐ c) Color of expectoration? White ☐ Yellow ☐ Green ☐ With blood ☐
93. Vomiting	a) Did the child vomit? No ☐ Little ☐ Moderate ☐ Severe ☐ b) What did he vomit? Solid ☐ Liquid ☐ Everything ☐ c) How long did he vomit? _____ days d) Did he lose appetite? _____
94. Feces	a) How were the feces? Very hard ☐ Hard ☐ Normal ☐ Loose ☐ Liquid ☐ b) Color of the feces? Yellow ☐ Brown ☐ Green ☐ Red ☐ Black ☐ c) How many times per day? _____ d) How many days? ____ e) Were worms seen? _____
95. Urine	a) Difficulty in urination? No ☐ Yes ☐ b) Retention of urine? No ☐ Yes ☐ c) Did urine diminish? No ☐ Yes ☐ d) Eliminated calculi? No ☐ Yes ☐ e) Color of urine? Dark ☐ Red ☐ Dirty ☐
96. Weight	a) Did the child lose weight? No ☐ A little ☐ Moderate ☐ Severe ☐ b) Did the arms get thinner? No ☐ Yes ☐ c) Legs? No ☐ Yes ☐ d) Face? No ☐ Yes ☐ e) Could ribs be seen under skin? No ☐ Yes ☐
97. Edema	a) Did the child have swollen legs? No ☐ Yes ☐ b) Swollen abdomen? No ☐ Yes c) Face? No ☐ Yes ☐
98. Skin	a) Did you see anything on skin? No ☐ Yes ☐ b) Appearance? Yellow ☐ Rash ☐ Pustule ☐ Cyanotic ☐ Pale ☐ Blemishes ☐ Depigmentation ☐ Dryness ☐
99. Hair	a) Did the child have much hair? No ☐ Yes ☐ b) Pull out easily? No ☐ Yes ☐ c) Change of color? No ☐ Yes ☐ d) Glossy? No ☐ Yes ☐
100. Neuromuscular activity	a) Did the child move actively? No ☐ Yes ☐ b) All parts of body? No ☐ Yes ☐ c) Delay in movement No ☐ Yes ☐ d) Since when _____ e) Convulsions? No ☐ Yes ☐
101. Pain	a) Did the child have pain? No ☐ Yes ☐ b) How long? _____ c) Continuous? No ☐ Yes ☐ d) Associated with what? _____
102. Accident	a) Did the child have a fall? No ☐ Yes ☐ b) Injury? _____ c) Other accident? No ☐ Yes ☐ d) Explain _____
103. Other	What other symptoms?
104. Observation	Provide data regarding these items before final illness.
105. To doctor	a) Did you take child to doctor? No ☐ Yes ☐ b) How soon after onset of illness? ____ c) What was condition of child? Slightly ill ☐ Moderately ill ☐ Very ill ☐
106. Source of information	Mother ☐ Father ☐ Other _____ Date _____ Interviewer _____

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Death - page 8

Name of child _____ Serial no. _____

Date of birth	Date of death	Sex	Age at death ___yrs. ___mos. ___days ___hrs.

AUTOPSY REPORT

107. Autopsy number _____ 108. Interval from death to initiation of autopsy _____

109. Weight _____ 110. Arm circumference _____

111. Other anthropometric measurements _____

112. Description of cadaver (note all positive findings, especially on nutrition) _____

113. Macroscopic examination of cavities and segments (positive findings of head, thorax, abdomen, pelvis, neck, limbs)

114. Macroscopic examination of organs (positive findings of appearance, surface, weight, color, consistency, etc.)

115. Microscopic examination of organs and tissues (positive findings of organs macroscopically abnormal and of those requested) _____

116. Positive laboratory findings from autopsy _____

117. Final diagnoses from autopsy: Direct cause of death: _____

Principal diagnosis (underlying cause): _____

Secondary diagnoses (associated causes): _____

118. Associated diagnoses not related with underlying cause: _____

119. Type of autopsy	Hospital ☐	Verification of death ☐	Medico-legal ☐	Complete ☐	Partial ☐	Incomplete ☐

Date _____ Interviewer _____

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Death - page 9

Name of child _____ Serial no. _____

Date of birth	Date of death	Sex	Age at death ____ yrs. ____ mos. ____ days ____ hrs.

120. Medical certification of cause of death (exact copy)

		Duration	Classification
I	a		
	b		
	c		
II			

121. SUMMARY OF INVESTIGATION

Medical interviewer _____

		Basis for diagnosis	Classification
Underlying cause			
Associated causes	1.		
	2.		
	3.		
Evaluation of nutrition			

Principal collaborator _____

122. ASSIGNMENT BY REFEREE

		Basis	Special code for nutritional status
Underlying cause			
Associated causes	1.		
	2.		
	3.		

Basis for diagnosis:
1. Autopsy
2. Hospital
3. Clinical, definite
4. Clinical, questionable
5. Interview only
6. Death certificate only

APPENDIX 2

UNDERLYING AND ASSOCIATED CAUSES OF DEATH[a] IN CHILDREN UNDER 5 YEARS, BY AGE GROUP, WITH RATES,[b] FOR AREAS OF 15 PROJECTS

	Page
Argentina	
Chaco Province Project	373
San Juan Province Project	379
Bolivia Project	387
Brazil	
Recife Project	391
Ribeirão Prêto Project	393
São Paulo Project	399
Canada, Sherbrooke Project	401
Chile Project	403
Colombia	
Cali Project	407
Cartagena Project	409
Medellín Project	411
El Salvador Project	413
Jamaica, Kingston-St. Andrew Project	417
Mexico, Monterrey Project	423
United States of America, California Project	425

[a] Specific area, sampling ratios, time periods, and bases for rates are given in Table 1 of this publication on page 9.

[b] Rates under 1 year of age per 100,000 live births; others per 100,000 population.

DEATHS
ARGENTINA—Chaco Province

Underlying and Associated Causes of Death in Children Under 5 Years, by Age Group, in Two-Year Period, 1968–1970.

Cause	Underlying cause						Associated cause					
	Under 5 years	Infant deaths			1 year	2-4 years	Under 5 years	Infant deaths			1 year	2-4 years
		Total	Under 28 days	28 days-11 mos.				Total	Under 28 days	28 days-11 mos.		
All causes	1701	1410	568	842	197	94	2025	1618	487	1131	284	123
Infective and parasitic diseases	762	598	85	513	119	45	228	156	23	133	46	26
Amebiasis 006	-	-	-	-	-	-	-	-	-	-	-	-
Diarrheal disease 009	594	493	46	447	81	20	133	82	4	78	31	20
Other intestinal infectious diseases 000-005,007,008	2	1	-	1	-	1	2	2	-	2	-	-
Tuberculosis 010-019	37	16	-	16	11	10	11	6	-	6	3	2
Diphtheria 032	-	-	-	-	-	-	-	-	-	-	-	-
Whooping cough 033	21	12	1	11	5	4	3	1	-	1	2	-
Tetanus 037	24	24	23	1	-	-	-	-	-	-	-	-
Septicemia 038	10	10	7	3	-	-	30	25	11	14	5	-
Measles 055	53	23	-	23	20	10	4	1	-	1	1	2
Congenital syphilis 090	9	9	6	3	-	-	-	-	-	-	-	-
Moniliasis 112	3	2	2	-	1	-	42	37	8	29	4	1
Helminthiases 120-129	-	-	-	-	-	-	-	-	-	-	-	-
Other Rest of 000-136	9	8	-	8	1	-	3	2	-	2	-	1
Malignant neoplasms 140-209	3	-	-	-	2	1	1	-	-	-	1	-
Neoplasms, other 210-239	3	2	1	1	-	1	-	-	-	-	-	-
Nutritional deficiency	48	30	-	30	16	2	613	455	12	443	111	47
Vitamin deficiency 260-266	-	-	-	-	-	-	-	-	-	-	-	-
Protein malnutrition 267	17	5	-	5	11	1	17	6	-	6	11	-
Nutritional marasmus 268	20	17	-	17	3	-	76	49	1	48	18	9
Other 269	11	8	-	8	2	1	520	400	11	389	82	38
Endocrine and metabolic diseases 240-258,270-279	4	3	2	1	-	1	-	-	-	-	-	-
Deficiency anemias 280,281	-	-	-	-	-	-	5	5	4	1	-	-
Other diseases of blood and blood-forming organs 282-289	1	1	1	-	-	-	10	7	-	7	2	1
Inflammatory diseases of central nervous system 320-324	27	19	-	19	3	5	38	30	4	26	4	4
Other diseases of nervous system and sense organs 310-315,330-389	22	17	-	17	3	2	22	16	1	15	2	4
Diseases of circulatory system 390-458	3	2	-	2	-	1	12	5	-	5	3	4
Pneumonia and influenza 470-486	211	181	47	134	21	9	278	212	37	175	49	17
Other diseases of respiratory system 460-466,490-519	68	56	7	49	9	3	31	17	-	17	10	4
Diseases of digestive system 520-577	13	9	4	5	-	4	12	10	1	9	1	1
Diseases of genito-urinary system 580-629	5	5	-	5	-	-	17	14	-	14	2	1
Diseases of skin and subcutaneous tissue 680-709	12	10	5	5	2	-	14	11	1	10	3	-
Diseases of musculoskeletal system 710-738	-	-	-	-	-	-	-	-	-	-	-	-
Congenital anomalies	56	46	23	23	5	5	21	19	8	11	1	1
Nervous system 740-743	10	9	6	3	-	1	3	3	-	3	-	-
Circulatory system 746,747	21	17	11	6	2	2	7	6	2	4	-	1
Respiratory system 748	3	2	1	1	1	-	-	-	-	-	-	-
Digestive system 749-751	13	13	4	9	-	-	5	5	3	2	-	-
Genito-urinary system 752,753	1	1	-	1	-	-	1	1	-	1	-	-
Musculoskeletal system 754-756	-	-	-	-	-	-	1	-	-	-	1	-
Down's disease 759.3	8	4	1	3	2	2	4	4	3	1	-	-
Other anomalies 744,745, 757,758, Rest of 759	-	-	-	-	-	-	-	-	-	-	-	-
Certain perinatal causes 760-778	371	371	370	1	-	-	385	385	375	10	-	-
Symptoms 780-789	20	15	3	12	4	1	331	271	21	250	48	12
Sudden death 795	8	7	2	5	-	1	-	-	-	-	-	-
Other ill-defined conditions 790-792,796	23	17	10	7	3	3	-	-	-	-	-	-
External causes E800-E999	41	21	8	13	10	10	7	5	-	5	1	1

DEATH RATES
Chaco Province—ARGENTINA

Death Rates from Underlying and Associated Causes in Children Under 5 Years, by Age Group, in Two-Year Period, 1968–1970.

Cause	Underlying cause						Associated cause					
	Under 5 years	Infant deaths			1 year	2-4 years	Under 5 years	Infant deaths			1 year	2-4 years
		Total	Under 28 days	28 days-11 mos.				Total	Under 28 days	28 days-11 mos.		
All causes	2214.8	8011.4	3227.3	4784.1	1235.9	211.8	2636.7	9193.2	2767.0	6426.1	1781.7	277.2
Infective and parasitic diseases	992.2	3397.7	483.0	2914.8	746.5	101.4	296.9	886.4	130.7	755.7	288.6	58.6
Amebiasis ... 006	-	-	-	-	-	-	-	-	-	-	-	-
Diarrheal disease ... 009	773.4	2801.1	261.4	2539.8	508.2	45.1	173.2	465.9	22.7	443.2	194.5	45.1
Other intestinal infectious diseases ... 000-005,007,008	2.6	5.7	-	5.7	-	2.3	2.6	11.4	-	11.4	-	-
Tuberculosis ... 010-019	48.2	90.9	-	90.9	69.0	22.5	14.3	34.1	-	34.1	18.8	4.5
Diphtheria ... 032	-	-	-	-	-	-	-	-	-	-	-	-
Whooping cough ... 033	27.3	68.2	5.7	62.5	31.4	9.0	3.9	5.7	-	5.7	12.5	-
Tetanus ... 037	31.2	136.4	130.7	5.7	-	-	-	-	-	-	-	-
Septicemia ... 038	13.0	56.8	39.8	17.0	-	-	39.1	142.0	62.5	79.5	31.4	-
Measles ... 055	69.0	130.7	-	130.7	125.5	22.5	5.2	5.7	-	5.7	6.3	4.5
Congenital syphilis ... 090	11.7	51.1	34.1	17.0	-	-	-	-	-	-	-	-
Moniliasis ... 112	3.9	11.4	11.4	-	6.3	-	54.7	210.2	45.5	164.8	25.1	2.3
Helminthiases ... 120-129	-	-	-	-	-	-	-	-	-	-	-	-
Other ... Rest of 000-136	11.7	45.5	-	45.5	6.3	-	3.9	11.4	-	11.4	-	2.3
Malignant neoplasms ... 140-209	3.9	-	-	-	12.5	2.3	1.3	-	-	-	6.3	-
Neoplasms, other ... 210-239	3.9	11.4	5.7	-	2.3	2.3	-	-	-	-	-	-
Nutritional deficiency	62.5	170.5	-	170.5	100.4	4.5	798.2	2585.2	68.2	2517.0	696.4	105.9
Vitamin deficiency ... 260-266	-	-	-	-	-	-	-	-	-	-	-	-
Protein malnutrition ... 267	22.1	28.4	-	28.4	69.0	2.3	22.1	34.1	-	34.1	69.0	-
Nutritional marasmus ... 268	26.0	96.6	-	96.6	18.8	-	99.0	278.4	5.7	272.7	112.9	20.3
Other ... 269	14.3	45.5	-	45.5	12.5	2.3	677.1	2272.7	62.5	2210.2	514.4	85.6
Endocrine and metabolic diseases ... 240-258,270-279	5.2	17.0	11.4	5.7	-	2.3	-	-	-	-	-	-
Deficiency anemias ... 280,281	-	-	-	-	-	-	6.5	28.4	22.7	5.7	-	-
Other diseases of blood and blood-forming organs ... 282-289	1.3	5.7	5.7	-	-	·	13.0	39.8	-	39.8	12.5	2.3
Inflammatory diseases of central nervous system ... 320-324	35.2	108.0	-	108.0	18.8	11.3	49.5	170.5	22.7	147.7	25.1	9.0
Other diseases of nervous system and sense organs ... 310-315,330-389	28.6	96.6	-	96.6	18.8	4.5	28.6	90.9	5.7	85.2	12.5	9.0
Diseases of circulatory system ... 390-458	3.9	11.4	-	11.4	-	2.3	15.6	28.4	-	28.4	18.8	9.0
Pneumonia and influenza . 470-486	274.7	1028.4	267.0	761.4	131.7	20.3	362.0	1204.5	210.2	994.3	307.4	38.3
Other diseases of respiratory system ... 460-466,490-519	88.5	318.2	39.8	278.4	56.5	6.8	40.4	96.6	-	96.6	62.7	9.0
Diseases of digestive system ... 520-577	16.9	51.1	22.7	28.4	-	9.0	15.6	56.8	5.7	51.1	6.3	2.3
Diseases of genito-urinary system ... 580-629	6.5	28.4	-	28.4	-	-	22.1	79.5	-	79.5	12.5	2.3
Diseases of skin and subcutaneous tissue ... 680-709	15.6	56.8	28.4	28.4	12.5	-	18.2	62.5	5.7	56.8	18.8	-
Diseases of musculoskeletal system ... 710-738	-	-	-	-	-	-	-	-	-	-	-	-
Congenital anomalies	72.9	261.4	130.7	130.7	31.4	11.3	27.3	108.0	45.5	62.5	6.3	2.3
Nervous system ... 740-743	13.0	51.1	34.1	17.0	-	2.3	3.9	17.0	-	17.0	-	-
Circulatory system ... 746,747	27.3	96.6	62.5	34.1	12.5	4.5	9.1	34.1	11.4	22.7	-	2.3
Respiratory system ... 748	3.9	11.4	5.7	5.7	6.3	-	-	-	-	-	-	-
Digestive system ... 749-751	16.9	73.9	22.7	51.1	-	-	6.5	28.4	17.0	11.4	-	-
Genito-urinary system . 752,753	1.3	5.7	-	5.7	-	-	1.3	5.7	-	5.7	-	-
Musculoskeletal system . 754-756	-	-	-	-	-	-	1.3	-	-	-	6.3	-
Down's disease ... 759.3	10.4	22.7	5.7	17.0	12.5	4.5	5.2	22.7	17.0	5.7	-	-
Other anomalies ... 744,745, 757,758, Rest of 759	-	-	-	-	-	-	-	-	-	-	-	-
Certain perinatal causes ... 760-778	483.1	2108.0	2102.3	5.7	-	-	501.3	2187.5	2130.7	56.8	-	-
Symptoms ... 780-789	26.0	85.2	17.0	68.2	25.1	2.3	431.0	1539.8	119.3	1420.5	301.1	27.0
Sudden death ... 795	10.4	39.8	11.4	28.4	-	2.3	-	-	-	-	-	-
Other ill-defined conditions ... 790-792,796	29.9	96.6	56.8	39.8	18.8	6.8	-	-	-	-	-	-
External causes ... E800-E999	53.4	119.3	45.5	73.9	62.7	22.5	9.1	28.4	-	28.4	6.3	2.3

DEATHS
ARGENTINA—Chaco Province, Resistencia

Underlying and Associated Causes of Death in Children Under 5 Years, by Age Group, in Two-Year Period, 1968–1970.

Cause	Underlying cause						Associated cause					
	Under 5 years	Infant deaths			1 year	2-4 years	Under 5 years	Infant deaths			1 year	2-4 years
		Total	Under 28 days	28 days-11 mos.				Total	Under 28 days	28 days-11 mos.		
All causes	864	747	327	420	83	34	1161	968	328	640	130	63
Infective and parasitic diseases	362	296	36	260	50	16	131	97	15	82	23	11
Amebiasis ... 006	-	-	-	-	-	-	-	-	-	-	-	-
Diarrheal disease ... 009	287	248	24	224	29	10	66	43	2	41	15	8
Other intestinal infectious diseases ... 000-005,007,008	1	1	-	1	-	-	1	1	-	1	-	-
Tuberculosis ... 010-019	25	13	-	13	8	4	9	6	-	6	2	1
Diphtheria ... 032	-	-	-	-	-	-	-	-	-	-	-	-
Whooping cough ... 033	1	1	-	1	-	-	1	-	-	-	1	-
Tetanus ... 037	9	9	8	1	-	-	-	-	-	-	-	-
Septicemia ... 038	3	3	2	1	-	-	21	19	8	11	2	-
Measles ... 055	23	9	-	9	12	2	1	-	-	-	1	-
Congenital syphilis ... 090	3	3	-	3	-	-	-	-	-	-	-	-
Moniliasis ... 112	3	2	2	-	1	-	30	27	5	22	2	1
Helminthiases ... 120-129	-	-	-	-	-	-	-	-	-	-	-	-
Other ... Rest of 000-136	7	7	-	7	-	-	2	1	-	1	-	1
Malignant neoplasms ... 140-209	1	-	-	-	1	-	-	-	-	-	-	-
Neoplasms, other ... 210-239	2	1	1	-	-	1	-	-	-	-	-	-
Nutritional deficiency	32	20	-	20	10	2	314	250	8	242	42	22
Vitamin deficiency ... 260-266	-	-	-	-	-	-	-	-	-	-	-	-
Protein malnutrition ... 267	10	2	-	2	7	1	9	5	-	5	4	-
Nutritional marasmus ... 268	16	14	-	14	2	-	54	38	1	37	9	7
Other ... 269	6	4	-	4	1	1	251	207	7	200	29	15
Endocrine and metabolic diseases ... 240-258,270-279	2	1	-	1	-	1	-	-	-	-	-	-
Deficiency anemias ... 280,281	-	-	-	-	-	-	2	2	2	-	-	-
Other diseases of blood and blood-forming organs ... 282-289	1	1	1	-	-	-	7	6	-	6	-	1
Inflammatory diseases of central nervous system ... 320-324	9	8	-	8	1	-	14	11	2	9	2	1
Other diseases of nervous system and sense organs ... 310-315,330-389	7	5	-	5	1	1	15	10	1	9	2	3
Diseases of circulatory system ... 390-458	3	2	-	2	-	1	7	2	-	2	2	3
Pneumonia and influenza . 470-486	94	84	25	59	8	2	159	125	27	98	25	9
Other diseases of respiratory system ... 460-466,490-519	24	20	2	18	3	1	17	9	-	9	5	3
Diseases of digestive system ... 520-577	5	4	2	2	-	1	7	7	1	6	-	-
Diseases of genito-urinary system ... 580-629	5	5	-	5	-	-	11	8	-	8	2	1
Diseases of skin and subcutaneous tissue ... 680-709	5	4	3	1	1	-	9	6	1	5	3	-
Diseases of musculoskeletal system ... 710-738	-	-	-	-	-	-	-	-	-	-	-	-
Congenital anomalies	41	35	15	20	2	4	15	14	7	7	1	-
Nervous system ... 740-743	8	7	4	3	-	1	2	2	-	2	-	-
Circulatory system ... 746,747	13	11	6	5	-	2	6	6	2	4	-	-
Respiratory system ... 748	3	2	1	1	1	-	-	-	-	-	-	-
Digestive system ... 749-751	11	11	3	8	-	-	3	3	3	-	-	-
Genito-urinary system . 752,753	1	1	-	1	-	-	1	1	-	1	-	-
Musculoskeletal system . 754-756	-	-	-	-	-	-	1	-	-	-	1	-
Down's disease ... 759.3	5	3	1	2	1	1	2	2	2	-	-	-
Other anomalies ... 744,745, 757,758, Rest of 759	-	-	-	-	-	-	-	-	-	-	-	-
Certain perinatal causes ... 760-778	236	236	236	-	-	-	257	257	251	6	-	-
Symptoms ... 780-789	10	7	-	7	2	1	191	161	13	148	22	8
Sudden death ... 795	3	3	1	2	-	-	-	-	-	-	-	-
Other ill-defined conditions ... 790-792,796	4	3	2	1	1	-	-	-	-	-	-	-
External causes ... E800-E999	18	12	3	9	3	3	5	3	-	3	1	1

DEATH RATES
Resistencia, Chaco Province—ARGENTINA

Death Rates from Underlying and Associated Causes in Children Under 5 Years, by Age Group, in Two-Year Period, 1968–1970.

Cause	Underlying cause						Associated cause					
	Under 5 years	Infant deaths			1 year	2-4 years	Under 5 years	Infant deaths			1 year	2-4 years
		Total	Under 28 days	28 days-11 mos.				Total	Under 28 days	28 days-11 mos.		
All causes	2070.0	7622.4	3336.7	4285.7	928.4	144.1	2781.5	9877.6	3346.9	6530.6	1454.1	267.1
Infective and parasitic diseases	867.3	3020.4	367.3	2653.1	559.3	67.8	313.8	989.8	153.1	836.7	257.3	46.6
Amebiasis 006	-	-	-	-	-	-	-	-	-	-	-	-
Diarrheal disease 009	687.6	2530.6	244.9	2285.7	324.4	42.4	158.1	438.8	20.4	418.4	167.8	33.9
Other intestinal infectious diseases 000-005,007,008	2.4	10.2	-	10.2	-	-	2.4	10.2	-	10.2	-	-
Tuberculosis 010-019	59.9	132.7	-	132.7	89.5	17.0	21.6	61.2	-	61.2	22.4	4.2
Diphtheria 032	-	-	-	-	-	-	-	-	-	-	-	-
Whooping cough 033	2.4	10.2	-	10.2	-	-	2.4	-	-	-	11.2	-
Tetanus 037	21.6	91.8	81.6	10.2	-	-	-	-	-	-	-	-
Septicemia 038	7.2	30.6	20.4	10.2	-	-	50.3	193.9	81.6	112.2	22.4	-
Measles 055	55.1	91.8	-	91.8	134.2	8.5	2.4	-	-	-	11.2	-
Congenital syphilis 090	7.2	30.6	-	30.6	-	-	-	-	-	-	-	-
Moniliasis 112	7.2	20.4	20.4	-	11.2	-	71.9	275.5	51.0	224.5	22.4	4.2
Helminthiases 120-129	-	-	-	-	-	-	-	-	-	-	-	-
Other Rest of 000-136	16.8	71.4	-	71.4	-	-	4.8	10.2	-	10.2	-	4.2
Malignant neoplasms 140-209	2.4	-	-	-	11.2	-	-	-	-	-	-	-
Neoplasms, other 210-239	4.8	10.2	10.2	-	-	4.2	-	-	-	-	-	-
Nutritional deficiency	76.7	204.1	-	204.1	111.9	8.5	752.3	2551.0	81.6	2469.4	469.8	93.3
Vitamin deficiency 260-266	-	-	-	-	-	-	-	-	-	-	-	-
Protein malnutrition 267	24.0	20.4	-	20.4	78.3	4.2	21.6	51.0	-	51.0	44.7	-
Nutritional marasmus 268	38.3	142.9	-	142.9	22.4	-	129.4	387.8	10.2	377.6	100.7	29.7
Other 269	14.4	40.8	-	40.8	11.2	4.2	601.3	2112.2	71.4	2040.8	324.4	63.6
Endocrine and metabolic diseases 240-258,270-279	4.8	10.2	-	10.2	-	4.2	-	-	-	-	-	-
Deficiency anemias 280,281	-	-	-	-	-	-	4.8	20.4	20.4	-	-	-
Other diseases of blood and blood-forming organs 282-289	2.4	10.2	10.2	-	-	-	16.8	61.2	-	61.2	-	4.2
Inflammatory diseases of central nervous system 320-324	21.6	81.6	-	81.6	11.2	-	33.5	112.2	20.4	91.8	22.4	4.2
Other diseases of nervous system and sense organs 310-315,330-389	16.8	51.0	-	51.0	11.2	4.2	35.9	102.0	10.2	91.8	22.4	12.7
Diseases of circulatory system 390-458	7.2	20.4	-	20.4	-	4.2	16.8	20.4	-	20.4	22.4	12.7
Pneumonia and influenza 470-486	225.2	857.1	255.1	602.0	89.5	8.5	380.9	1275.5	275.5	1000.0	279.6	38.2
Other diseases of respiratory system 460-466,490-519	57.5	204.1	20.4	183.7	33.6	4.2	40.7	91.8	-	91.8	55.9	12.7
Diseases of digestive system 520-577	12.0	40.8	20.4	20.4	-	4.2	16.8	71.4	10.2	61.2	-	-
Diseases of genito-urinary system 580-629	12.0	51.0	-	51.0	-	-	26.4	81.6	-	81.6	22.4	4.2
Diseases of skin and subcutaneous tissue 680-709	12.0	40.8	30.6	10.2	11.2	-	21.6	61.2	10.2	51.0	33.6	-
Diseases of musculoskeletal system 710-738	-	-	-	-	-	-	-	-	-	-	-	-
Congenital anomalies	98.2	357.1	153.1	204.1	22.4	17.0	35.9	142.9	71.4	71.4	11.2	-
Nervous system 740-743	19.2	71.4	40.8	30.6	-	4.2	4.8	20.4	-	20.4	-	-
Circulatory system 746,747	31.1	112.2	61.2	51.0	-	8.5	14.4	61.2	20.4	40.8	-	-
Respiratory system 748	7.2	20.4	10.2	10.2	11.2	-	-	-	-	-	-	-
Digestive system 749-751	26.4	112.2	30.6	81.6	-	-	7.2	30.6	30.6	-	-	-
Genito-urinary system 752,753	2.4	10.2	-	10.2	-	-	2.4	10.2	-	10.2	-	-
Musculoskeletal system 754-756	-	-	-	-	-	-	2.4	-	-	-	11.2	-
Down's disease 759.3	12.0	30.6	10.2	20.4	11.2	4.2	4.8	20.4	20.4	-	-	-
Other anomalies 744,745, 757,758, Rest of 759	-	-	-	-	-	-	-	-	-	-	-	-
Certain perinatal causes 760-778	565.4	2408.2	2408.2	-	-	-	615.7	2622.4	2561.2	61.2	-	-
Symptoms 780-789	24.0	71.4	-	71.4	22.4	4.2	457.6	1642.9	132.7	1510.2	246.1	33.9
Sudden death 795	7.2	30.6	10.2	20.4	-	-	-	-	-	-	-	-
Other ill-defined conditions 790-792,796	9.6	30.6	20.4	10.2	11.2	-	-	-	-	-	-	-
External causes E800-E999	43.1	122.4	30.6	91.8	33.6	12.7	12.0	30.6	-	30.6	11.2	4.2

DEATHS
ARGENTINA—Chaco Province, Rural Departments

Underlying and Associated Causes of Death in Children Under 5 Years, by Age Group, in Two-Year Period, 1968–1970.

Cause	Underlying cause						Associated cause					
	Under 5 years	Infant deaths			1 year	2-4 years	Under 5 years	Infant deaths			1 year	2-4 years
		Total	Under 28 days	28 days-11 mos.				Total	Under 28 days	28 days-11 mos.		
All causes	837	663	241	422	114	60	864	650	159	491	154	60
Infective and parasitic diseases	400	302	49	253	69	29	97	59	8	51	23	15
Amebiasis ... 006	-	-	-	-	-	-	-	-	-	-	-	-
Diarrheal disease ... 009	307	245	22	223	52	10	67	39	2	37	16	12
Other intestinal infectious diseases ... 000-005,007,008	1	-	-	-	-	1	1	1	-	1	-	-
Tuberculosis ... 010-019	12	3	-	3	3	6	2	-	-	-	1	1
Diphtheria ... 032	-	-	-	-	-	-	-	-	-	-	-	-
Whooping cough ... 033	20	11	1	10	5	4	2	1	-	1	1	-
Tetanus ... 037	15	15	15	-	-	-	-	-	-	-	-	-
Septicemia ... 038	7	7	5	2	-	-	9	6	3	3	3	-
Measles ... 055	30	14	-	14	8	8	3	1	-	1	-	2
Congenital syphilis ... 090	6	6	6	-	-	-	-	-	-	-	-	-
Moniliasis ... 112	-	-	-	-	-	-	12	10	3	7	2	-
Helminthiases ... 120-129	-	-	-	-	-	-	-	-	-	-	-	-
Other ... Rest of 000-136	2	1	-	1	1	-	1	1	-	1	-	-
Malignant neoplasms ... 140-209	2	-	-	-	1	1	1	-	-	-	1	-
Neoplasms, other ... 210-239	1	1	-	1	-	-	-	-	-	-	-	-
Nutritional deficiency	16	10	-	10	6	-	299	205	4	201	69	25
Vitamin deficiency ... 260-266	-	-	-	-	-	-	-	-	-	-	-	-
Protein malnutrition ... 267	7	3	-	3	4	-	8	1	-	1	7	-
Nutritional marasmus ... 268	4	3	-	3	1	-	22	11	-	11	9	2
Other ... 269	5	4	-	4	1	-	269	193	4	189	53	23
Endocrine and metabolic diseases ... 240-258,270-279	2	2	2	-	-	-	-	-	-	-	-	-
Deficiency anemias ... 280,281	-	-	-	-	-	-	3	3	2	1	-	-
Other diseases of blood and blood-forming organs ... 282-289	-	-	-	-	-	-	3	1	-	1	2	-
Inflammatory diseases of central nervous system ... 320-324	18	11	-	11	2	5	24	19	2	17	2	3
Other diseases of nervous system and sense organs ... 310-315,330-389	15	12	-	12	2	1	7	6	-	6	-	1
Diseases of circulatory system ... 390-458	-	-	-	-	-	-	5	3	-	3	1	1
Pneumonia and influenza . 470-486	117	97	22	75	13	7	119	87	10	77	24	8
Other diseases of respiratory system ... 460-466,490-519	44	36	5	31	6	2	14	8	-	8	5	1
Diseases of digestive system ... 520-577	8	5	2	3	-	3	5	3	-	3	1	1
Diseases of genito-urinary system ... 580-629	-	-	-	-	-	-	6	6	-	6	-	-
Diseases of skin and subcutaneous tissue ... 680-709	7	6	2	4	1	-	5	5	-	5	-	-
Diseases of musculoskeletal system ... 710-738	-	-	-	-	-	-	-	-	-	-	-	-
Congenital anomalies	15	11	8	3	3	1	6	5	1	4	-	1
Nervous system ... 740-743	2	2	2	-	-	-	1	1	-	1	-	-
Circulatory system ... 746,747	8	6	5	1	2	-	1	-	-	-	-	1
Respiratory system ... 748	-	-	-	-	-	-	-	-	-	-	-	-
Digestive system ... 749-751	2	2	1	1	-	-	2	2	-	2	-	-
Genito-urinary system . 752,753	-	-	-	-	-	-	-	-	-	-	-	-
Musculoskeletal system . 754-756	-	-	-	-	-	-	-	-	-	-	-	-
Down's disease ... 759.3	3	1	-	1	1	1	2	2	1	1	-	-
Other anomalies ... 744,745, 757,758, Rest of 759	-	-	-	-	-	-	-	-	-	-	-	-
Certain perinatal causes ... 760-778	135	135	134	1	-	-	128	128	124	4	-	-
Symptoms ... 780-789	10	8	3	5	2	-	140	110	8	102	26	4
Sudden death ... 795	5	4	1	3	-	1	-	-		-	-	-
Other ill-defined conditions ... 790-792,796	19	14	8	6	2	3	-	-	-	-	-	-
External causes ... E800-E999	23	9	5	4	7	7	2	2	-	2	-	-

DEATH RATES
Rural Departments, Chaco Province—ARGENTINA

Death Rates from Underlying and Associated Causes in Children Under 5 Years, by Age Group, in Two-Year Period, 1968–1970.

Cause	Underlying cause						Associated cause					
	Under 5 years	Infant deaths			1 year	2-4 years	Under 5 years	Infant deaths			1 year	2-4 years
		Total	Under 28 days	28 days-11 mos.				Total	Under 28 days	28 days-11 mos.		
All causes	2387.3	8500.0	3089.7	5410.3	1628.6	288.6	2464.3	8333.3	2038.5	6294.9	2200.0	288.6
Infective and parasitic diseases	1140.9	3871.8	628.2	3243.6	985.7	139.5	276.7	756.4	102.6	653.8	328.6	72.2
Amebiasis 006	-	-	-	-	-	-	-	-	-	-	-	-
Diarrheal disease 009	875.6	3141.0	282.1	2859.0	742.9	48.1	191.1	500.0	25.6	474.4	228.6	57.7
Other intestinal infectious diseases 000-005,007,008	2.9	-	-	-	-	4.8	2.9	12.8	-	12.8	-	-
Tuberculosis 010-019	34.2	38.5	-	38.5	42.9	28.9	5.7	-	-	-	14.3	4.8
Diphtheria 032	-	-	-	-	-	-	-	-	-	-	-	-
Whooping cough 033	57.0	141.0	12.8	128.2	71.4	19.2	5.7	12.8	-	12.8	14.3	-
Tetanus 037	42.8	192.3	192.3	-	-	-	-	-	-	-	-	-
Septicemia 038	20.0	89.7	64.1	25.6	-	-	25.7	76.9	38.5	38.5	42.9	-
Measles 055	85.6	179.5	-	179.5	114.3	38.5	8.6	12.8	-	12.8	-	9.6
Congenital syphilis 090	17.1	76.9	76.9	-	-	-	-	-	-	-	-	-
Moniliasis 112	-	-	-	-	-	-	34.2	128.2	38.5	89.7	28.6	-
Helminthiases 120-129	-	-	-	-	-	-	-	-	-	-	-	-
Other Rest of 000-136	5.7	12.8	-	12.8	14.3	-	2.9	12.8	-	12.8	-	-
Malignant neoplasms 140-209	5.7	-	-	-	14.3	4.8	2.9	-	-	-	14.3	-
Neoplasms, other 210-239	2.9	12.8	-	12.8	-	-	-	-	-	-	-	-
Nutritional deficiency	45.6	128.2	-	128.2	85.7	-	852.8	2628.2	51.3	2576.9	985.7	120.3
Vitamin deficiency 260-266	-	-	-	-	-	-	-	-	-	-	-	-
Protein malnutrition 267	20.0	38.5	-	38.5	57.1	-	22.8	12.8	-	12.8	100.0	-
Nutritional marasmus 268	11.4	38.5	-	38.5	14.3	-	62.7	141.0	-	141.0	128.6	9.6
Other 269	14.3	51.3	-	51.3	14.3	-	767.3	2474.4	51.3	2423.1	757.1	110.6
Endocrine and metabolic diseases 240-258,270-279	5.7	25.6	25.6	-	-	-	-	-	-	-	-	-
Deficiency anemias 280,281	-	-	-	-	-	-	8.6	38.5	25.6	12.8	-	-
Other diseases of blood and blood-forming organs 282-289	-	-	-	-	-	-	8.6	12.8	-	12.8	28.6	-
Inflammatory diseases of central nervous system 320-324	51.3	141.0	-	141.0	28.6	24.1	68.5	243.6	25.6	217.9	28.6	14.4
Other diseases of nervous system and sense organs 310-315,330-389	42.8	153.8	-	153.8	28.6	4.8	20.0	76.9	-	76.9	-	4.8
Diseases of circulatory system 390-458	-	-	-	-	-	-	14.3	38.5	-	38.5	14.3	4.8
Pneumonia and influenza 470-486	333.7	1243.6	282.1	961.5	185.7	33.7	339.4	1115.4	128.2	987.2	342.9	38.5
Other diseases of respiratory system 460-466,490-519	125.5	461.5	64.1	397.4	85.7	9.6	39.9	102.6	-	102.6	71.4	4.8
Diseases of digestive system 520-577	22.8	64.1	25.6	38.5	-	14.4	14.3	38.5	-	38.5	14.3	4.8
Diseases of genito-urinary system 580-629	-	-	-	-	-	-	17.1	76.9	-	76.9	-	-
Diseases of skin and subcutaneous tissue 680-709	20.0	76.9	25.6	51.3	14.3	-	14.3	64.1	-	64.1	-	-
Diseases of musculoskeletal system 710-738	-	-	-	-	-	-	-	-	-	-	-	-
Congenital anomalies	42.8	141.0	102.6	38.5	42.9	4.8	17.1	64.1	12.8	51.3	-	4.8
Nervous system 740-743	5.7	25.6	25.6	-	-	-	2.9	12.8	-	12.8	-	-
Circulatory system 746,747	22.8	76.9	64.1	12.8	28.6	-	2.9	-	-	-	-	4.8
Respiratory system 748	-	-	-	-	-	-	-	-	-	-	-	-
Digestive system 749-751	5.7	25.6	12.8	12.8	-	-	5.7	25.6	-	25.6	-	-
Genito-urinary system 752,753	-	-	-	-	-	-	-	-	-	-	-	-
Musculoskeletal system 754-756	-	-	-	-	-	-	-	-	-	-	-	-
Down's disease 759.3	8.6	12.8	-	12.8	14.3	4.8	5.7	25.6	12.8	12.8	-	-
Other anomalies 744,745, 757,758, Rest of 759	-	-	-	-	-	-	-	-	-	-	-	-
Certain perinatal causes 760-778	385.1	1730.8	1717.9	12.8	-	-	369.1	1641.0	1589.7	51.3	-	-
Symptoms 780-789	28.5	102.6	38.5	64.1	28.6	-	399.3	1410.3	102.6	1307.7	371.4	19.2
Sudden death 795	14.3	51.3	12.8	38.5	-	4.8	-	-	-	-	-	-
Other ill-defined conditions 790-792,796	54.2	179.5	102.6	76.9	28.6	14.4	-	-	-	-	-	-
External causes E800-E999	65.6	115.4	64.1	51.3	100.0	33.7	5.7	25.6	-	25.6	-	-

DEATHS
ARGENTINA—San Juan Province

Underlying and Associated Causes of Death in Children Under 5 Years, by Age Group, in Two-Year Period, 1968–1970.

Cause	Underlying cause						Associated cause					
	Under 5 years	Infant deaths			1 year	2-4 years	Under 5 years	Infant deaths			1 year	2-4 years
		Total	Under 28 days	28 days-11 mos.				Total	Under 28 days	28 days-11 mos.		
All causes	2156	1900	906	994	153	103	4176	3785	1808	1977	256	135
Infective and parasitic diseases	740	635	161	474	66	39	576	528	216	312	32	16
Amebiasis 006	-	-	-	-	-	-	-	-	-	-	-	-
Diarrheal disease 009	538	510	128	382	23	5	263	232	68	164	22	9
Other intestinal infectious diseases 000-005,007,008	3	3	-	3	-	-	1	-	-	-	1	-
Tuberculosis 010-019	12	4	-	4	1	7	4	2	-	2	-	2
Diphtheria 032	-	-	-	-	-	-	-	-	-	-	-	-
Whooping cough 033	20	14	-	14	5	1	1	-	-	-	1	-
Tetanus 037	3	3	3	-	-	-	-	-	-	-	-	-
Septicemia 038	28	26	25	1	-	2	94	91	59	32	2	1
Measles 055	96	43	-	43	34	19	6	1	-	1	2	3
Congenital syphilis 090	6	6	2	4	-	-	1	1	-	1	-	-
Moniliasis 112	3	3	3	-	-	-	204	199	89	110	4	1
Helminthiases 120-129	-	-	-	-	-	-	-	-	-	-	-	-
Other Rest of 000-136	31	23	-	23	3	5	2	2	-	2	-	-
Malignant neoplasms 140-209	5	2	-	2	1	2	1	1	-	1	-	-
Neoplasms, other 210-239	1	1	1	-	-	-	1	1	1	-	-	-
Nutritional deficiency	72	55	2	53	11	6	535	456	35	421	52	27
Vitamin deficiency 260-266	-	-	-	-	-	-	1	1	-	1	-	-
Protein malnutrition 267	8	1	-	1	3	4	2	1	-	1	1	-
Nutritional marasmus 268	58	50	-	50	7	1	119	108	5	103	5	6
Other 269	6	4	2	2	1	1	413	346	30	316	46	21
Endocrine and metabolic diseases 240-258,270-279	5	3	2	1	-	2	7	6	4	2	-	1
Deficiency anemias 280,281	-	-	-	-	-	-	22	22	19	3	-	-
Other diseases of blood and blood-forming organs 282-289	3	1	-	1	1	1	55	52	3	49	2	1
Inflammatory diseases of central nervous system 320-324	50	38	1	37	4	8	44	33	5	28	7	4
Other diseases of nervous system and sense organs 310-315,330-389	20	13	1	12	4	3	66	54	9	45	4	8
Diseases of circulatory system 390-458	3	1	-	1	1	1	50	37	5	32	6	7
Pneumonia and influenza 470-486	322	304	85	219	13	5	536	437	156	281	62	37
Other diseases of respiratory system 460-466,490-519	109	90	3	87	16	3	105	89	5	84	11	5
Diseases of digestive system 520-577	19	15	4	11	3	1	140	126	21	105	11	3
Diseases of genito-urinary system 580-629	7	6	-	6	-	1	20	16	2	14	4	-
Diseases of skin and subcutaneous tissue 680-709	10	10	4	6	-	-	34	32	14	18	2	-
Diseases of musculoskeletal system 710-738	-	-	-	-	-	-	-	-	-	-	-	-
Congenital anomalies	98	86	43	43	7	5	66	59	29	30	6	1
Nervous system 740-743	23	19	14	5	1	3	4	3	2	1	1	-
Circulatory system 746,747	33	29	9	20	3	1	27	25	10	15	1	1
Respiratory system 748	1	1	1	-	-	-	-	-	-	-	-	-
Digestive system 749-751	32	30	14	16	1	1	9	9	5	4	-	-
Genito-urinary system 752,753	1	-	-	-	1	-	6	6	5	1	-	-
Musculoskeletal system 754-756	5	4	4	-	1	-	3	3	3	-	-	-
Down's disease 759.3	2	2	-	2	-	-	16	12	4	8	4	-
Other anomalies 744,745, 757,758, Rest of 759	1	1	1	-	-	-	1	1	-	1	-	-
Certain perinatal causes 760-778	591	591	590	1	-	-	1172	1172	1154	18	-	-
Symptoms 780-789	4	4	-	4	-	-	700	631	120	511	47	22
Sudden death 795	22	22	5	17	-	-	-	-	-	-	-	-
Other ill-defined conditions 790-792,796	5	5	1	4	-	-	1	1	-	1	-	-
External causes E800-E999	70	18	3	15	26	26	45	32	10	22	10	3

Death Rates from Underlying and Associated Causes in Children Under 5 Years, by Age Group, in Two-Year Period, 1968–1970.

Cause	Underlying cause						Associated cause					
	Under 5 years	Infant deaths			1 year	2-4 years	Under 5 years	Infant deaths			1 year	2-4 years
		Total	Under 28 days	28 days-11 mos.				Total	Under 28 days	28 days-11 mos.		
All causes	2063.9	8133.6	3878.4	4255.1	727.2	163.1	3997.7	16202.9	7739.7	8463.2	1216.7	213.8
Infective and parasitic diseases	708.4	2718.3	689.2	2029.1	313.7	61.8	551.4	2260.3	924.7	1335.6	152.1	25.3
Amebiasis 006	-	-	-	-	-	-	-	-	-	-	-	-
Diarrheal disease 009	515.0	2183.2	547.9	1635.3	109.3	7.9	251.8	993.2	291.1	702.1	104.6	14.3
Other intestinal infectious diseases 000-005,007,008	2.9	12.8	-	12.8	-	-	1.0	-	-	-	4.8	-
Tuberculosis 010-019	11.5	17.1	-	17.1	4.8	11.1	3.8	8.6	-	8.6	-	3.2
Diphtheria 032	-	-	-	-	-	-	-	-	-	-	-	-
Whooping cough 033	19.1	59.9	-	59.9	23.8	1.6	1.0	-	-	-	4.8	-
Tetanus 037	2.9	12.8	12.8	-	-	-	-	-	-	-	-	-
Septicemia 038	26.8	111.3	107.0	4.3	-	3.2	90.0	389.6	252.6	137.0	9.5	1.6
Measles 055	91.9	184.1	-	184.1	161.6	30.1	5.7	4.3	-	4.3	9.5	4.8
Congenital syphilis 090	5.7	25.7	8.6	17.1	-	-	1.0	4.3	-	4.3	-	-
Moniliasis 112	2.9	12.8	12.8	-	-	-	195.3	851.9	381.0	470.9	19.0	1.6
Helminthiases 120-129	-	-	-	-	-	-	-	-	-	-	-	-
Other Rest of 000-136	29.7	98.5	-	98.5	14.3	7.9	1.9	8.6	-	8.6	-	-
Malignant neoplasms 140-209	4.8	8.6	-	8.6	4.8	3.2	1.0	4.3	-	4.3	-	-
Neoplasms, other 210-239	1.0	4.3	4.3	-	-	-	1.0	4.3	4.3	-	-	-
Nutritional deficiency	68.9	235.4	8.6	226.9	52.3	9.5	512.2	1952.1	149.8	1802.2	247.1	42.8
Vitamin deficiency 260-266	-	-	-	-	-	-	1.0	4.3	-	4.3	-	-
Protein malnutrition 267	7.7	4.3	-	4.3	14.3	6.3	1.9	4.3	-	4.3	4.8	-
Nutritional marasmus 268	55.5	214.0	-	214.0	33.3	1.6	113.9	462.3	21.4	440.9	23.8	9.5
Other 269	5.7	17.1	8.6	8.6	4.8	1.6	395.4	1481.2	128.4	1352.7	218.6	33.3
Endocrine and metabolic diseases 240-258,270-279	4.8	12.8	8.6	4.3	-	3.2	6.7	25.7	17.1	8.6	-	1.6
Deficiency anemias 280,281	-	-	-	-	-	-	21.1	94.2	81.3	12.8	-	-
Other diseases of blood and blood-forming organs 282-289	2.9	4.3	-	4.3	4.8	1.6	52.7	222.6	12.8	209.8	9.5	1.6
Inflammatory diseases of central nervous system 320-324	47.9	162.7	4.3	158.4	19.0	12.7	42.1	141.3	21.4	119.9	33.3	6.3
Other diseases of nervous system and sense organs 310-315,330-389	19.1	55.7	4.3	51.4	19.0	4.8	63.2	231.2	38.5	192.6	19.0	12.7
Diseases of circulatory system 390-458	2.9	4.3	-	4.3	4.8	1.6	47.9	158.4	21.4	137.0	28.5	11.1
Pneumonia and influenza 470-486	308.3	1301.4	363.9	937.5	61.8	7.9	513.1	1870.7	667.8	1202.9	294.7	58.6
Other diseases of respiratory system 460-466,490-519	104.3	385.3	12.8	372.4	76.0	4.8	100.5	381.0	21.4	359.6	52.3	7.9
Diseases of digestive system 520-577	18.2	64.2	17.1	47.1	14.3	1.6	134.0	539.4	89.9	449.5	52.3	4.8
Diseases of genito-urinary system 580-629	6.7	25.7	-	25.7	-	1.6	19.1	68.5	8.6	59.9	19.0	-
Diseases of skin and subcutaneous tissue 680-709	9.6	42.8	17.1	25.7	-	-	32.5	137.0	59.9	77.1	9.5	-
Diseases of musculoskeletal system 710-738	-	-	-	-	-	-	-	-	-	-	-	-
Congenital anomalies	93.8	368.2	184.1	184.1	33.3	7.9	63.2	252.6	124.1	128.4	28.5	1.6
Nervous system 740-743	22.0	81.3	39.9	21.4	4.8	4.8	3.8	12.8	8.6	4.3	4.8	-
Circulatory system 746,747	31.6	124.1	38.5	85.6	14.3	1.6	25.8	107.0	42.8	64.2	4.8	1.6
Respiratory system 748	1.0	4.3	4.3	-	-	-	-	-	-	-	-	-
Digestive system 749-751	30.6	128.4	59.9	68.5	4.8	1.6	8.6	38.5	21.4	17.1	-	-
Genito-urinary system 752,753	1.0	-	-	-	4.8	-	5.7	25.7	21.4	4.3	-	-
Musculoskeletal system 754-756	4.8	17.1	17.1	-	4.8	-	2.9	12.8	12.8	-	-	-
Down's disease 759.3	1.9	8.6	-	8.6	-	-	15.3	51.4	17.1	34.2	19.0	-
Other anomalies 744,745, 757,758, Rest of 759	1.0	4.3	4.3	-	-	-	1.0	4.3	-	4.3	-	-
Certain perinatal causes 760-778	565.8	2530.0	2525.7	4.3	-	-	1122.0	5017.1	4940.1	77.1	-	-
Symptoms 780-789	3.8	17.1	-	17.1	-	-	670.1	2701.2	513.7	2187.5	223.4	34.8
Sudden death 795	21.1	94.2	21.4	72.8	-	-	-	-	-	-	-	-
Other ill-defined conditions 790-792,796	4.8	21.4	4.3	17.1	-	-	1.0	4.3	-	4.3	-	-
External causes E800-E999	67.0	77.1	12.8	64.2	123.6	41.2	43.1	137.0	42.8	94.2	47.5	4.8

DEATHS
ARGENTINA—San Juan Province, City of San Juan

Underlying and Associated Causes of Death in Children Under 5 Years, by Age Group, in Two-Year Period, 1968–1970.

Cause	Underlying cause						Associated cause					
	Under 5 years	Infant deaths			1 year	2-4 years	Under 5 years	Infant deaths			1 year	2-4 years
		Total	Under 28 days	28 days-11 mos.				Total	Under 28 days	28 days-11 mos.		
All causes	326	295	172	123	20	11	635	587	333	254	33	15
Infective and parasitic diseases	90	81	24	57	6	3	82	80	36	44	2	-
Amebiasis 006	-	-	-	-	-	-	-	-	-	-	-	-
Diarrheal disease 009	64	62	18	44	1	1	30	29	13	16	1	-
Other intestinal infectious diseases 000-005,007,008	-	-	-	-	-	-	-	-	-	-	-	-
Tuberculosis 010-019	-	-	-	-	-	-	-	-	-	-	-	-
Diphtheria 032	-	-	-	-	-	-	-	-	-	-	-	-
Whooping cough 033	3	3	-	3	-	-	-	-	-	-	-	-
Tetanus 037	1	1	1	-	-	-	-	-	-	-	-	-
Septicemia 038	6	6	5	1	-	-	17	16	9	7	1	-
Measles 055	10	5	-	5	4	1	-	-	-	-	-	-
Congenital syphilis 090	1	1	-	1	-	-	-	-	-	-	-	-
Moniliasis 112	-	-	-	-	-	-	34	34	14	20	-	-
Helminthiases 120-129	-	-	-	-	-	-	-	-	-	-	-	-
Other Rest of 000-136	5	3	-	3	1	1	1	1	-	1	-	-
Malignant neoplasms 140-209	1	1	-	1	-	-	1	1	-	1	-	-
Neoplasms, other 210-239	-	-	-	-	-	-	-	-	-	-	-	-
Nutritional deficiency	4	4	1	3	-	-	62	51	4	47	8	3
Vitamin deficiency 260-266	-	-	-	-	-	-	-	-	-	-	-	-
Protein malnutrition 267	-	-	-	-	-	-	-	-	-	-	-	-
Nutritional marasmus 268	3	3	-	3	-	-	17	16	1	15	-	1
Other 269	1	1	1	-	-	-	45	35	3	32	8	2
Endocrine and metabolic diseases 240-258,270-279	1	-	-	-	-	1	3	2	2	-	-	1
Deficiency anemias 280,281	-	-	-	-	-	-	4	4	3	1	-	-
Other diseases of blood and blood-forming organs 282-289	1	-	-	-	-	1	9	9	2	7	-	-
Inflammatory diseases of central nervous system 320-324	11	8	-	8	1	2	4	3	2	1	-	1
Other diseases of nervous system and sense organs 310-315,330-389	5	3	-	3	1	1	7	5	2	3	1	1
Diseases of circulatory system 390-458	-	-	-	-	-	-	10	6	-	6	3	1
Pneumonia and influenza 470-486	34	34	10	24	-	-	68	58	24	34	6	4
Other diseases of respiratory system 460-466,490-519	12	9	-	9	3	-	12	11	2	9	1	-
Diseases of digestive system 520-577	4	3	2	1	1	-	21	19	4	15	2	-
Diseases of genito-urinary system 580-629	2	2	-	2	-	-	1	1	-	1	-	-
Diseases of skin and subcutaneous tissue 680-709	3	3	2	1	-	-	7	7	3	4	-	-
Diseases of musculoskeletal system 710-738	-	-	-	-	-	-	-	-	-	-	-	-
Congenital anomalies	21	18	10	8	3	-	11	8	2	6	2	1
Nervous system 740-743	5	5	4	1	-	-	-	-	-	-	-	-
Circulatory system 746,747	10	7	-	7	3	-	5	4	1	3	-	1
Respiratory system 748	-	-	-	-	-	-	-	-	-	-	-	-
Digestive system 749-751	4	4	4	-	-	-	1	1	-	1	-	-
Genito-urinary system 752,753	-	-	-	-	-	-	1	1	1	-	-	-
Musculoskeletal system 754-756	1	1	1	-	-	-	-	-	-	-	-	-
Down's disease 759.3	-	-	-	-	-	-	4	2	-	2	2	-
Other anomalies 744,745, 757,758, Rest of 759	1	1	1	-	-	-	-	-	-	-	-	-
Certain perinatal causes 760-778	123	123	122	1	-	-	230	230	227	3	-	-
Symptoms 780-789	1	1	-	1	-	-	91	84	18	66	5	2
Sudden death 795	1	1	1	-	-	-	-	-	-	-	-	-
Other ill-defined conditions 790-792,796	-	-	-	-	-	-	-	-	-	-	-	-
External causes E800-E999	12	4	-	4	5	3	12	8	2	6	3	1

DEATH RATES
City of San Juan, San Juan Province—ARGENTINA

Death Rates from Underlying and Associated Causes in Children Under 5 Years, by Age Group, in Two-Year Period, 1968–1970.

Cause	Underlying cause						Associated cause					
	Under 5 years	Infant deaths			1 year	2-4 years	Under 5 years	Infant deaths			1 year	2-4 years
		Total	Under 28 days	28 days-11 mos.				Total	Under 28 days	28 days-11 mos.		
All causes	1291.6	5068.7	2955.3	2113.4	395.3	72.6	2515.8	10085.9	5721.6	4364.3	652.2	98.9
Infective and parasitic diseases	356.6	1391.8	412.4	979.4	118.6	19.8	324.9	1374.6	618.6	756.0	39.5	-
Amebiasis 006	-	-	-	-	-	-	-	-	-	-	-	-
Diarrheal disease 009	253.6	1065.3	309.3	756.0	19.8	6.6	118.9	498.3	223.4	274.9	19.8	-
Other intestinal infectious diseases 000-005,007,008	-	-	-	-	-	-	-	-	-	-	-	-
Tuberculosis 010-019	-	-	-	-	-	-	-	-	-	-	-	-
Diphtheria 032	-	-	-	-	-	-	-	-	-	-	-	-
Whooping cough 033	11.9	51.5	-	51.5	-	-	-	-	-	-	-	-
Tetanus 037	4.0	17.2	17.2	-	-	-	-	-	-	-	-	-
Septicemia 038	23.8	103.1	85.9	17.2	-	-	67.4	274.9	154.6	120.3	19.8	-
Measles 055	39.6	85.9	-	85.9	79.1	6.6	-	-	-	-	-	-
Congenital syphilis 090	4.0	17.2	-	17.2	-	-	-	-	-	-	-	-
Moniliasis 112	-	-	-	-	-	-	134.7	584.2	240.5	343.6	-	-
Helminthiases 120-129	-	-	-	-	-	-	-	-	-	-	-	-
Other Rest of 000-136	19.8	51.5	-	51.5	19.8	6.6	4.0	17.2	-	17.2	-	-
Malignant neoplasms 140-209	4.0	17.2	-	17.2	-	-	4.0	17.2	-	17.2	-	-
Neoplasms, other 210-239	-	-	-	-	-	-	-	-	-	-	-	-
Nutritional deficiency	15.8	68.7	17.2	51.5	-	-	245.6	876.3	68.7	807.6	158.1	19.8
Vitamin deficiency 260-266	-	-	-	-	-	-	-	-	-	-	-	-
Protein malnutrition 267	-	-	-	-	-	-	-	-	-	-	-	-
Nutritional marasmus 268	11.9	51.5	-	51.5	-	-	67.4	274.9	17.2	257.7	-	6.6
Other 269	4.0	17.2	17.2	-	-	-	178.3	601.4	51.5	549.8	158.1	13.2
Endocrine and metabolic diseases 240-258,270-279	4.0	-	-	-	-	6.6	11.9	34.4	34.4	-	-	6.6
Deficiency anemias 280,281	-	-	-	-	-	-	15.8	68.7	51.5	17.2	-	-
Other diseases of blood and blood-forming organs 282-289	4.0	-	-	-	-	6.6	35.7	154.6	34.4	120.3	-	-
Inflammatory diseases of central nervous system 320-324	43.6	137.5	-	137.5	19.8	13.2	15.8	51.5	34.4	17.2	-	6.6
Other diseases of nervous system and sense organs 310-315,330-389	19.8	51.5	-	51.5	19.8	6.6	27.7	85.9	34.4	51.5	19.8	6.6
Diseases of circulatory system 390-458	-	-	-	-	-	-	39.6	103.1	-	103.1	59.3	6.6
Pneumonia and influenza 470-486	134.7	584.2	171.8	412.4	-	-	269.4	996.6	412.4	584.2	118.6	26.4
Other diseases of respiratory system 460-466,490-519	47.5	154.6	-	154.6	59.3	-	47.5	189.0	34.4	154.6	19.8	-
Diseases of digestive system 520-577	15.8	51.5	34.4	17.2	19.8	-	83.2	326.5	68.7	257.7	39.5	-
Diseases of genito-urinary system 580-629	7.9	34.4	-	34.4	-	-	4.0	17.2	-	17.2	-	-
Diseases of skin and subcutaneous tissue 680-709	11.9	51.5	34.4	17.2	-	-	27.7	120.3	51.5	68.7	-	-
Diseases of musculoskeletal system 710-738	-	-	-	-	-	-	-	-	-	-	-	-
Congenital anomalies	83.2	309.3	171.8	137.5	59.3	-	43.6	137.5	34.4	103.1	39.5	6.6
Nervous system 740-743	19.8	85.9	68.7	17.2	-	-	-	-	-	-	-	-
Circulatory system 746,747	39.6	120.3	-	120.3	59.3	-	19.8	68.7	17.2	51.5	-	6.6
Respiratory system 748	-	-	-	-	-	-	-	-	-	-	-	-
Digestive system 749-751	15.8	68.7	68.7	-	-	-	4.0	17.2	-	17.2	-	-
Genito-urinary system 752,753	-	-	-	-	-	-	4.0	17.2	17.2	-	-	-
Musculoskeletal system 754-756	4.0	17.2	17.2	-	-	-	-	-	-	-	-	-
Down's disease 759.3	-	-	-	-	-	-	15.8	34.4	-	34.4	39.5	-
Other anomalies 744,745, 757,758, Rest of 759	4.0	17.2	17.2	-	-	-	-	-	-	-	-	-
Certain perinatal causes 760-778	487.3	2113.4	2096.2	17.2	-	-	911.3	3951.9	3900.3	51.5	-	-
Symptoms 780-789	4.0	17.2	-	17.2	-	-	360.5	1443.3	309.3	1134.0	98.8	13.2
Sudden death 795	4.0	17.2	17.2	-	-	-	-	-	-	-	-	-
Other ill-defined conditions 790-792,796	-	-	-	-	-	-	-	-	-	-	-	-
External causes E800-E999	47.5	68.7	-	68.7	98.8	19.8	47.5	137.5	34.4	103.1	59.3	6.6

DEATHS
ARGENTINA—San Juan Province, Suburban Departments

Underlying and Associated Causes of Death in Children Under 5 Years, by Age Group, in Two-Year Period, 1968–1970.

Cause	Underlying cause						Associated cause					
	Under 5 years	Infant deaths			1 year	2-4 years	Under 5 years	Infant deaths			1 year	2-4 years
		Total	Under 28 days	28 days-11 mos.				Total	Under 28 days	28 days-11 mos.		
All causes	780	696	353	343	50	34	1571	1468	735	733	75	28
Infective and parasitic diseases	244	220	61	159	17	7	221	207	77	130	10	4
Amebiasis 006	-	-	-	-	-	-	-	-	-	-	-	-
Diarrheal disease 009	177	170	48	122	7	-	104	95	26	69	7	2
Other intestinal infectious diseases 000-005,007,008	1	1	-	1	-	-	-	-	-	-	-	-
Tuberculosis 010-019	3	3	-	3	-	-	1	1	-	1	-	-
Diphtheria 032	-	-	-	-	-	-	-	-	-	-	-	-
Whooping cough 033	4	4	-	4	-	-	-	-	-	-	-	-
Tetanus 037	1	1	1	-	-	-	-	-	-	-	-	-
Septicemia 038	12	11	11	-	-	1	41	39	24	15	1	1
Measles 055	31	18	-	18	9	4	3	1	-	1	1	1
Congenital syphilis 090	2	2	1	1	-	-	-	-	-	-	-	-
Moniliasis 112	-	-	-	-	-	-	71	70	27	43	1	-
Helminthiases 120-129	-	-	-	-	-	-	-	-	-	-	-	-
Other Rest of 000-136	13	10	-	10	1	2	1	1	-	1	-	-
Malignant neoplasms 140-209	3	1	-	1	1	1	-	-	-	-	-	-
Neoplasms, other 210-239	1	1	1	-	-	-	1	1	1	-	-	-
Nutritional deficiency	29	22	-	22	4	3	185	165	14	151	16	4
Vitamin deficiency 260-266	-	-	-	-	-	-	-	-	-	-	-	-
Protein malnutrition 267	1	-	-	-	-	1	1	1	-	1	-	-
Nutritional marasmus 268	24	20	-	20	3	1	32	29	2	27	2	1
Other 269	4	2	-	2	1	1	152	135	12	123	14	3
Endocrine and metabolic diseases 240-258,270-279	4	3	2	1	-	1	2	2	1	1	-	-
Deficiency anemias 280,281	-	-	-	-	-	-	11	11	10	1	-	-
Other diseases of blood and blood-forming organs 282-289	1	1	-	1	-	-	21	21	1	20	-	-
Inflammatory diseases of central nervous system 320-324	16	12	1	11	2	2	17	13	2	11	3	1
Other diseases of nervous system and sense organs 310-315,330-389	7	3	1	2	3	1	26	23	2	21	2	1
Diseases of circulatory system 390-458	-	-	-	-	-	-	13	11	3	8	1	1
Pneumonia and influenza 470-486	109	102	27	75	5	2	190	166	64	102	16	8
Other diseases of respiratory system 460-466,490-519	40	35	2	33	4	1	38	32	-	32	5	1
Diseases of digestive system 520-577	7	5	1	4	2	-	54	50	12	38	3	1
Diseases of genito-urinary system 580-629	3	3	-	3	-	-	4	4	1	3	-	-
Diseases of skin and subcutaneous tissue 680-709	5	5	2	3	-	-	10	9	5	4	1	-
Diseases of musculoskeletal system 710-738	-	-	-	-	-	-	-	-	-	-	-	-
Congenital anomalies	41	37	22	15	2	2	38	37	23	14	1	-
Nervous system 740-743	8	7	5	2	-	1	3	2	1	1	1	-
Circulatory system 746,747	15	15	7	8	-	-	15	15	9	6	-	-
Respiratory system 748	1	1	1	-	-	-	-	-	-	-	-	-
Digestive system 749-751	12	10	6	4	1	1	6	6	4	2	-	-
Genito-urinary system 752,753	-	-	-	-	-	-	5	5	4	1	-	-
Musculoskeletal system 754-756	4	3	3	-	1	-	2	2	2	-	-	-
Down's disease 759.3	1	1	-	1	-	-	6	6	3	3	-	-
Other anomalies 744,745, 757,758, Rest of 759	-	-	-	-	-	-	1	1	-	1	-	-
Certain perinatal causes 760-778	229	229	229	-	-	-	480	480	472	8	-	-
Symptoms 780-789	1	1	-	1	-	-	247	228	44	184	14	5
Sudden death 795	5	5	1	4	-	-	-	-	-	-	-	-
Other ill-defined conditions 790-792,796	1	1	-	1	-	-	-	-	-	-	-	-
External causes E800-E999	34	10	3	7	10	14	13	8	3	5	3	2

DEATH RATES
Suburban Departments, San Juan Province—ARGENTINA

Death Rates from Underlying and Associated Causes in Children Under 5 Years, by Age Group, in Two-Year Period, 1968–1970.

Cause	Underlying cause						Associated cause					
	Under 5 years	Infant deaths			1 year	2-4 years	Under 5 years	Infant deaths			1 year	2-4 years
		Total	Under 28 days	28 days-11 mos.				Total	Under 28 days	28 days-11 mos.		
All causes	2194.7	8787.9	4457.1	4330.8	698.3	158.4	4420.4	18535.4	9280.3	9255.1	1047.5	130.5
Infective and parasitic diseases	686.6	2777.8	770.2	2007.6	237.4	32.6	621.8	2613.6	972.2	1641.4	139.7	18.6
Amebiasis 006	-	-	-	-	-	-	-	-	-	-	-	-
Diarrheal disease 009	498.0	2146.5	606.1	1540.4	97.8	-	292.6	1199.5	328.3	871.2	97.8	9.3
Other intestinal infectious diseases 000-005,007,008	2.8	12.6	-	12.6	-	-	-	-	-	-	-	-
Tuberculosis 010-019	8.4	37.9	-	37.9	-	-	2.8	12.6	-	12.6	-	-
Diphtheria 032	-	-	-	-	-	-	-	-	-	-	-	-
Whooping cough 033	11.3	50.5	-	50.5	-	-	-	-	-	-	-	-
Tetanus 037	2.8	12.6	12.6	-	-	-	-	-	-	-	-	-
Septicemia 038	33.8	138.9	138.9	-	-	4.7	115.4	492.4	303.0	189.4	14.0	4.7
Measles 055	87.2	227.3	-	227.3	125.7	18.6	8.4	12.6	-	12.6	14.0	4.7
Congenital syphilis 090	5.6	25.3	12.6	12.6	-	-	-	-	-	-	-	-
Moniliasis 112	-	-	-	-	-	-	199.8	883.8	340.9	542.9	14.0	-
Helminthiases 120-129	-	-	-	-	-	-	-	-	-	-	-	-
Other Rest of 000-136	36.6	126.3	-	126.3	14.0	9.3	2.8	12.6	-	12.6	-	-
Malignant neoplasms 140-209	8.4	12.6	-	12.6	14.0	4.7	-	-	-	-	-	-
Neoplasms, other 210-239	2.8	12.6	12.6	-	-	-	2.8	12.6	12.6	-	-	-
Nutritional deficiency	81.6	277.8	-	277.8	55.9	14.0	520.5	2083.3	176.8	1906.6	223.5	18.6
Vitamin deficiency 260-266	-	-	-	-	-	-	-	-	-	-	-	-
Protein malnutrition 267	2.8	-	-	-	-	4.7	2.8	12.6	-	12.6	-	-
Nutritional marasmus 268	67.5	252.5	-	252.5	41.9	4.7	90.0	366.2	25.3	340.9	27.9	4.7
Other 269	11.3	25.3	-	25.3	14.0	4.7	427.7	1704.5	151.5	1553.0	195.5	14.0
Endocrine and metabolic diseases 240-258,270-279	11.3	37.9	25.3	12.6	-	4.7	5.6	25.3	12.6	12.6	-	-
Deficiency anemias 280,281	-	-	-	-	-	-	31.0	138.9	126.3	12.6	-	-
Other diseases of blood and blood-forming organs 282-289	2.8	12.6	-	12.6	-	-	59.1	265.2	12.6	252.5	-	-
Inflammatory diseases of central nervous system 320-324	45.0	151.5	12.6	138.9	27.9	9.3	47.8	164.1	25.3	138.9	41.9	4.7
Other diseases of nervous system and sense organs 310-315,330-389	19.7	37.9	12.6	25.3	41.9	4.7	73.2	290.4	25.3	265.2	27.9	4.7
Diseases of circulatory system 390-458	-	-	-	-	-	-	36.6	138.9	37.9	101.0	14.0	4.7
Pneumonia and influenza 470-486	306.7	1287.9	340.9	947.0	69.8	9.3	534.6	2096.0	808.1	1287.9	223.5	37.3
Other diseases of respiratory system 460-466,490-519	112.5	441.9	25.3	416.7	55.9	4.7	106.9	404.0	-	404.0	69.8	4.7
Diseases of digestive system 520-577	19.7	63.1	12.6	50.5	27.9	-	151.9	631.3	151.5	479.8	41.9	4.7
Diseases of genito-urinary system 580-629	8.4	37.9	-	37.9	-	-	11.3	50.5	12.6	37.9	-	-
Diseases of skin and subcutaneous tissue 680-709	14.1	63.1	25.3	37.9	-	-	28.1	113.6	63.1	50.5	14.0	-
Diseases of musculoskeletal system 710-738	-	-	-	-	-	-	-	-	-	-	-	-
Congenital anomalies	115.4	467.2	277.8	189.4	27.9	9.3	106.9	467.2	290.4	176.8	14.0	-
Nervous system 740-743	22.5	88.4	63.1	25.3	-	4.7	8.4	25.3	12.6	12.6	14.0	-
Circulatory system 746,747	42.2	189.4	88.4	101.0	-	-	42.2	189.4	113.6	75.8	-	-
Respiratory system 748	2.8	12.6	12.6	-	-	-	-	-	-	-	-	-
Digestive system 749-751	33.8	126.3	75.8	50.5	14.0	4.7	16.9	75.8	50.5	25.3	-	-
Genito-urinary system 752,753	-	-	-	-	-	-	14.1	63.1	50.5	12.6	-	-
Musculoskeletal system 754-756	11.3	37.9	37.9	-	14.0	-	5.6	25.3	25.3	-	-	-
Down's disease 759.3	2.8	12.6	-	12.6	-	-	16.9	75.8	37.9	37.9	-	-
Other anomalies 744,745, 757,758, Rest of 759	-	-	-	-	-	-	2.8	12.6	-	12.6	-	-
Certain perinatal causes 760-778	644.3	2891.4	2891.4	-	-	-	1350.6	6060.6	5959.6	101.0	-	-
Symptoms 780-789	2.8	12.6	-	12.6	-	-	695.0	2878.8	555.6	2323.2	195.5	23.3
Sudden death 795	14.1	63.1	12.6	50.5	-	-	-	-	-	-	-	-
Other ill-defined conditions 790-792,796	2.8	12.6	-	12.6	-	-	-	-	-	-	-	-
External causes E800-E999	95.7	126.3	37.9	88.4	139.7	65.2	36.6	101.0	37.9	63.1	41.9	9.3

DEATHS
ARGENTINA—San Juan Province, Rural Departments

Underlying and Associated Causes of Death in Children Under 5 Years, by Age Group, in Two-Year Period, 1968–1970.

Cause	Underlying cause						Associated cause					
	Under 5 years	Infant deaths			1 year	2-4 years	Under 5 years	Infant deaths			1 year	2-4 years
		Total	Under 28 days	28 days-11 mos.				Total	Under 28 days	28 days-11 mos.		
All causes	1050	909	381	528	83	58	1970	1730	740	990	148	92
Infective and parasitic diseases	406	334	76	258	43	29	273	241	103	138	20	12
Amebiasis ... 006	-	-	-	-	-	-	-	-	-	-	-	-
Diarrheal disease ... 009	297	278	62	216	15	4	129	108	29	79	14	7
Other intestinal infectious diseases ... 000-005,007,008	2	2	-	2	-	-	1	-	-	-	1	-
Tuberculosis ... 010-019	9	1	-	1	1	7	3	1	-	1	-	2
Diphtheria ... 032	-	-	-	-	-	-	-	-	-	-	-	-
Whooping cough ... 033	13	7	-	7	5	1	1	-	-	-	1	-
Tetanus ... 037	1	1	1	-	-	-	-	-	-	-	-	-
Septicemia ... 038	10	9	9	-	-	1	36	36	26	10	-	-
Measles ... 055	55	20	-	20	21	14	3	-	-	-	1	2
Congenital syphilis ... 090	3	3	1	2	-	-	1	1	-	1	-	-
Moniliasis ... 112	3	3	3	-	-	-	99	95	48	47	3	1
Helminthiases ... 120-129	-	-	-	-	-	-	-	-	-	-	-	-
Other ... Rest of 000-136	13	10	-	10	1	2	-	-	-	-	-	-
Malignant neoplasms ... 140-209	1	-	-	-	-	1	-	-	-	-	-	-
Neoplasms, other ... 210-239	-	-	-	-	-	-	-	-	-	-	-	-
Nutritional deficiency	39	29	1	28	7	3	288	240	17	223	28	20
Vitamin deficiency ... 260-266	-	-	-	-	-	-	1	1	-	1	-	-
Protein malnutrition ... 267	7	1	-	1	3	3	1	-	-	-	1	-
Nutritional marasmus ... 268	31	27	-	27	4	-	70	63	2	61	3	4
Other ... 269	1	1	1	-	-	-	216	176	15	161	24	16
Endocrine and metabolic diseases ... 240-258,270-279	-	-	-	-	-	-	2	2	1	1	-	-
Deficiency anemias ... 280,281	-	-	-	-	-	-	7	7	6	1	-	-
Other diseases of blood and blood-forming organs ... 282-289	1	-	-	-	1	-	25	22	-	22	2	1
Inflammatory diseases of central nervous system ... 320-324	23	18	-	18	1	4	23	17	1	16	4	2
Other diseases of nervous system and sense organs ... 310-315,330-389	8	7	-	7	-	1	33	26	5	21	1	6
Diseases of circulatory system ... 390-458	3	1	-	1	1	1	27	20	2	18	2	5
Pneumonia and influenza ... 470-486	179	168	48	120	8	3	278	213	68	145	40	25
Other diseases of respiratory system ... 460-466,490-519	57	46	1	45	9	2	55	46	3	43	5	4
Diseases of digestive system ... 520-577	8	7	1	6	-	1	65	57	5	52	6	2
Diseases of genito-urinary system ... 580-629	2	1	-	1	-	1	15	11	1	10	4	-
Diseases of skin and subcutaneous tissue ... 680-709	2	2	-	2	-	-	17	16	6	10	1	-
Diseases of musculoskeletal system ... 710-738	-	-	-	-	-	-	-	-	-	-	-	-
Congenital anomalies	36	31	11	20	2	3	17	14	4	10	3	-
Nervous system ... 740-743	10	7	5	2	1	2	1	1	1	-	-	-
Circulatory system ... 746,747	8	7	2	5	-	1	7	6	-	6	1	-
Respiratory system ... 748	-	-	-	-	-	-	-	-	-	-	-	-
Digestive system ... 749-751	16	16	4	12	-	-	2	2	1	1	-	-
Genito-urinary system ... 752,753	1	-	-	-	1	-	-	-	-	-	-	-
Musculoskeletal system ... 754-756	-	-	-	-	-	-	1	1	1	-	-	-
Down's disease ... 759.3	1	1	-	1	-	-	6	4	1	3	2	-
Other anomalies ... 744,745, 757,758, Rest of 759	-	-	-	-	-	-	-	-	-	-	-	-
Certain perinatal causes ... 760-778	239	239	239	-	-	-	462	462	455	7	-	-
Symptoms ... 780-789	2	2	-	2	-	-	362	319	58	261	28	15
Sudden death ... 795	16	16	3	13	-	-	-	-	-	-	-	-
Other ill-defined conditions ... 790-792,796	4	4	1	3	-	-	1	1	-	1	-	-
External causes ... E800-E999	24	4	-	4	11	9	20	16	5	11	4	-

DEATH RATES
Rural Departments, San Juan Province—ARGENTINA

Death Rates from Underlying and Associated Causes in Children Under 5 Years, by Age Group, in Two-Year Period, 1968–1970.

Cause	Underlying cause						Associated cause					
	Under 5 years	Infant deaths			1 year	2-4 years	Under 5 years	Infant deaths			1 year	2-4 years
		Total	Under 28 days	28 days-11 mos.				Total	Under 28 days	28 days-11 mos.		
All causes	2403.8	9449.1	3960.5	5488.6	941.0	218.7	4510.1	17983.4	7692.3	10291.1	1678.0	346.9
Infective and parasitic diseases	929.5	3471.9	790.0	2681.9	487.5	109.4	625.0	2505.2	1070.7	1434.5	226.8	45.2
Amebiasis 006	-	-	-	-	-	-	-	-	-	-	-	-
Diarrheal disease 009	679.9	2889.8	644.5	2245.3	170.1	15.1	295.3	1122.7	301.5	821.2	158.7	26.4
Other intestinal infectious diseases 000-005,007,008	4.6	20.8	-	20.8	-	-	2.3	-	-	-	11.3	-
Tuberculosis 010-019	20.6	10.4	-	10.4	11.3	26.4	6.9	10.4	-	10.4	-	7.5
Diphtheria 032	-	-	-	-	-	-	-	-	-	-	-	-
Whooping cough 033	29.8	72.8	-	72.8	56.7	3.8	2.3	-	-	-	11.3	-
Tetanus 037	2.3	10.4	10.4	-	-	-	-	-	-	-	-	-
Septicemia 038	22.9	93.6	93.6	-	-	3.8	82.4	374.2	270.3	104.0	-	-
Measles 055	125.9	207.9	-	207.9	238.1	52.8	6.9	-	-	-	11.3	7.5
Congenital syphilis 090	6.9	31.2	10.4	20.8	-	-	2.3	10.4	-	10.4	-	-
Moniliasis 112	6.9	31.2	31.2	-	-	-	226.6	987.5	499.0	488.6	34.0	3.8
Helminthiases 120-129	-	-	-	-	-	-	-	-	-	-	-	-
Other Rest of 000-136	29.8	104.0	-	104.0	11.3	7.5	-	-	-	-	-	-
Malignant neoplasms 140-209	2.3	-	-	-	-	3.8	-	-	-	-	-	-
Neoplasms, other 210-239	-	-	-	-	-	-	-	-	-	-	-	-
Nutritional deficiency	89.3	301.5	10.4	291.1	79.4	11.3	659.3	2494.8	176.7	2318.1	317.5	75.4
Vitamin deficiency 260-266	-	-	-	-	-	-	2.3	10.4	-	10.4	-	-
Protein malnutrition 267	16.0	10.4	-	10.4	34.0	11.3	2.3	-	-	-	11.3	-
Nutritional marasmus 268	71.0	280.7	-	280.7	45.4	-	160.3	654.9	20.8	634.1	34.0	15.1
Other 269	2.3	10.4	10.4	-	-	-	494.5	1829.5	155.9	1673.6	272.1	60.3
Endocrine and metabolic diseases 240-258,270-279	-	-	-	-	-	-	4.6	20.8	10.4	10.4	-	-
Deficiency anemias 280,281	-	-	-	-	-	-	16.0	72.8	62.4	10.4	-	-
Other diseases of blood and blood-forming organs 282-289	2.3	-	-	-	11.3	-	57.2	228.7	-	228.7	22.7	3.8
Inflammatory diseases of central nervous system 320-324	52.7	187.1	-	187.1	11.3	15.1	52.7	176.7	10.4	166.3	45.4	7.5
Other diseases of nervous system and sense organs 310-315,330-389	18.3	72.8	-	72.8	-	3.8	75.5	270.3	52.0	218.3	11.3	22.6
Diseases of circulatory system 390-458	6.9	10.4	-	10.4	11.3	3.8	61.8	207.9	20.8	187.1	22.7	18.9
Pneumonia and influenza 470-486	409.8	1746.4	499.0	1247.4	90.7	11.3	636.4	2214.1	706.9	1507.3	453.5	94.3
Other diseases of respiratory system 460-466,490-519	130.5	478.2	10.4	467.8	102.0	7.5	125.9	478.2	31.2	447.0	56.7	15.1
Diseases of digestive system 520-577	18.3	72.8	10.4	62.4	-	3.8	148.8	592.5	52.0	540.5	68.0	7.5
Diseases of genito-urinary system 580-629	4.6	10.4	-	10.4	-	3.8	34.3	114.3	10.4	104.0	45.4	-
Diseases of skin and subcutaneous tissue 680-709	4.6	20.8	-	20.8	-	-	38.9	166.3	62.4	104.0	11.3	-
Diseases of musculoskeletal system 710-738	-	-	-	-	-	-	-	-	-	-	-	-
Congenital anomalies	82.4	322.2	114.3	207.9	22.7	11.3	38.9	145.5	41.6	104.0	34.0	-
Nervous system 740-743	22.9	72.8	52.0	20.8	11.3	7.5	2.3	10.4	10.4	-	-	-
Circulatory system 746,747	18.3	72.8	20.8	52.0	-	3.8	16.0	62.4	-	62.4	11.3	-
Respiratory system 748	-	-	-	-	-	-	-	-	-	-	-	-
Digestive system 749-751	36.6	166.3	41.6	124.7	-	-	4.6	20.8	10.4	10.4	-	-
Genito-urinary system 752,753	2.3	-	-	-	11.3	-	-	-	-	-	-	-
Musculoskeletal system 754-756	-	-	-	-	-	-	2.3	10.4	10.4	-	-	-
Down's disease 759.3	2.3	10.4	-	10.4	-	-	13.7	41.6	10.4	31.2	22.7	-
Other anomalies 744,745, 757,758, Rest of 759	-	-	-	-	-	-	-	-	-	-	-	-
Certain perinatal causes 760-778	547.2	2484.4	2484.4	-	-	-	1057.7	4802.5	4729.7	72.8	-	-
Symptoms 780-789	4.6	20.8	-	20.8	-	-	828.8	3316.0	602.9	2713.1	317.5	56.6
Sudden death 795	36.6	166.3	31.2	135.1	-	-	-	-	-	-	-	-
Other ill-defined conditions 790-792,796	9.2	41.6	10.4	31.2	-	-	2.3	10.4	-	10.4	-	-
External causes E800-E999	54.9	41.6	-	41.6	124.7	33.9	45.8	166.3	52.0	114.3	45.4	-

DEATHS
BOLIVIA—La Pa:

Underlying and Associated Causes of Death in Children Under 5 Years, by Age Group, in Two-Year Period, 1968–1970.

Cause	Underlying cause						Associated cause					
	Under 5 years	Infant deaths			1 year	2-4 years	Under 5 years	Infant deaths			1 year	2-4 years
		Total	Under 28 days	28 days-11 mos.				Total	Under 28 days	28 days-11 mos.		
All causes	4115	2685	1049	1636	899	531	4898	2841	1046	1795	1371	686
Infective and parasitic diseases	1757	835	108	727	607	315	555	239	58	181	194	122
Amebiasis 006	2	-	-	-	1	1	1	-	-	-	-	1
Diarrheal disease 009	1011	591	81	510	319	101	434	173	20	153	170	91
Other intestinal infectious diseases 000-005,007,008	11	5	1	4	3	3	1	1	-	1	-	-
Tuberculosis 010-019	64	11	1	10	19	34	18	1	-	1	6	11
Diphtheria 032	-	-	-	-	-	-	-	-	-	-	-	-
Whooping cough 033	57	29	2	27	14	14	1	-	-	-	-	1
Tetanus 037	-	-	-	-	-	-	-	-	-	-	-	-
Septicemia 038	22	22	18	4	-	-	41	40	33	7	-	1
Measles 055	554	151	1	150	246	157	10	1	-	1	4	5
Congenital syphilis 090	3	3	1	2	-	-	1	1	-	1	-	-
Moniliasis 112	1	1	-	1	-	-	35	21	5	16	9	5
Helminthiases 120-129	1	1	-	1	-	-	10	-	-	-	4	6
Other Rest of 000-136	31	21	3	18	5	5	3	1	-	1	1	1
Malignant neoplasms 140-209	8	-	-	-	1	7	1	-	-	-	-	1
Neoplasms, other 210-239	1	1	-	1	-	-	2	2	1	1	-	-
Nutritional deficiency	69	36	1	35	21	12	1414	710	66	644	468	236
Vitamin deficiency 260-266	-	-	-	-	-	-	-	-	-	-	-	-
Protein malnutrition 267	33	10	-	10	15	8	75	13	-	13	44	18
Nutritional marasmus 268	28	20	1	19	5	3	143	58	2	56	54	31
Other 269	8	6	-	6	1	1	1196	639	64	575	370	187
Endocrine and metabolic diseases 240-258,270-279	1	1	-	1	-	-	2	2	1	1	-	-
Deficiency anemias 280,281	-	-	-	-	-	-	5	4	3	1	-	1
Other diseases of blood and blood-forming organs 282-289	4	2	-	2	1	1	12	6	-	6	3	3
Inflammatory diseases of central nervous system 320-324	33	16	3	13	12	5	33	19	3	16	8	6
Other diseases of nervous system and sense organs 310-315,330-389	14	6	-	6	2	6	23	9	2	7	8	6
Diseases of circulatory system 390-458	9	7	-	7	1	1	17	9	1	8	4	4
Pneumonia and influenza 470-486	1171	897	285	612	180	94	1138	571	118	453	370	197
Other diseases of respiratory system 460-466,490-519	141	99	13	86	25	17	62	29	1	28	16	17
Diseases of digestive system 520-577	28	18	7	11	4	6	32	20	8	12	7	5
Diseases of genito-urinary system 580-629	3	-	-	-	1	2	17	7	-	7	10	-
Diseases of skin and subcutaneous tissue 680-709	10	10	8	2	-	-	11	7	4	3	2	2
Diseases of musculoskeletal system 710-738	-	-	-	-	-	-	-	-	-	-	-	-
Congenital anomalies	50	47	27	20	2	1	32	26	21	5	4	2
Nervous system 740-743	8	7	3	4	-	1	-	-	-	-	-	-
Circulatory system 746,747	16	15	8	7	1	-	7	5	3	2	1	1
Respiratory system 748	-	-	-	-	-	-	3	3	3	-	-	-
Digestive system 749-751	24	24	16	8	-	-	7	7	6	1	-	-
Genito-urinary system 752,753	1	-	-	-	1	-	5	3	3	-	2	-
Musculoskeletal system 754-756	-	-	-	-	-	-	2	2	1	1	-	-
Down's disease 759.3	1	1	-	1	-	-	8	6	5	1	1	1
Other anomalies 744,745, 757,758, Rest of 759	-	-	-	-	-	-	-	-	-	-	-	-
Certain perinatal causes 760-778	548	548	543	5	-	-	710	710	697	13	-	-
Symptoms 780-789	12	11	2	9	-	1	820	466	60	406	273	81
Sudden death 795	14	13	3	10	1	-	-	-	-	-	-	-
Other ill-defined conditions 790-792,796	165	114	42	72	25	26	-	-	-	-	-	-
External causes E800-E999	77	24	7	17	16	37	12	5	2	3	4	3

DEATH RATES
La Paz—BOLIVIA

Death Rates from Underlying and Associated Causes in Children Under 5 Years, by Age Group, in Two-Year Period, 1968–1970.

Cause	Underlying cause						Associated cause					
	Under 5 years	Infant deaths			1 year	2-4 years	Under 5 years	Infant deaths			1 year	2-4 years
		Total	Under 28 days	28 days-11 mos.				Total	Under 28 days	28 days-11 mos.		
All causes	2660.0	7304.1	2853.6	4450.5	2716.0	610.3	3166.1	7728.5	2845.5	4883.0	4142.0	788.5
Infective and parasitic diseases	1135.7	2271.5	293.8	1977.7	1833.8	362.1	358.8	650.2	157.8	492.4	586.1	140.2
Amebiasis ... 006	1.3	-	-	-	3.0	1.1	0.6	-	-	-	-	1.1
Diarrheal disease ... 009	653.5	1607.7	220.3	1387.4	963.7	116.1	280.5	470.6	54.4	416.2	513.6	104.6
Other intestinal infectious diseases ... 000-005,007,008	7.1	13.6	2.7	10.9	9.1	3.4	0.6	2.7	-	2.7	-	-
Tuberculosis ... 010-019	41.4	29.9	2.7	27.2	57.4	39.1	11.6	2.7	-	2.7	18.1	12.6
Diphtheria ... 032	-	-	-	-	-	-	-	-	-	-	-	-
Whooping cough ... 033	36.8	78.9	5.4	73.4	42.3	16.1	0.6	-	-	-	-	1.1
Tetanus ... 037	-	-	-	-	-	-	-	-	-	-	-	-
Septicemia ... 038	14.2	59.8	49.0	10.9	-	-	26.5	108.8	89.8	19.0	-	1.1
Measles ... 055	358.1	410.8	2.7	408.1	743.2	180.5	6.5	2.7	-	2.7	12.1	5.7
Congenital syphilis ... 090	1.9	8.2	2.7	5.4	-	-	0.6	2.7	-	2.7	-	-
Moniliasis ... 112	0.6	2.7	-	2.7	-	-	22.6	57.1	13.6	43.5	27.2	5.7
Helminthiases ... 120-129	0.6	2.7	-	2.7	-	-	6.5	-	-	-	12.1	0.9
Other ... Rest of 000-136	20.0	57.1	8.2	49.0	15.1	5.7	1.9	2.7	-	2.7	3.0	1.1
Malignant neoplasms ... 140-209	5.2	-	-	-	3.0	8.0	0.6	-	-	-	-	1.1
Neoplasms, other ... 210-239	0.6	2.7	-	2.7	-	-	1.3	5.4	2.7	2.7	-	-
Nutritional deficiency	44.6	97.9	2.7	95.2	63.4	13.8	914.0	1931.4	179.5	1751.9	1413.9	271.3
Vitamin deficiency ... 260-266	-	-	-	-	-	-	-	-	-	-	-	-
Protein malnutrition ... 267	21.3	27.2	-	27.2	45.3	9.2	48.5	35.4	-	35.4	132.9	20.7
Nutritional marasmus ... 268	18.1	54.4	2.7	51.7	15.1	3.4	92.4	157.8	5.4	152.3	163.1	35.6
Other ... 269	5.2	16.3	-	16.3	3.0	1.1	773.1	1738.3	174.1	1564.2	1117.8	214.9
Endocrine and metabolic diseases ... 240-258,270-279	0.6	2.7	-	2.7	-	-	1.3	5.4	2.7	2.7	-	-
Deficiency anemias ... 280,281	-	-	-	-	-	-	3.2	10.9	8.2	2.7	-	1.1
Other diseases of blood and blood-forming organs ... 282-289	2.6	5.4	-	5.4	3.0	1.1	7.8	16.3	-	16.3	9.1	3.4
Inflammatory diseases of central nervous system ... 320-324	21.3	43.5	8.2	35.4	36.3	5.7	21.3	51.7	8.2	43.5	24.2	6.0
Other diseases of nervous system and sense organs ... 310-315,330-389	9.0	16.3	-	16.3	6.0	6.9	14.9	24.5	5.4	19.0	24.2	6.9
Diseases of circulatory system ... 390-458	5.8	19.0	-	19.0	3.0	1.1	11.0	24.5	2.7	21.8	12.1	4.6
Pneumonia and influenza . 470-486	756.9	2440.2	775.3	1664.9	543.8	108.0	735.6	1553.3	321.0	1232.3	1117.8	226.4
Other diseases of respiratory system ... 460-466,490-519	91.9	269.3	35.4	233.9	75.5	19.5	40.1	78.9	2.7	76.2	48.3	19.5
Diseases of digestive system ... 520-577	18.1	49.0	19.0	29.9	12.1	6.9	20.7	54.4	21.8	32.6	21.1	5.7
Diseases of genito-urinary system ... 580-629	1.9	-	-	-	3.0	2.3	11.0	19.0	-	19.0	30.2	-
Diseases of skin and subcutaneous tissue ... 680-709	6.5	27.2	21.8	5.4	-	-	7.1	19.0	10.9	8.2	6.0	2.3
Diseases of musculoskeletal system ... 710-738	-	-	-	-	-	-	-	-	-	-	-	-
Congenital anomalies	32.3	127.9	73.4	54.4	6.0	1.1	20.7	70.7	57.1	13.6	12.1	2.3
Nervous system ... 740-743	5.2	19.0	8.2	10.9	-	1.1	-	-	-	-	-	-
Circulatory system ... 746,747	10.3	40.8	21.8	19.0	3.0	-	4.5	13.6	8.2	5.4	3.0	1.1
Respiratory system ... 748	-	-	-	-	-	-	1.9	8.2	8.2	-	-	-
Digestive system ... 749-751	15.5	65.3	43.5	21.8	-	-	4.5	19.0	16.3	2.7	-	-
Genito-urinary system . 752,753	0.6	-	-	-	3.0	-	3.2	8.2	8.2	-	6.0	-
Musculoskeletal system . 754-756	-	-	-	-	-	-	1.3	5.4	2.7	2.7	-	-
Down's disease ... 759.3	0.6	2.7	-	2.7	-	-	5.2	16.3	13.6	2.7	3.0	1.1
Other anomalies ... 744,745, 757,758, Rest of 759	-	-	-	-	-	-	-	-	-	-	-	-
Certain perinatal causes ... 760-778	354.2	1490.8	1477.1	13.6	-	-	459.0	1931.4	1896.1	35.4	-	-
Symptoms ... 780-789	7.8	29.9	5.4	24.5	-	1.1	530.1	1267.7	163.2	1104.5	824.8	93.1
Sudden death ... 795	9.0	35.4	8.2	27.2	3.0	-	-	-	-	-	-	-
Other ill-defined conditions ... 790-792,796	106.7	310.1	114.3	195.9	75.5	29.9	-	-	-	-	-	-
External causes ... E800-E999	49.8	65.3	19.0	46.2	48.3	42.5	7.8	13.6	5.4	8.2	12.1	3.4

DEATHS
BOLIVIA—Viacha

Underlying and Associated Causes of Death in Children Under 5 Years, by Age Group, in Two-Year Period, 1968–1970.

Cause	Underlying cause						Associated cause					
	Under 5 years	Infant deaths			1 year	2-4 years	Under 5 years	Infant deaths			1 year	2-4 years
		Total	Under 28 days	28 days-11 mos.				Total	Under 28 days	28 days-11 mos.		
All causes	161	105	42	63	36	20	144	82	26	56	46	16
Infective and parasitic diseases	66	32	2	30	22	12	17	10	-	10	3	4
Amebiasis ... 006	-	-	-	-	-	-	-	-	-	-	-	-
Diarrheal disease ... 009	36	19	2	17	12	5	17	10	-	10	3	4
Other intestinal infectious diseases ... 000-005,007,008	-	-	-	-	-	-	-	-	-	-	-	-
Tuberculosis ... 010-019	1	1	-	1	-	-	-	-	-	-	-	-
Diphtheria ... 032	-	-	-	-	-	-	-	-	-	-	-	-
Whooping cough ... 033	4	1	-	1	3	-	-	-	-	-	-	-
Tetanus ... 037	-	-	-	-	-	-	-	-	-	-	-	-
Septicemia ... 038	-	-	-	-	-	-	-	-	-	-	-	-
Measles ... 055	25	11	-	11	7	7	-	-	-	-	-	-
Congenital syphilis ... 090	-	-	-	-	-	-	-	-	-	-	-	-
Moniliasis ... 112	-	-	-	-	-	-	-	-	-	-	-	-
Helminthiases ... 120-129	-	-	-	-	-	-	-	-	-	-	-	-
Other ... Rest of 000-136	-	-	-	-	-	-	-	-	-	-	-	-
Malignant neoplasms ... 140-209	-	-	-	-	-	-	-	-	-	-	-	-
Neoplasms, other ... 210-239	-	-	-	-	-	-	-	-	-	-	-	-
Nutritional deficiency	1	-	-	-	-	1	48	25	1	24	19	4
Vitamin deficiency ... 260-266	-	-	-	-	-	-	-	-	-	-	-	-
Protein malnutrition ... 267	-	-	-	-	-	-	8	-	-	-	7	1
Nutritional marasmus ... 268	-	-	-	-	-	-	5	4	-	4	1	-
Other ... 269	1	-	-	-	-	1	35	21	1	20	11	3
Endocrine and metabolic diseases ... 240-258,270-279	-	-	-	-	-	-	-	-	-	-	-	-
Deficiency anemias ... 280,281	-	-	-	-	-	-	-	-	-	-	-	-
Other diseases of blood and blood-forming organs ... 282-289	-	-	-	-	-	-	-	-	-	-	-	-
Inflammatory diseases of central nervous system ... 320-324	2	1	-	1	1	-	-	-	-	-	-	-
Other diseases of nervous system and sense organs ... 310-315,330-389	1	1	-	1	-	-	1	-	-	-	-	1
Diseases of circulatory system ... 390-458	-	-	-	-	-	-	-	-	-	-	-	-
Pneumonia and influenza . 470-486	48	34	10	24	9	5	38	17	1	16	15	6
Other diseases of respiratory system ... 460-466,490-519	9	5	-	5	3	1	5	1	-	1	3	1
Diseases of digestive system ... 520-577	-	-	-	-	-	-	-	-	-	-	-	-
Diseases of genito-urinary system ... 580-629	-	-	-	-	-	-	-	-	-	-	-	-
Diseases of skin and subcutaneous tissue ... 680-709	-	-	-	-	-	-	-	-	-	-	-	-
Diseases of musculoskeletal system ... 710-738	-	-	-	-	-	-	-	-	-	-	-	-
Congenital anomalies	-	-	-	-	-	-	-	-	-	-	-	-
Nervous system ... 740-743	-	-	-	-	-	-	-	-	-	-	-	-
Circulatory system ... 746,747	-	-	-	-	-	-	-	-	-	-	-	-
Respiratory system ... 748	-	-	-	-	-	-	-	-	-	-	-	-
Digestive system ... 749-751	-	-	-	-	-	-	-	-	-	-	-	-
Genito-urinary system . 752,753	-	-	-	-	-	-	-	-	-	-	-	-
Musculoskeletal system . 754-756	-	-	-	-	-	-	-	-	-	-	-	-
Down's disease ... 759.3	-	-	-	-	-	-	-	-	-	-	-	-
Other anomalies ... 744,745, 757,758, Rest of 739	-	-	-	-	-	-	-	-	-	-	-	-
Certain perinatal causes ... 760-778	29	29	29	-	-	-	24	24	24	-	-	-
Symptoms ... 780-789	-	-	-	-	-	-	11	5	-	5	6	-
Sudden death ... 795	-	-	-	-	-	-	-	-	-	-	-	-
Other ill-defined conditions ... 790-792,796	2	2	1	1	-	-	-	-	-	-	-	-
External causes ... E800-E999	3	1	-	1	1	1	-	-	-	-	-	-

DEATH RATES
Viacha—BOLIVIA

Death Rates from Underlying and Associated Causes in Children Under 5 Years, by Age Group, in Two-Year Period, 1968–1970.

Cause	Underlying cause						Associated cause					
	Under 5 years	Infant deaths			1 year	2-4 years	Under 5 years	Infant deaths			1 year	2-4 years
		Total	Under 28 days	28 days-11 mos.				Total	Under 28 days	28 days-11 mos.		
All causes	4806.0	12352.9	4941.2	7411.8	5070.4	1069.5	4298.5	9647.1	3058.8	6588.2	6478.9	855.6
Infective and parasitic diseases	1970.1	3764.7	235.3	3529.4	3098.6	641.7	507.5	1176.5	-	1176.5	422.5	213.9
Amebiasis 006	-	-	-	-	-	-	-	-	-	-	-	-
Diarrheal disease 009	1074.6	2235.3	235.3	2000.0	1690.1	267.4	507.5	1176.5	-	1176.5	422.5	213.9
Other intestinal infectious diseases 000-005,007,008	-	-	-	-	-	-	-	-	-	-	-	-
Tuberculosis 010-019	29.9	117.6	-	117.6	-	-	-	-	-	-	-	-
Diphtheria 032	-	-	-	-	-	-	-	-	-	-	-	-
Whooping cough 033	119.4	117.6	-	117.6	422.5	-	-	-	-	-	-	-
Tetanus 037	-	-	-	-	-	-	-	-	-	-	-	-
Septicemia 038	-	-	-	-	-	-	-	-	-	-	-	-
Measles 055	746.3	1294.1	-	1294.1	985.9	374.3	-	-	-	-	-	-
Congenital syphilis 090	-	-	-	-	-	-	-	-	-	-	-	-
Moniliasis 112	-	-	-	-	-	-	-	-	-	-	-	-
Helminthiases 120-129	-	-	-	-	-	-	-	-	-	-	-	-
Other Rest of 000-136	-	-	-	-	-	-	-	-	-	-	-	-
Malignant neoplasms 140-209	-	-	-	-	-	-	-	-	-	-	-	-
Neoplasms, other 210-239	-	-	-	-	-	-	-	-	-	-	-	-
Nutritional deficiency	29.9	-	-	-	-	53.5	1432.8	2941.2	117.6	2823.5	2676.1	213.9
Vitamin deficiency 260-266	-	-	-	-	-	-	-	-	-	-	-	-
Protein malnutrition 267	-	-	-	-	-	-	238.8	-	-	-	985.9	53.5
Nutritional marasmus 268	-	-	-	-	-	-	149.3	470.6	-	470.6	140.8	-
Other 269	29.9	-	-	-	-	53.5	1044.8	2470.6	117.6	2352.9	1549.3	160.4
Endocrine and metabolic diseases 240-258,270-279	-	-	-	-	-	-	-	-	-	-	-	-
Deficiency anemias 280,281	-	-	-	-	-	-	-	-	-	-	-	-
Other diseases of blood and blood-forming organs 282-289	-	-	-	-	-	-	-	-	-	-	-	-
Inflammatory diseases of central nervous system 320-324	59.7	117.6	-	117.6	140.8	-	-	-	-	-	-	-
Other diseases of nervous system and sense organs 310-315,330-389	29.9	117.6	-	117.6	-	-	29.9	-	-	-	-	53.5
Diseases of circulatory system 390-458	-	-	-	-	-	-	-	-	-	-	-	-
Pneumonia and influenza 470-486	1432.8	4000.0	1176.5	2823.5	1267.6	267.4	1134.3	2000.0	117.6	1882.4	2112.7	320.9
Other diseases of respiratory system 460-466,490-519	268.7	588.2	-	588.2	422.5	53.5	149.3	117.6	-	117.6	422.5	53.5
Diseases of digestive system 520-577	-	-	-	-	-	-	-	-	-	-	-	-
Diseases of genito-urinary system 580-629	-	-	-	-	-	-	-	-	-	-	-	-
Diseases of skin and subcutaneous tissue 680-709	-	-	-	-	-	-	-	-	-	-	-	-
Diseases of musculoskeletal system 710-738	-	-	-	-	-	-	-	-	-	-	-	-
Congenital anomalies	-	-	-	-	-	-	-	-	-	-	-	-
Nervous system 740-743	-	-	-	-	-	-	-	-	-	-	-	-
Circulatory system 746,747	-	-	-	-	-	-	-	-	-	-	-	-
Respiratory system 748	-	-	-	-	-	-	-	-	-	-	-	-
Digestive system 749-751	-	-	-	-	-	-	-	-	-	-	-	-
Genito-urinary system 752,753	-	-	-	-	-	-	-	-	-	-	-	-
Musculoskeletal system 754-756	-	-	-	-	-	-	-	-	-	-	-	-
Down's disease 759.3	-	-	-	-	-	-	-	-	-	-	-	-
Other anomalies 744,745, 757,758, Rest of 759	-	-	-	-	-	-	-	-	-	-	-	-
Certain perinatal causes 760-778	865.7	3411.8	3411.8	-	-	-	716.4	2823.5	2823.5	-	-	-
Symptoms 780-789	-	-	-	-	-	-	328.4	588.2	-	588.2	845.1	-
Sudden death 795	-	-	-	-	-	-	-	-	-	-	-	-
Other ill-defined conditions 790-792,796	59.7	235.3	117.6	117.6	-	-	-	-	-	-	-	-
External causes E800-E999	89.6	117.6	-	117.6	140.8	53.5	-	-	-	-	-	-

DEATHS
BRAZIL—Recife

Underlying and Associated Causes of Death in Children Under 5 Years, by Age Group, in Two-Year Period, 1968–1970.

Cause	Underlying cause						Associated cause					
	Under 5 years	Infant deaths			1 year	2-4 years	Under 5 years	Infant deaths			1 year	2-4 years
		Total	Under 28 days	28 days-11 mos.				Total	Under 28 days	28 days-11 mos.		
All causes	3635	2773	1073	1700	515	347	7178	5084	1554	3530	1219	875
Infective and parasitic diseases	1929	1411	198	1213	313	205	1375	711	145	566	381	283
Amebiasis ... 006	1	1	-	1	-	-	1	-	-	-	-	1
Diarrheal disease ... 009	1268	1141	146	995	92	35	648	316	37	279	195	137
Other intestinal infectious diseases ... 000-005,007,008	16	11	2	9	2	3	11	5	1	4	3	3
Tuberculosis ... 010-019	63	18	-	18	21	24	29	9	-	9	7	13
Diphtheria ... 032	29	9	-	9	16	4	-	-	-	-	-	-
Whooping cough ... 033	31	16	-	16	8	7	2	-	-	-	1	1
Tetanus ... 037	29	27	22	5	-	2	-	-	-	-	-	-
Septicemia ... 038	28	23	18	5	4	1	201	175	77	98	13	13
Measles ... 055	397	130	1	129	153	114	9	4	-	4	1	4
Congenital syphilis ... 090	22	22	7	15	-	-	2	2	-	2	-	-
Moniliasis ... 112	2	1	1	-	1	-	110	96	30	66	12	2
Helminthiases ... 120-129	16	-	-	-	10	6	346	92	-	92	146	108
Other ... Rest of 000-136	27	12	1	11	6	9	16	12	-	12	3	1
Malignant neoplasms ... 140-209	7	1	1	-	2	4	1	-	-	-	-	1
Neoplasms, other ... 210-239	-	-	-	-	-	-	-	-	-	-	-	-
Nutritional deficiency	147	47	-	47	54	46	1532	1033	42	991	300	199
Vitamin deficiency ... 260-266	-	-	-	-	-	-	-	-	-	-	-	-
Protein malnutrition ... 267	106	23	-	23	43	40	216	56	-	56	87	73
Nutritional marasmus ... 268	39	22	-	22	11	6	460	318	2	316	92	50
Other ... 269	2	2	-	2	-	-	856	659	40	619	121	76
Endocrine and metabolic diseases ... 240-258,270-279	4	3	1	2	-	1	50	48	7	41	-	2
Deficiency anemias ... 280,281	-	-	-	-	-	-	27	12	3	9	9	6
Other diseases of blood and blood-forming organs ... 282-289	9	7	1	6	1	1	94	41	1	40	32	21
Inflammatory diseases of central nervous system ... 320-324	42	22	3	19	11	9	50	34	4	30	7	9
Other diseases of nervous system and sense organs ... 310-315,330-389	41	22	1	21	8	11	108	73	6	67	13	22
Diseases of circulatory system ... 390-458	3	1	-	1	-	2	101	52	1	51	27	22
Pneumonia and influenza . 470-486	357	265	59	206	63	29	1244	794	131	663	273	177
Other diseases of respiratory system ... 460-466,490-519	88	51	3	48	27	10	178	107	2	105	49	22
Diseases of digestive system ... 520-577	17	13	6	7	3	1	105	70	11	59	13	22
Diseases of genito-urinary system ... 580-629	5	2	-	2	-	3	50	35	6	29	5	10
Diseases of skin and subcutaneous tissue ... 680-709	39	34	9	25	2	3	82	63	8	55	11	8
Diseases of musculoskeletal system ... 710-738	-	-	-	-	-	-	1	1	-	1	-	-
Congenital anomalies	121	111	55	56	4	6	88	81	42	39	3	4
Nervous system ... 740-743	35	31	12	19	1	3	8	7	2	5	1	-
Circulatory system ... 746,747	45	41	19	22	3	1	30	27	16	11	1	2
Respiratory system ... 748	-	-	-	-	-	-	-	-	-	-	-	-
Digestive system ... 749-751	24	23	13	10	-	1	12	11	7	4	1	-
Genito-urinary system . 752,753	1	1	-	1	-	-	12	12	6	6	-	-
Musculoskeletal system . 754-756	5	5	4	1	-	-	4	4	3	1	-	-
Down's disease ... 759.3	4	3	-	3	-	1	18	16	4	12	-	2
Other anomalies ... 744,745, 757,758, Rest of 759	7	7	7	-	-	-	4	4	4	-	-	-
Certain perinatal causes ... 760-778	725	725	721	4	-	-	1095	1095	1053	42	-	-
Symptoms ... 780-789	7	4	-	4	2	1	977	820	80	740	92	65
Sudden death ... 795	5	5	3	2	-	-	-	-	-	-	-	-
Other ill-defined conditions ... 790-792,796	45	35	8	27	9	1	-	-	-	-	-	-
External causes ... E800-E999	44	14	4	10	16	14	20	14	12	2	4	2

DEATH RATES
Recife—BRAZIL

Death Rates from Underlying and Associated Causes in Children Under 5 Years, by Age Group, in Two-Year Period, 1968–1970.

Cause	Underlying cause						Associated cause					
	Under 5 years	Infant deaths			1 year	2-4 years	Under 5 years	Infant deaths			1 year	2-4 years
		Total	Under 28 days	28 days-11 mos.				Total	Under 28 days	28 days-11 mos.		
All causes	2933.6	9121.7	3529.6	5592.1	1920.2	503.0	5792.9	16723.7	5111.8	11611.8	4545.1	1268.3
Infective and parasitic diseases	1556.8	4641.4	651.3	3990.1	1167.0	297.1	1109.7	2338.8	477.0	1861.8	1420.6	410.2
Amebiasis 006	0.8	3.3	-	3.3	-	-	0.8	-	-	-	-	1.4
Diarrheal disease 009	1023.3	3753.3	480.3	3273.0	343.0	50.7	523.0	1039.5	121.7	917.8	727.1	198.6
Other intestinal infectious diseases 000-005,007,008	12.9	36.2	6.6	29.6	7.5	4.3	8.9	16.4	3.3	13.2	11.2	4.3
Tuberculosis 010-019	50.8	59.2	-	59.2	78.3	34.8	23.4	29.6	-	29.6	26.1	18.8
Diphtheria 032	23.4	29.6	-	29.6	59.7	5.8	-	-	-	-	-	-
Whooping cough 033	25.0	52.6	-	52.6	29.8	10.1	1.6	-	-	-	3.7	1.4
Tetanus 037	23.4	88.8	72.4	16.4	-	2.9	-	-	-	-	-	-
Septicemia 038	22.6	75.7	59.2	16.4	14.9	1.4	162.2	575.7	253.3	322.4	48.5	18.8
Measles 055	320.4	427.6	3.3	424.3	570.5	165.2	7.3	13.2	-	13.2	3.7	5.8
Congenital syphilis 090	17.8	72.4	23.0	49.3	-	-	1.6	6.6	-	6.6	-	-
Moniliasis 112	1.6	3.3	3.3	-	3.7	-	88.8	315.8	98.7	217.1	44.7	2.9
Helminthiases 120-129	12.9	-	-	-	37.3	8.7	279.2	302.6	-	302.6	544.4	156.5
Other Rest of 000-136	21.8	39.5	3.3	36.2	22.4	13.0	12.9	39.5	-	39.5	11.2	1.4
Malignant neoplasms 140-209	5.6	3.3	3.3	-	7.5	5.8	0.8	-	-	-	-	1.4
Neoplasms, other 210-239	-	-	-	-	-	-	-	-	-	-	-	-
Nutritional deficiency	118.6	154.6	-	154.6	201.3	66.7	1236.4	3398.0	138.2	3259.9	1118.6	288.4
Vitamin deficiency 260-266	-	-	-	-	-	-	-	-	-	-	-	-
Protein malnutrition 267	85.5	75.7	-	75.7	160.3	58.0	174.3	184.2	-	184.2	324.4	105.8
Nutritional marasmus 268	31.5	72.4	-	72.4	41.0	8.7	371.2	1046.1	6.6	1039.5	343.0	72.5
Other 269	1.6	6.6	-	6.6	-	-	690.8	2167.8	131.6	2036.2	451.2	110.2
Endocrine and metabolic diseases 240-258,270-279	3.2	9.9	3.3	6.6	-	1.4	40.4	157.9	23.0	134.9	-	2.9
Deficiency anemias 280,281	-	-	-	-	-	-	21.8	39.5	9.9	29.6	33.6	8.7
Other diseases of blood and blood-forming organs 282-289	7.3	23.0	3.3	19.7	3.7	1.4	75.9	134.9	3.3	131.6	119.3	30.4
Inflammatory diseases of central nervous system 320-324	33.9	72.4	9.9	62.5	41.0	13.0	40.4	111.8	13.2	98.7	26.1	13.0
Other diseases of nervous system and sense organs 310-315,330-389	33.1	72.4	3.3	69.1	29.8	15.9	87.2	240.1	19.7	220.4	48.5	31.9
Diseases of circulatory system 390-458	2.4	3.3	-	3.3	-	2.9	81.5	171.1	3.3	167.8	100.7	31.9
Pneumonia and influenza 470-486	288.1	871.7	194.1	677.6	234.9	42.0	1004.0	2611.8	430.9	2180.9	1017.9	256.6
Other diseases of respiratory system 460-466,490-519	71.0	167.8	9.9	157.9	100.7	14.5	143.7	352.0	6.6	345.4	182.7	31.9
Diseases of digestive system 520-577	13.7	42.8	19.7	23.0	11.2	1.4	84.7	230.3	36.2	194.1	48.5	31.9
Diseases of genito-urinary system 580-629	4.0	6.6	-	6.6	-	4.3	40.4	115.1	19.7	95.4	18.6	14.5
Diseases of skin and subcutaneous tissue 680-709	31.5	111.8	29.6	82.2	7.5	4.3	66.2	207.2	26.3	180.9	41.0	11.6
Diseases of musculoskeletal system 710-738	-	-	-	-	-	-	0.8	3.3	-	3.3	-	-
Congenital anomalies	97.7	365.1	180.9	184.2	14.9	8.7	71.0	266.4	138.2	128.3	11.2	5.8
Nervous system 740-743	28.2	102.0	39.5	62.5	3.7	4.3	6.5	23.0	6.6	16.4	3.7	-
Circulatory system 746,747	36.3	134.9	62.5	72.4	11.2	1.4	24.2	88.8	52.6	36.2	3.7	2.9
Respiratory system 748	-	-	-	-	-	-	-	-	-	-	-	-
Digestive system 749-751	19.4	75.7	42.8	32.9	-	1.4	9.7	36.2	23.0	13.2	3.7	-
Genito-urinary system 752,753	0.8	3.3	-	3.3	-	-	9.7	39.5	19.7	19.7	-	-
Musculoskeletal system 754-756	4.0	16.4	13.2	3.3	-	-	3.2	13.2	9.9	3.3	-	-
Down's disease 759.3	3.2	9.9	-	9.9	-	1.4	14.5	52.6	13.2	39.5	-	2.9
Other anomalies 744,745, 757,758, Rest of 759	5.6	23.0	23.0	-	-	-	3.2	13.2	13.2	-	-	-
Certain perinatal causes 760-778	585.1	2384.9	2371.7	13.2	-	-	883.7	3602.0	3463.8	138.2	-	-
Symptoms 780-789	5.6	13.2	-	13.2	7.5	1.4	788.5	2697.4	263.2	2434.2	343.0	94.2
Sudden death 795	4.0	16.4	9.9	6.6	-	-	-	-	-	-	-	-
Other ill-defined conditions 790-792,796	36.3	115.1	26.3	88.8	33.6	1.4	-	-	-	-	-	-
External causes E800-E999	35.5	46.1	13.2	32.9	59.7	20.3	16.1	46.1	39.5	6.6	14.9	2.9

DEATHS
BRAZIL—Ribeirão Prêto, City of Ribeirão Prêto

Underlying and Associated Causes of Death in Children Under 5 Years, by Age Group, in Two-Year Period, 1968–1970.

Cause	Underlying cause						Associated cause					
	Under 5 years	Infant deaths			1 year	2-4 years	Under 5 years	Infant deaths			1 year	2-4 years
		Total	Under 28 days	28 days-11 mos.				Total	Under 28 days	28 days-11 mos.		
All causes	464	400	223	177	34	30	933	773	339	434	82	78
Infective and parasitic diseases	172	138	27	111	17	17	91	49	8	41	18	24
Amebiasis 006	-	-	-	-	-	-	-	-	-	-	-	-
Diarrheal disease 009	121	115	22	93	4	2	45	26	2	24	10	9
Other intestinal infectious diseases 000-005,007,008	2	2	1	1	-	-	-	-	-	-	-	-
Tuberculosis 010-019	1	-	-	-	1	-	1	-	-	-	1	-
Diphtheria 032	-	-	-	-	-	-	-	-	-	-	-	-
Whooping cough 033	3	-	-	-	3	-	-	-	-	-	-	-
Tetanus 037	-	-	-	-	-	-	-	-	-	-	-	-
Septicemia 038	3	3	2	1	-	-	14	12	5	7	1	1
Measles 055	29	8	-	8	8	13	1	-	-	-	1	-
Congenital syphilis 090	-	-	-	-	-	-	3	2	-	2	1	-
Moniliasis 112	1	1	-	1	-	-	6	6	1	5	-	-
Helminthiases 120-129	-	-	-	-	-	-	19	2	-	2	3	14
Other Rest of 000-136	12	9	2	7	1	2	2	1	-	1	1	-
Malignant neoplasms 140-209	2	-	-	-	1	1	1	-	-	-	1	-
Neoplasms, other 210-239	-	-	-	-	-	-	-	-	-	-	-	-
Nutritional deficiency	7	2	-	2	2	3	153	114	-	114	18	21
Vitamin deficiency 260-266	-	-	-	-	-	-	-	-	-	-	-	-
Protein malnutrition 267	6	1	-	1	2	3	10	-	-	-	5	5
Nutritional marasmus 268	1	1	-	1	-	-	43	32	-	32	6	5
Other 269	-	-	-	-	-	-	100	82	-	82	7	11
Endocrine and metabolic diseases 240-258,270-279	2	2	1	1	-	-	1	1	-	1	-	-
Deficiency anemias 280,281	1	1	-	1	-	-	2	2	2	-	-	-
Other diseases of blood and blood-forming organs 282-289	2	1	-	1	-	1	4	3	-	3	1	-
Inflammatory diseases of central nervous system 320-324	9	8	1	7	-	1	8	6	-	6	1	1
Other diseases of nervous system and sense organs 310-315,330-389	5	5	-	5	-	-	25	17	1	16	6	2
Diseases of circulatory system 390-458	1	1	-	1	-	-	15	10	-	10	3	2
Pneumonia and influenza 470-486	41	31	12	19	9	1	147	110	30	80	17	20
Other diseases of respiratory system 460-466,490-519	4	4	-	4	-	-	17	11	1	10	4	2
Diseases of digestive system 520-577	3	3	1	2	-	-	12	10	4	6	2	-
Diseases of genito-urinary system 580-629	1	1	-	1	-	-	7	7	-	7	-	-
Diseases of skin and subcutaneous tissue 680-709	3	2	1	1	-	1	7	7	1	6	-	-
Diseases of musculoskeletal system 710-738	-	-	-	-	-	-	-	-	-	-	-	-
Congenital anomalies	42	38	19	19	3	1	25	24	11	13	1	-
Nervous system 740-743	7	7	3	4	-	-	1	1	-	1	-	-
Circulatory system 746,747	18	15	9	6	3	-	8	8	2	6	-	-
Respiratory system 748	-	-	-	-	-	-	-	-	-	-	-	-
Digestive system 749-751	10	10	4	6	-	-	4	4	3	1	-	-
Genito-urinary system 752,753	2	1	-	1	-	1	4	4	2	2	-	-
Musculoskeletal system 754-756	2	2	2	-	-	-	4	4	3	1	-	-
Down's disease 759.3	3	3	1	2	-	-	4	3	1	2	1	-
Other anomalies 744,745, 757,758, Rest of 759	-	-	-	-	-	-	-	-	-	-	-	-
Certain perinatal causes 760-778	159	159	159	-	-	-	274	274	269	5	-	-
Symptoms 780-789	-	-	-	-	-	-	125	111	11	100	9	5
Sudden death 795	1	1	1	-	-	-	-	-	-	-	-	-
Other ill-defined conditions 790-792,796	-	-	-	-	-	-	1	-	-	-	-	1
External causes E800-E999	9	3	1	2	2	4	18	17	1	16	1	-

DEATH RATES
City of Ribeirão Prêto, Ribeirão Prêto—BRAZIL

Death Rates from Underlying and Associated Causes in Children Under 5 Years, by Age Group, in Two-Year Period, 1968–1970.

Cause	Underlying cause						Associated cause					
	Under 5 years	Infant deaths			1 year	2-4 years	Under 5 years	Infant deaths			1 year	2-4 years
		Total	Under 28 days	28 days-11 mos.				Total	Under 28 days	28 days-11 mos.		
All causes	1088.4	4296.5	2395.3	1901.2	385.9	120.7	2188.6	8302.9	3641.2	4661.7	930.8	313.8
Infective and parasitic diseases	403.5	1482.3	290.0	1192.3	193.0	68.4	213.5	526.3	85.9	440.4	204.3	96.5
Amebiasis 006	-	-	-	-	-	-	-	-	-	-	-	-
Diarrheal disease 009	283.8	1235.2	236.3	998.9	45.4	8.0	105.6	279.3	21.5	257.8	113.5	36.2
Other intestinal infectious diseases 000-005,007,008	4.7	21.5	10.7	10.7	-	-	-	-	-	-	-	-
Tuberculosis 010-019	2.3	-	-	-	11.4	-	2.3	-	-	-	11.4	-
Diphtheria 032	-	-	-	-	-	-	-	-	-	-	-	-
Whooping cough 033	7.0	-	-	-	34.1	-	-	-	-	-	-	-
Tetanus 037	-	-	-	-	-	-	-	-	-	-	-	-
Septicemia 038	7.0	32.2	21.5	10.7	-	-	32.8	128.9	53.7	75.2	11.4	4.0
Measles 055	68.0	85.9	-	85.9	90.8	52.3	2.3	-	-	-	11.4	-
Congenital syphilis 090	-	-	-	-	-	-	7.0	21.3	-	21.5	11.4	-
Moniliasis 112	2.3	10.7	-	10.7	-	-	14.1	64.4	10.7	53.7	-	-
Helminthiases 120-129	-	-	-	-	-	-	44.6	21.5	-	21.5	34.1	56.3
Other Rest of 000-136	28.1	96.7	21.5	75.2	11.4	8.0	4.7	10.7	-	10.7	11.4	-
Malignant neoplasms 140-209	4.7	-	-	-	11.4	4.0	2.3	-	-	-	11.4	-
Neoplasms, other 210-239	-	-	-	-	-	-	-	-	-	-	-	-
Nutritional deficiency	16.4	21.5	-	21.5	22.7	12.1	358.9	1224.5	-	1224.5	204.3	84.5
Vitamin deficiency 260-266	-	-	-	-	-	-	-	-	-	-	-	-
Protein malnutrition 267	14.1	10.7	-	10.7	22.7	12.1	23.5	-	-	-	56.8	20.1
Nutritional marasmus 268	2.3	10.7	-	10.7	-	-	100.9	343.7	-	343.7	68.1	20.1
Other 269	-	-	-	-	-	-	234.6	880.8	-	880.8	79.5	44.2
Endocrine and metabolic diseases 240-258,270-279	4.7	21.5	10.7	10.7	-	-	2.3	10.7	-	10.7	-	-
Deficiency anemias 280,281	2.3	10.7	-	10.7	-	-	4.7	21.5	21.5	-	-	-
Other diseases of blood and blood-forming organs 282-289	4.7	10.7	-	10.7	-	4.0	9.4	32.2	-	32.2	11.4	-
Inflammatory diseases of central nervous system 320-324	21.1	85.9	10.7	75.2	-	4.0	18.8	64.4	-	64.4	11.4	4.0
Other diseases of nervous system and sense organs 310-315,330-389	11.7	53.7	-	53.7	-	-	58.6	182.6	10.7	171.9	68.1	8.0
Diseases of circulatory system 390-458	2.3	10.7	-	10.7	-	-	35.2	107.4	-	107.4	34.1	8.0
Pneumonia and influenza 470-486	96.2	333.0	128.9	204.1	102.2	4.0	344.8	1181.5	322.2	859.3	193.0	80.5
Other diseases of respiratory system 460-466,490-519	9.4	43.0	-	43.0	-	-	39.9	118.2	10.7	107.4	45.4	8.0
Diseases of digestive system 520-577	7.0	32.2	10.7	21.5	-	-	28.1	107.4	43.0	64.4	22.7	-
Diseases of genito-urinary system 580-629	2.3	10.7	-	10.7	-	-	16.4	75.2	-	75.2	-	-
Diseases of skin and subcutaneous tissue 680-709	7.0	21.5	10.7	10.7	-	4.0	16.4	75.2	10.7	64.4	-	-
Diseases of musculoskeletal system 710-738	-	-	-	-	-	-	-	-	-	-	-	-
Congenital anomalies	98.5	408.2	204.1	204.1	34.1	4.0	58.6	257.8	118.2	139.6	11.4	-
Nervous system 740-743	16.4	75.2	32.2	43.0	-	-	2.3	10.7	-	10.7	-	-
Circulatory system 746,747	42.2	161.1	96.7	64.4	34.1	-	18.8	85.9	21.5	64.4	-	-
Respiratory system 748	-	-	-	-	-	-	-	-	-	-	-	-
Digestive system 749-751	23.5	107.4	43.0	64.4	-	-	9.4	43.0	32.2	10.7	-	-
Genito-urinary system 752,753	4.7	10.7	-	10.7	-	4.0	9.4	43.0	21.5	21.5	-	-
Musculoskeletal system 754-756	4.7	21.5	21.5	-	-	-	9.4	43.0	32.2	10.7	-	-
Down's disease 759.3	7.0	32.2	10.7	21.5	-	-	9.4	32.2	10.7	21.5	11.4	-
Other anomalies 744,745, 757,758, Rest of 759	-	-	-	-	-	-	-	-	-	-	-	-
Certain perinatal causes 760-778	373.0	1707.8	1707.8	-	-	-	642.7	2943.1	2889.4	53.7	-	-
Symptoms 780-789	-	-	-	-	-	-	293.2	1192.3	118.2	1074.1	102.2	20.1
Sudden death 795	2.3	10.7	10.7	-	-	-	-	-	-	-	-	-
Other ill-defined conditions 790-792,796	-	-	-	-	-	-	2.3	-	-	-	-	4.0
External causes E800-E999	21.1	32.2	10.7	21.5	22.7	16.1	42.2	182.6	10.7	171.9	11.4	-

DEATHS
BRAZIL—Ribeirão Prêto, Franca

Underlying and Associated Causes of Death in Children Under 5 Years, by Age Group, in Two-Year Period, 1968–1970.

Cause	Underlying cause						Associated cause					
	Under 5 years	Infant deaths			1 year	2-4 years	Under 5 years	Infant deaths			1 year	2-4 years
		Total	Under 28 days	28 days-11 mos.				Total	Under 28 days	28 days-11 mos.		
All causes	434	364	188	176	32	38	749	625	280	345	65	59
Infective and parasitic diseases	175	144	33	111	20	11	58	36	11	25	9	13
Amebiasis ... 006	-	-	-	-	-	-	-	-	-	-	-	-
Diarrheal disease ... 009	150	134	32	102	11	5	31	21	3	18	4	6
Other intestinal infectious diseases ... 000-005,007,008	2	1	-	1	1	-	-	-	-	-	-	-
Tuberculosis ... 010-019	-	-	-	-	-	-	-	-	-	-	-	-
Diphtheria ... 032	-	-	-	-	-	-	-	-	-	-	-	-
Whooping cough ... 033	3	-	-	-	3	-	1	1	-	1	-	-
Tetanus ... 037	-	-	-	-	-	-	-	-	-	-	-	-
Septicemia ... 038	3	1	1	-	1	1	10	8	7	1	1	1
Measles ... 055	10	3	-	3	3	4	-	-	-	-	-	-
Congenital syphilis ... 090	-	-	-	-	-	-	-	-	-	-	-	-
Moniliasis ... 112	-	-	-	-	-	-	8	6	1	5	2	-
Helminthiases ... 120-129	-	-	-	-	-	-	8	-	-	-	2	6
Other ... Rest of 000-136	7	5	-	5	1	1	-	-	-	-	-	-
Malignant neoplasms ... 140-209	3	-	-	-	1	2	-	-	-	-	-	-
Neoplasms, other ... 210-239	1	1	-	1	-	-	-	-	-	-	-	-
Nutritional deficiency	17	9	-	9	2	6	141	110	5	105	19	12
Vitamin deficiency ... 260-266	-	-	-	-	-	-	-	-	-	-	-	-
Protein malnutrition ... 267	7	1	-	1	2	4	3	1	-	1	2	-
Nutritional marasmus ... 268	10	8	-	8	-	2	34	30	-	30	2	2
Other ... 269	-	-	-	-	-	-	104	79	5	74	15	10
Endocrine and metabolic diseases ... 240-258,270-279	-	-	-	-	-	-	-	-	-	-	-	-
Deficiency anemias ... 280,281	-	-	-	-	-	-	-	-	-	-	-	-
Other diseases of blood and blood-forming organs ... 282-289	-	-	-	-	-	-	11	8	1	7	-	3
Inflammatory diseases of central nervous system ... 320-324	8	2	-	2	2	4	9	3	-	3	4	2
Other diseases of nervous system and sense organs ... 310-315,330-389	8	7	1	6	-	1	6	3	-	3	2	1
Diseases of circulatory system ... 390-458	2	-	-	-	-	2	11	4	-	4	3	4
Pneumonia and influenza . 470-486	37	29	9	20	4	4	83	61	10	51	14	8
Other diseases of respiratory system ... 460-466,490-519	12	11	2	9	1	-	11	7	-	7	2	2
Diseases of digestive system ... 520-577	1	1	1	-	-	-	10	9	3	6	-	1
Diseases of genito-urinary system ... 580-629	4	3	1	2	-	1	2	2	-	2	-	-
Diseases of skin and subcutaneous tissue ... 680-709	4	4	3	1	-	-	5	4	1	3	-	1
Diseases of musculoskeletal system ... 710-738	1	1	-	1	-	-	-	-	-	-	-	-
Congenital anomalies	23	20	12	8	1	2	17	15	8	7	-	2
Nervous system ... 740-743	3	3	1	2	-	-	-	-	-	-	-	-
Circulatory system ... 746,747	7	5	4	1	-	2	6	6	3	3	-	-
Respiratory system ... 748	2	2	2	-	-	-	-	-	-	-	-	-
Digestive system ... 749-751	7	7	3	4	-	-	5	4	2	2	-	1
Genito-urinary system . 752,753	-	-	-	-	-	-	-	-	-	-	-	-
Musculoskeletal system . 754-756	2	2	2	-	-	-	-	-	-	-	-	-
Down's disease ... 759.3	2	1	-	1	1	-	6	5	3	2	-	1
Other anomalies ... 744,745, 757,758, Rest of 759	-	-	-	-	-	-	-	-	-	-	-	-
Certain perinatal causes ... 760-778	122	122	122	-	-	-	205	205	200	5	-	-
Symptoms ... 780-789	1	-	-	-	-	1	171	151	37	114	11	9
Sudden death ... 795	4	3	1	2	-	1	-	-	-	-	-	-
Other ill-defined conditions ... 790-792,796	5	5	2	3	-	-	-	-	-	-	-	-
External causes ... E800-E999	6	2	1	1	1	3	9	7	4	3	1	1

DEATH RATES
Franca, Ribeirão Prêto—BRAZIL

Death Rates from Underlying and Associated Causes in Children Under 5 Years, by Age Group, in Two-Year Period, 1968–1970.

Cause	Underlying cause						Associated cause					
	Under 5 years	Infant deaths			1 year	2-4 years	Under 5 years	Infant deaths			1 year	2-4 years
		Total	Under 28 days	28 days-11 mos.				Total	Under 28 days	28 days-11 mos.		
All causes	1942.7	7151.3	3693.5	3457.8	688.2	294.6	3352.7	12279.0	5501.0	6778.0	1397.8	457.4
Infective and parasitic diseases	783.3	2829.1	648.3	2180.7	430.1	85.3	259.6	707.3	216.1	491.2	193.5	100.8
Amebiasis 006	-	-	-	-	-	-	-	-	-	-	-	-
Diarrheal disease 009	671.4	2632.6	628.7	2003.9	236.6	38.8	138.8	412.6	58.9	353.6	86.0	46.5
Other intestinal infectious diseases 000-005,007,008	9.0	19.6	-	19.6	21.5	-	-	-	-	-	-	-
Tuberculosis 010-019	-	-	-	-	-	-	-	-	-	-	-	-
Diphtheria 032	-	-	-	-	-	-	-	-	-	-	-	-
Whooping cough 033	13.4	-	-	-	64.5	-	4.5	19.6	-	19.6	-	-
Tetanus 037	-	-	-	-	-	-	-	-	-	-	-	-
Septicemia 038	13.4	19.6	19.6	-	21.5	7.8	44.8	157.2	137.5	19.6	21.5	7.8
Measles 055	44.8	58.9	-	58.9	64.5	31.0	-	-	-	-	-	-
Congenital syphilis 090	-	-	-	-	-	-	-	-	-	-	-	-
Moniliasis 112	-	-	-	-	-	-	35.8	117.9	19.6	98.2	43.0	-
Helminthiases 120-129	-	-	-	-	-	-	35.8	-	-	-	43.0	46.5
Other Rest of 000-136	31.3	98.2	-	98.2	21.5	7.8	-	-	-	-	-	-
Malignant neoplasms 140-209	13.4	-	-	-	21.5	15.5	-	-	-	-	-	-
Neoplasms, other 210-239	4.5	19.6	-	19.6	-	-	-	-	-	-	-	-
Nutritional deficiency	76.1	176.8	-	176.8	43.0	46.5	631.2	2161.1	98.2	2062.9	408.6	93.0
Vitamin deficiency 260-266	-	-	-	-	-	-	-	-	-	-	-	-
Protein malnutrition 267	31.3	19.6	-	19.6	43.0	31.0	13.4	19.6	-	19.6	43.0	-
Nutritional marasmus 268	44.8	157.2	-	157.2	-	15.5	152.2	589.4	-	589.4	43.0	15.5
Other 269	-	-	-	-	-	-	465.5	1552.1	98.2	1453.8	322.6	77.5
Endocrine and metabolic diseases 240-258,270-279	-	-	-	-	-	-	-	-	-	-	-	-
Deficiency anemias 280,281	-	-	-	-	-	-	-	-	-	-	-	-
Other diseases of blood and blood-forming organs 282-289	-	-	-	-	-	-	49.2	157.2	19.6	137.5	-	23.3
Inflammatory diseases of central nervous system 320-324	35.8	39.3	-	39.3	43.0	31.0	40.3	58.9	-	58.9	86.0	15.5
Other diseases of nervous system and sense organs 310-315,330-389	35.8	137.5	19.6	117.9	-	7.8	26.9	58.9	-	58.9	43.0	7.8
Diseases of circulatory system 390-458	9.0	-	-	-	-	15.5	49.2	78.6	-	78.6	64.5	31.0
Pneumonia and influenza 470-486	165.6	569.7	176.8	392.9	86.0	31.0	371.5	1198.4	196.5	1002.0	301.1	62.0
Other diseases of respiratory system 460-466,490-519	53.7	216.1	39.3	176.8	21.5	-	49.2	137.5	-	137.5	43.0	15.5
Diseases of digestive system 520-577	4.5	19.6	19.6	-	-	-	44.8	176.8	58.9	117.9	-	7.8
Diseases of genito-urinary system 580-629	17.9	58.9	19.6	39.3	-	7.8	9.0	39.3	-	39.3	-	-
Diseases of skin and subcutaneous tissue 680-709	17.9	78.9	58.9	19.6	-	-	22.4	78.6	19.6	58.9	-	7.8
Diseases of musculoskeletal system 710-738	4.5	19.6	-	19.6	-	-	-	-	-	-	-	-
Congenital anomalies	103.0	392.9	235.8	157.2	21.5	15.5	76.1	294.7	157.2	137.5	-	15.5
Nervous system 740-743	13.4	58.9	19.6	39.3	-	-	-	-	-	-	-	-
Circulatory system 746,747	31.3	98.2	78.6	19.6	-	15.5	26.9	117.9	58.9	58.9	-	-
Respiratory system 748	9.0	39.3	39.3	-	-	-	-	-	-	-	-	-
Digestive system 749-751	31.3	137.5	58.9	78.6	-	-	22.4	78.6	39.3	39.3	-	7.8
Genito-urinary system 752,753	-	-	-	-	-	-	-	-	-	-	-	-
Musculoskeletal system 754-756	9.0	39.3	39.3	-	-	-	-	-	-	-	-	-
Down's disease 759.3	9.0	19.6	-	19.6	21.5	-	26.9	98.2	58.9	39.3	-	7.8
Other anomalies 744,745, 757,758, Rest of 759	-	-	-	-	-	-	-	-	-	-	-	-
Certain perinatal causes 760-778	546.1	2396.9	2396.9	-	-	-	917.6	4027.5	3929.3	98.2	-	-
Symptoms 780-789	4.5	-	-	-	-	7.8	765.4	2966.6	726.9	2239.7	236.6	69.8
Sudden death 795	17.9	58.9	19.6	39.3	-	7.8	-	-	-	-	-	-
Other ill-defined conditions 790-792,796	22.4	98.2	39.3	58.9	-	-	-	-	-	-	-	-
External causes E800-E999	26.9	39.3	19.6	19.6	21.5	23.3	40.3	137.5	78.6	58.9	21.5	7.8

DEATHS
BRAZIL—Ribeirão Prêto Communities

Underlying and Associated Causes of Death in Children Under 5 Years, by Age Group, in Two-Year Period, 1968–1970.

Cause	Underlying cause						Associated cause					
	Under 5 years	Infant deaths			1 year	2–4 years	Under 5 years	Infant deaths			1 year	2–4 years
		Total	Under 28 days	28 days–11 mos.				Total	Under 28 days	28 days–11 mos.		
All causes	228	195	104	91	13	20	389	328	142	186	32	29
Infective and parasitic diseases	82	68	7	61	8	6	31	21	5	16	5	5
Amebiasis ... 006	-	-	-	-	-	-	-	-	-	-	-	-
Diarrheal disease ... 009	66	59	5	54	5	2	14	9	2	7	3	2
Other intestinal infectious diseases ... 000–005,007,008	2	2	1	1	-	-	-	-	-	-	-	-
Tuberculosis ... 010–019	1	1	-	1	-	-	1	1	-	1	-	-
Diphtheria ... 032	-	-	-	-	-	-	-	-	-	-	-	-
Whooping cough ... 033	1	1	-	1	-	-	-	-	-	-	-	-
Tetanus ... 037	1	1	1	-	-	-	-	-	-	-	-	-
Septicemia ... 038	-	-	-	-	-	-	7	7	3	4	-	-
Measles ... 055	7	2	-	2	2	3	-	-	-	-	-	-
Congenital syphilis ... 090	1	1	-	1	-	-	-	-	-	-	-	-
Moniliasis ... 112	-	-	-	-	-	-	3	3	-	3	-	-
Helminthiases ... 120–129	1	-	-	-	1	-	5	1	-	1	2	2
Other ... Rest of 000–136	2	1	-	1	-	1	1	-	-	-	-	1
Malignant neoplasms ... 140–209	4	-	-	-	-	4	1	-	-	-	-	1
Neoplasms, other ... 210–239	-	-	-	-	-	-	-	-	-	-	-	-
Nutritional deficiency	3	-	-	-	1	2	84	64	1	63	8	12
Vitamin deficiency ... 260–266	-	-	-	-	-	-	-	-	-	-	-	-
Protein malnutrition ... 267	3	-	-	-	1	2	2	-	-	-	2	-
Nutritional marasmus ... 268	-	-	-	-	-	-	25	18	-	18	2	5
Other ... 269	-	-	-	-	-	-	57	46	1	45	4	7
Endocrine and metabolic diseases ... 240–258,270–279	-	-	-	-	-	-	-	-	-	-	-	-
Deficiency anemias ... 280,281	-	-	-	-	-	-	1	1	1	-	-	-
Other diseases of blood and blood-forming organs ... 282–289	-	-	-	-	-	-	2	1	-	1	-	1
Inflammatory diseases of central nervous system ... 320–324	3	1	-	1	-	2	2	1	-	1	1	-
Other diseases of nervous system and sense organs ... 310–315,330–389	4	4	-	4	-	-	8	8	-	8	-	-
Diseases of circulatory system ... 390–458	-	-	-	-	-	-	5	4	-	4	1	-
Pneumonia and influenza . 470–486	22	20	6	14	2	-	48	36	14	22	7	5
Other diseases of respiratory system ... 460–466,490–519	4	3	-	3	1	-	3	3	1	2	-	-
Diseases of digestive system ... 520–577	-	-	-	-	-	-	7	5	1	4	2	-
Diseases of genito-urinary system ... 580–629	2	-	-	-	-	2	-	-	-	-	-	-
Diseases of skin and subcutaneous tissue ... 680–709	1	1	1	-	-	-	2	1	-	1	-	1
Diseases of musculoskeletal system ... 710–738	-	-	-	-	-	-	-	-	-	-	-	-
Congenital anomalies	11	10	4	6	1	-	7	6	4	2	1	-
Nervous system ... 740–743	2	2	-	2	-	-	-	-	-	-	-	-
Circulatory system ... 746,747	3	3	1	2	-	-	5	4	3	1	1	-
Respiratory system ... 748	-	-	-	-	-	-	1	1	1	-	-	-
Digestive system ... 749–751	4	4	3	1	-	-	-	-	-	-	-	-
Genito-urinary system . 752,753	-	-	-	-	-	-	-	-	-	-	-	-
Musculoskeletal system . 754–756	-	-	-	-	-	-	-	-	-	-	-	-
Down's disease ... 759.3	2	1	-	1	1	-	1	1	-	1	-	-
Other anomalies ... 744,745, 757,758, Rest of 759	-	-	-	-	-	-	-	-	-	-	-	-
Certain perinatal causes ... 760–778	85	85	85	-	-	-	108	108	106	2	-	-
Symptoms ... 780–789	-	-	-	-	-	-	79	68	8	60	7	4
Sudden death ... 795	1	1	1	-	-	-	-	-	-	-	-	-
Other ill-defined conditions ... 790–792,796	2	1	-	1	-	1	-	-	-	-	-	-
External causes ... E800–E999	4	1	-	1	-	3	1	1	1	-	-	-

DEATH RATES
Ribeirão Prêto Communities—BRAZIL

Death Rates from Underlying and Associated Causes in Children Under 5 Years, by Age Group, in Two-Year Period, 1968–1970.

Cause	Underlying cause						Associated cause					
	Under 5 years	Infant deaths			1 year	2-4 years	Under 5 years	Infant deaths			1 year	2-4 years
		Total	Under 28 days	28 days-11 mos.				Total	Under 28 days	28 days-11 mos.		
All causes	1300.6	5078.1	2708.3	2369.8	360.1	195.3	2219.1	8541.7	3697.9	4843.8	886.4	283.2
Infective and parasitic diseases	467.8	1770.8	182.3	1588.5	221.6	58.6	176.8	546.9	130.2	416.7	138.5	48.8
Amebiasis 006	-	-	-	-	-	-	-	-	-	-	-	-
Diarrheal disease 009	376.5	1536.5	130.2	1406.2	138.5	19.5	79.9	234.4	52.1	182.3	83.1	19.5
Other intestinal infectious diseases 000-005,007,008	11.4	52.1	26.0	26.0	-	-	-	-	-	-	-	-
Tuberculosis 010-019	5.7	26.0	-	26.0	-	-	5.7	26.0	-	26.0	-	-
Diphtheria 032	-	-	-	-	-	-	-	-	-	-	-	-
Whooping cough 033	5.7	26.0	-	26.0	-	-	-	-	-	-	-	-
Tetanus 037	5.7	26.0	26.0	-	-	-	-	-	-	-	-	-
Septicemia 038	-	-	-	-	-	-	39.9	182.3	78.1	104.2	-	-
Measles 055	39.9	52.1	-	52.1	55.4	29.3	-	-	-	-	-	-
Congenital syphilis 090	5.7	26.0	-	26.0	-	-	-	-	-	-	-	-
Moniliasis 112	-	-	-	-	-	-	17.1	78.1	-	78.1	-	-
Helminthiases 120-129	5.7	-	-	-	27.7	-	28.5	26.0	-	26.0	55.4	19.5
Other Rest of 000-136	11.4	26.0	-	26.0	-	9.8	5.7	-	-	-	-	9.8
Malignant neoplasms 140-209	22.8	-	-	-	-	39.1	5.7	-	-	-	-	9.8
Neoplasms, other 210-239	-	-	-	-	-	-	-	-	-	-	-	-
Nutritional deficiency	17.1	-	-	-	27.7	19.5	479.2	1666.7	26.0	1640.6	221.6	117.2
Vitamin deficiency 260-266	-	-	-	-	-	-	-	-	-	-	-	-
Protein malnutrition 267	17.1	-	-	-	27.7	19.5	11.4	-	-	-	55.4	-
Nutritional marasmus 268	-	-	-	-	-	-	142.6	468.8	-	468.8	55.4	48.8
Other 269	-	-	-	-	-	-	325.2	1197.9	26.0	1171.9	110.8	68.4
Endocrine and metabolic diseases 240-258,270-279	-	-	-	-	-	-	-	-	-	-	-	-
Deficiency anemias 280,281	-	-	-	-	-	-	5.7	26.0	26.0	-	-	-
Other diseases of blood and blood-forming organs 282-289	-	-	-	-	-	-	11.4	26.0	-	26.0	-	9.8
Inflammatory diseases of central nervous system 320-324	17.1	26.0	-	26.0	-	19.5	11.4	26.0	-	26.0	27.7	-
Other diseases of nervous system and sense organs 310-315,330-389	22.8	104.2	-	104.2	-	-	45.6	208.3	-	208.3	-	-
Diseases of circulatory system 390-458	-	-	-	-	-	-	28.5	104.2	-	104.2	27.7	-
Pneumonia and influenza 470-486	125.5	520.8	156.2	364.6	55.4	-	273.8	937.5	364.6	572.9	193.9	48.8
Other diseases of respiratory system 460-466,490-519	22.8	78.1	-	78.1	27.7	-	17.1	78.1	26.0	52.1	-	-
Diseases of digestive system 520-577	-	-	-	-	-	-	39.9	130.2	26.0	104.2	55.4	-
Diseases of genito-urinary system 580-629	11.4	-	-	-	-	19.5	-	-	-	-	-	-
Diseases of skin and subcutaneous tissue 680-709	5.7	26.0	26.0	-	-	-	11.4	26.0	-	26.0	-	9.8
Diseases of musculoskeletal system 710-738	-	-	-	-	-	-	-	-	-	-	-	-
Congenital anomalies	62.7	260.4	104.2	156.2	27.7	-	39.9	156.2	104.2	52.1	27.7	-
Nervous system 740-743	11.4	52.1	-	52.1	-	-	-	-	-	-	-	-
Circulatory system 746,747	17.1	78.1	26.0	52.1	-	-	28.5	104.2	78.1	26.0	27.7	-
Respiratory system 748	-	-	-	-	-	-	5.7	26.0	26.0	-	-	-
Digestive system 749-751	22.8	104.2	78.1	26.0	-	-	-	-	-	-	-	-
Genito-urinary system 752,753	-	-	-	-	-	-	-	-	-	-	-	-
Musculoskeletal system 754-756	-	-	-	-	-	-	-	-	-	-	-	-
Down's disease 759.3	11.4	26.0	-	26.0	27.7	-	5.7	26.0	0	26.0	-	-
Other anomalies 744,745, 757,758, Rest of 759	-	-	-	-	-	-	-	-	-	-	-	-
Certain perinatal causes 760-778	484.9	2213.5	2213.5	-	-	-	616.1	2812.5	2760.4	52.1	-	-
Symptoms 780-789	-	-	-	-	-	-	450.7	1770.8	208.3	1562.5	193.9	39.1
Sudden death 795	5.7	26.0	26.0	-	-	-	-	-	-	-	-	-
Other ill-defined conditions 790-792,796	11.4	26.0	-	26.0	-	9.8	-	-	-	-	-	-
External causes E800-E999	22.8	26.0	-	26.0	-	29.3	5.7	26.0	26.0	-	-	-

DEATHS
BRAZIL—São Paulo

Underlying and Associated Causes of Death in Children Under 5 Years, by Age Group, in Two-Year Period, 1968–1970.

Cause	Underlying cause						Associated cause					
	Under 5 years	Infant deaths			1 year	2-4 years	Under 5 years	Infant deaths			1 year	2-4 years
		Total	Under 28 days	28 days-11 mos.				Total	Under 28 days	28 days-11 mos.		
All causes	4312	3788	1958	1830	282	242	8676	7651	3433	4218	576	449
Infective and parasitic diseases	1629	1411	438	973	126	92	1288	1067	342	725	125	96
Amebiasis ... 006	1	1	-	1	-	-	-	-	-	-	-	-
Diarrheal disease ... 009	1200	1149	356	793	37	14	568	476	127	349	56	36
Other intestinal infectious diseases ... 000-005,007,008	68	64	15	49	2	2	19	15	1	14	2	2
Tuberculosis ... 010-019	26	6	-	6	10	10	16	2	-	2	7	7
Diphtheria ... 032	7	2	-	2	1	4	-	-	-	-	-	-
Whooping cough ... 033	35	22	-	22	7	6	1	1	-	1	-	-
Tetanus ... 037	7	7	7	-	-	-	1	1	-	1	-	-
Septicemia ... 038	41	40	33	7	1	-	190	174	79	95	8	8
Measles ... 055	156	52	-	52	61	43	6	4	-	4	-	2
Congenital syphilis ... 090	26	26	15	11	-	-	2	2	1	1	-	-
Moniliasis ... 112	9	9	9	-	-	-	362	350	133	217	9	3
Helminthiases ... 120-129	5	1	-	1	1	3	92	18	-	18	37	37
Other ... Rest of 000-136	48	32	3	29	6	10	31	24	1	23	6	1
Malignant neoplasms ... 140-209	24	2	-	2	4	18	1	-	-	-	-	1
Neoplasms, other ... 210-239	2	1	1	-	-	1	2	2	1	1	-	-
Nutritional deficiency	99	61	2	59	30	8	1214	1001	106	895	116	97
Vitamin deficiency ... 260-266	2	-	-	-	2	-	1	1	-	1	-	-
Protein malnutrition ... 267	29	5	-	5	18	6	29	9	-	9	9	11
Nutritional marasmus ... 268	59	49	1	48	8	2	240	206	6	200	18	16
Other ... 269	9	7	1	6	2	-	944	785	100	685	89	70
Endocrine and metabolic diseases ... 240-258,270-279	8	6	3	3	-	2	5	5	1	4	-	-
Deficiency anemias ... 280,281	-	-	-	-	-	-	10	9	7	2	-	1
Other diseases of blood and blood-forming organs ... 282-289	6	2	-	2	2	2	148	117	5	112	24	7
Inflammatory diseases of central nervous system ... 320-324	73	59	14	45	11	3	84	73	15	58	5	6
Other diseases of nervous system and sense organs ... 310-315,330-389	144	118	15	103	11	15	150	122	13	109	16	12
Diseases of circulatory system ... 390-458	20	15	1	14	2	3	153	109	12	97	18	26
Pneumonia and influenza . 470-486	584	510	175	335	48	26	1163	940	324	616	132	91
Other diseases of respiratory system ... 460-466,490-519	125	94	9	85	15	16	154	105	10	95	27	22
Diseases of digestive system ... 520-577	28	25	11	14	1	2	139	122	28	94	5	12
Diseases of genito-urinary system ... 580-629	48	43	7	36	2	3	127	113	16	97	6	8
Diseases of skin and subcutaneous tissue ... 680-709	10	10	4	6	-	-	61	54	10	44	5	2
Diseases of musculoskeletal system ... 710-738	2	1	-	1	-	1	1	1	-	1	-	-
Congenital anomalies	238	213	117	96	10	15	164	144	61	83	10	10
Nervous system ... 740-743	59	52	31	21	2	5	16	16	4	12	-	-
Circulatory system ... 746,747	111	101	48	53	3	7	70	64	22	42	3	3
Respiratory system ... 748	2	2	1	1	-	-	2	2	2	-	-	-
Digestive system ... 749-751	44	40	25	15	3	1	23	21	11	10	2	-
Genito-urinary system . 752,753	2	2	1	1	-	-	7	7	3	4	-	-
Musculoskeletal system . 754-756	3	1	1	-	1	1	13	9	7	2	-	4
Down's disease ... 759.3	13	11	6	5	1	1	30	23	11	12	5	2
Other anomalies ... 744,745, 757,758, Rest of 759	4	4	4	-	-	-	3	2	1	1	-	1
Certain perinatal causes ... 760-778	1148	1148	1133	15	-	-	2205	2205	2131	74	-	-
Symptoms ... 780-789	5	5	2	3	-	-	1568	1433	333	1100	82	53
Sudden death ... 795	18	16	3	13	1	1	-	-	-	-	-	-
Other ill-defined conditions ... 790-792,796	24	21	12	9	2	1	-	-	-	-	-	-
External causes ... E800-E999	77	27	11	16	17	33	39	29	18	11	5	5

DEATH RATES
São Paulo—BRAZIL

Death Rates from Underlying and Associated Causes in Children Under 5 Years, by Age Group, in Two-Year Period, 1968–1970.

Cause	Underlying cause						Associated cause					
	Under 5 years	Infant deaths			1 year	2-4 years	Under 5 years	Infant deaths			1 year	2-4 years
		Total	Under 28 days	28 days-11 mos.				Total	Under 28 days	28 days-11 mos.		
All causes	1769.3	6513.1	3366.6	3146.5	520.9	180.2	3560.0	13155.1	5902.7	7252.4	1063.9	334.4
Infective and parasitic diseases	668.4	2426.1	753.1	1673.0	232.7	68.5	528.5	1834.6	588.0	1246.6	230.9	71.5
Amebiasis 006	0.4	1.7	-	1.7	-	-	-	-	-	-	-	-
Diarrheal disease 009	492.4	1975.6	612.1	1363.5	68.3	10.4	233.1	818.4	218.4	600.1	103.4	26.8
Other intestinal infectious diseases 000-005,007,008	27.9	110.0	25.8	84.3	3.7	1.5	7.8	25.8	1.7	24.1	3.7	1.5
Tuberculosis 010-019	10.7	10.3	-	10.3	18.5	7.4	6.6	3.4	-	3.4	12.9	5.2
Diphtheria 032	2.9	3.4	-	3.4	1.8	3.0	-	-	-	-	-	-
Whooping cough 033	14.4	37.8	-	37.8	12.9	4.5	0.4	1.7	-	1.7	-	-
Tetanus 037	2.9	12.0	12.0	-	-	-	0.4	1.7	-	1.7	-	-
Septicemia 038	16.8	68.8	56.7	12.0	1.8	-	78.0	299.2	135.8	163.3	14.8	6.0
Measles 055	64.0	89.4	-	89.4	112.7	32.0	2.5	6.9	-	6.9	-	1.5
Congenital syphilis 090	10.7	44.7	25.8	18.9	-	-	0.8	3.4	1.7	1.7	-	-
Moniliasis 112	3.7	15.5	15.5	-	-	-	148.5	601.8	228.7	373.1	16.6	2.2
Helminthiases 120-129	2.1	1.7	-	1.7	1.8	2.2	37.7	30.9	-	30.9	68.3	27.6
Other Rest of 000-136	19.7	55.0	5.2	49.9	11.1	7.4	12.7	41.3	1.7	39.5	11.1	0.7
Malignant neoplasms 140-209	9.8	3.4	-	3.4	7.4	13.4	0.4	-	-	-	-	0.7
Neoplasms, other 210-239	0.8	1.7	1.7	-	-	0.7	0.8	3.4	1.7	1.7	-	-
Nutritional deficiency	40.6	104.9	3.4	101.4	55.4	6.0	498.1	1721.1	182.3	1538.9	214.3	72.2
Vitamin deficiency 260-266	0.8	-	-	-	3.7	-	0.4	1.7	-	1.7	-	-
Protein malnutrition 267	11.9	8.6	-	8.6	33.2	4.5	11.9	15.5	-	15.5	16.6	8.2
Nutritional marasmus 268	24.2	84.3	1.7	82.5	14.8	1.5	98.5	354.2	10.3	343.9	33.2	11.9
Other 269	3.7	12.0	1.7	10.3	3.7	-	387.3	1349.7	171.9	1177.8	164.4	52.1
Endocrine and metabolic diseases 240-258,270-279	3.3	10.3	5.2	5.2	-	1.5	2.1	8.6	1.7	6.9	-	-
Deficiency anemias 280,281	-	-	-	-	-	-	4.1	15.5	12.0	3.4	-	0.7
Other diseases of blood and blood-forming organs 282-289	2.5	3.4	-	3.4	3.7	1.5	60.7	201.2	8.6	192.6	44.3	5.2
Inflammatory diseases of central nervous system 320-324	30.0	101.4	24.1	77.4	20.3	2.2	34.5	125.5	25.8	99.7	9.2	4.5
Other diseases of nervous system and sense organs 310-315,330-389	59.1	202.9	25.8	177.1	20.3	11.2	61.5	209.8	22.4	187.4	29.6	8.9
Diseases of circulatory system 390-458	8.2	25.8	1.7	24.1	3.7	2.2	62.8	187.4	20.6	166.8	33.2	19.4
Pneumonia and influenza 470-486	239.6	876.9	300.9	576.0	88.7	19.4	477.2	1616.2	557.1	1059.1	243.8	67.8
Other diseases of respiratory system 460-466,490-519	51.3	161.6	15.5	146.1	27.7	11.9	63.2	180.5	17.2	163.3	49.9	16.4
Diseases of digestive system 520-577	11.5	43.0	18.9	24.1	1.8	1.5	57.0	209.8	48.1	161.6	9.2	8.9
Diseases of genito-urinary system 580-629	19.7	73.9	12.0	61.9	3.7	2.2	52.1	194.3	27.5	166.8	11.1	6.0
Diseases of skin and subcutaneous tissue 680-709	4.1	17.2	6.9	10.3	-	-	25.0	92.8	17.2	75.7	9.2	1.5
Diseases of musculoskeletal system 710-738	0.8	1.7	-	1.7	-	0.7	0.4	1.7	-	1.7	-	-
Congenital anomalies	97.7	366.2	201.2	165.1	18.5	11.2	67.3	247.6	104.9	142.7	18.5	7.4
Nervous system 740-743	24.2	89.4	53.3	36.1	3.7	3.7	6.6	27.5	6.9	20.6	-	-
Circulatory system 746,747	45.5	173.7	82.5	91.1	5.5	5.2	28.7	110.0	37.8	72.2	5.5	2.2
Respiratory system 748	0.8	3.4	1.7	1.7	-	-	0.8	3.4	3.4	-	-	-
Digestive system 749-751	18.1	68.8	43.0	25.8	5.5	0.7	9.4	36.1	18.9	17.2	3.7	-
Genito-urinary system 752,753	0.8	3.4	1.7	1.7	-	-	2.9	12.0	5.2	6.9	-	-
Musculoskeletal system 754-756	1.2	1.7	1.7	-	1.8	0.7	5.3	15.5	12.0	3.4	-	3.0
Down's disease 759.3	5.3	18.9	10.3	8.6	1.8	0.7	12.3	39.5	18.9	20.6	9.2	1.5
Other anomalies 744,745, 757,758, Rest of 759	1.6	6.9	6.9	-	-	-	1.2	3.4	1.7	1.7	-	0.7
Certain perinatal causes 760-778	471.1	1973.9	1948.1	25.8	-	-	904.8	3791.3	3664.0	127.2	-	-
Symptoms 780-789	2.1	8.6	3.4	5.2	-	-	643.4	2463.9	572.6	1891.3	151.5	39.5
Sudden death 795	7.4	27.5	5.2	22.4	1.8	0.7	-	-	-	-	-	-
Other ill-defined conditions 790-792,796	9.8	36.1	20.6	15.5	3.7	0.7	-	-	-	-	-	-
External causes E800-E999	31.6	46.4	18.9	27.5	31.4	24.6	16.0	49.9	30.9	18.9	9.2	3.7

DEATHS
CANADA—Sherbrooke

Underlying and Associated Causes of Death in Children Under 5 Years, by Age Group, in Two-Year Period, 1970-1971.

Cause	Underlying cause						Associated cause					
	Under 5 years	Infant deaths			1 year	2-4 years	Under 5 years	Infant deaths			1 year	2-4 years
		Total	Under 28 days	28 days-11 mos.				Total	Under 28 days	28 days-11 mos.		
All causes	371	310	229	81	20	41	484	446	366	80	17	21
Infective and parasitic diseases	7	4	1	3	1	2	12	8	3	5	2	2
Amebiasis 006	-	-	-	-	-	-	-	-	-	-	-	-
Diarrheal disease 009	3	2	-	2	-	1	3	2	-	2	1	-
Other intestinal infectious diseases 000-005,007,008	-	-	-	-	-	-	-	-	-	-	-	-
Tuberculosis 010-019	-	-	-	-	-	-	-	-	-	-	-	-
Diphtheria 032	-	-	-	-	-	-	-	-	-	-	-	-
Whooping cough 033	-	-	-	-	-	-	1	-	-	-	-	1
Tetanus 037	-	-	-	-	-	-	-	-	-	-	-	-
Septicemia 038	1	1	1	-	-	-	8	6	3	3	1	1
Measles 055	1	-	-	-	1	-	-	-	-	-	-	-
Congenital syphilis 090	-	-	-	-	-	-	-	-	-	-	-	-
Moniliasis 112	-	-	-	-	-	-	-	-	-	-	-	-
Helminthiases 120-129	-	-	-	-	-	-	-	-	-	-	-	-
Other Rest of 000-136	2	1	-	1	-	1	-	-	-	-	-	-
Malignant neoplasms 140-209	11	1	-	1	3	7	-	-	-	-	-	-
Neoplasms, other 210-239	1	1	1	-	-	-	-	-	-	-	-	-
Nutritional deficiency	-	-	-	-	-	-	12	6	-	6	4	2
Vitamin deficiency 260-266	-	-	-	-	-	-	-	-	-	-	-	-
Protein malnutrition 267	-	-	-	-	-	-	-	-	-	-	-	-
Nutritional marasmus 268	-	-	-	-	-	-	4	1	-	1	2	1
Other 269	-	-	-	-	-	-	8	5	-	5	2	1
Endocrine and metabolic diseases 240-258,270-279	5	5	1	4	-	-	1	1	-	1	-	-
Deficiency anemias 280,281	-	-	-	-	-	-	1	1	1	-	-	-
Other diseases of blood and blood-forming organs 282-289	-	-	-	-	-	-	3	3	-	3	-	-
Inflammatory diseases of central nervous system 320-324	2	-	-	-	1	1	11	9	4	5	-	2
Other diseases of nervous system and sense organs 310-315,330-389	5	1	-	1	2	2	3	1	-	1	-	2
Diseases of circulatory system 390-458	1	-	-	-	1	-	16	14	2	12	2	-
Pneumonia and influenza 470-486	26	23	5	18	1	2	33	23	5	18	4	6
Other diseases of respiratory system 460-466,490-519	6	4	-	4	2	-	2	2	-	2	-	-
Diseases of digestive system 520-577	5	4	3	1	-	1	6	4	3	1	1	1
Diseases of genito-urinary system 580-629	-	-	-	-	-	-	3	1	1	-	1	1
Diseases of skin and subcutaneous tissue 680-709	2	2	-	2	-	-	-	-	-	-	-	-
Diseases of musculoskeletal system 710-738	-	-	-	-	-	-	-	-	-	-	-	-
Congenital anomalies	105	98	65	33	3	4	85	81	63	18	1	3
Nervous system 740-743	37	36	26	10	-	1	7	6	6	-	-	1
Circulatory system 746,747	38	37	22	15	1	-	43	43	34	9	-	-
Respiratory system 748	-	-	-	-	-	-	8	8	7	1	-	-
Digestive system 749-751	10	10	4	6	-	-	9	8	6	2	-	1
Genito-urinary system 752,753	6	6	6	-	-	-	7	6	5	1	1	-
Musculoskeletal system 754-756	6	5	5	-	-	1	2	1	1	-	-	1
Down's disease 759.3	5	1	-	1	2	2	7	7	2	5	-	-
Other anomalies 744,745, 757,758, Rest of 759	3	3	2	1	-	-	2	2	2	-	-	-
Certain perinatal causes 760-778	152	152	152	-	-	-	283	283	282	1	-	-
Symptoms 780-789	-	-	-	-	-	-	5	3	-	3	1	1
Sudden death 795	6	6	-	6	-	-	-	-	-	-	-	-
Other ill-defined conditions 790-792,796	-	-	-	-	-	-	-	-	-	-	-	-
External causes E800-E999	37	9	1	8	6	22	8	6	2	4	1	1

DEATH RATES
Sherbrooke—CANADA

Death Rates from Underlying and Associated Causes in Children Under 5 Years, by Age Group, in Two-Year Period, 1970–1971.

Cause	Underlying cause						Associated cause					
	Under 5 years	Infant deaths			1 year	2-4 years	Under 5 years	Infant deaths			1 year	2-4 years
		Total	Under 28 days	28 days-11 mos.				Total	Under 28 days	28 days-11 mos.		
All causes	407.4	1826.8	1349.4	477.3	117.6	71.5	531.5	2628.2	2156.7	471.4	100.0	36.6
Infective and parasitic diseases	7.7	23.6	5.9	17.7	5.9	3.5	13.2	47.1	17.7	29.5	11.8	3.5
Amebiasis ... 006	-	-	-	-	-	-	-	-	-	-	-	-
Diarrheal disease ... 009	3.3	11.8	-	11.8	-	1.7	3.3	11.8	-	11.8	5.9	-
Other intestinal infectious diseases ... 000-005,007,008	-	-	-	-	-	-	-	-	-	-	-	-
Tuberculosis ... 010-019	-	-	-	-	-	-	-	-	-	-	-	-
Diphtheria ... 032	-	-	-	-	-	-	-	-	-	-	-	-
Whooping cough ... 033	-	-	-	-	-	-	1.1	-	-	-	-	1.7
Tetanus ... 037	-	-	-	-	-	-	-	-	-	-	-	-
Septicemia ... 038	1.1	5.9	5.9	-	-	-	8.8	35.4	17.7	17.7	5.9	1.7
Measles ... 055	1.1	-	-	-	5.9	-	-	-	-	-	-	-
Congenital syphilis ... 090	-	-	-	-	-	-	-	-	-	-	-	-
Moniliasis ... 112	-	-	-	-	-	-	-	-	-	-	-	-
Helminthiases ... 120-129	-	-	-	-	-	-	-	-	-	-	-	-
Other ... Rest of 000-136	2.2	5.9	-	5.9	-	1.7	-	-	-	-	-	-
Malignant neoplasms ... 140-209	12.1	5.9	-	5.9	17.6	12.2	-	-	-	-	-	-
Neoplasms, other ... 210-239	1.1	5.9	5.9	-	-	-	-	-	-	-	-	-
Nutritional deficiency	-	-	-	-	-	-	13.2	35.4	-	35.4	23.5	3.5
Vitamin deficiency ... 260-266	-	-	-	-	-	-	-	-	-	-	-	-
Protein malnutrition ... 267	-	-	-	-	-	-	-	-	-	-	-	-
Nutritional marasmus ... 268	-	-	-	-	-	-	4.4	5.9	-	5.9	11.8	1.7
Other ... 269	-	-	-	-	-	-	8.8	29.5	-	29.5	11.8	1.7
Endocrine and metabolic diseases ... 240-258,270-279	5.5	29.5	5.9	23.6	-	-	1.1	5.9	-	5.9	-	-
Deficiency anemias ... 280,281	-	-	-	-	-	-	1.1	5.9	5.9	-	-	-
Other diseases of blood and blood-forming organs ... 282-289	-	-	-	-	-	-	3.3	17.7	-	17.7	-	-
Inflammatory diseases of central nervous system ... 320-324	2.2	-	-	-	5.9	1.7	12.1	53.0	23.6	29.5	-	3.5
Other diseases of nervous system and sense organs ... 310-315,330-389	5.5	5.9	-	5.9	11.8	3.5	3.3	5.9	-	5.9	-	3.5
Diseases of circulatory system ... 390-458	1.1	-	-	-	5.9	-	17.6	82.5	11.8	70.7	11.8	-
Pneumonia and influenza . 470-486	28.6	135.5	29.5	106.1	5.9	3.5	36.2	135.5	29.5	106.1	23.5	10.5
Other diseases of respiratory system ... 460-466,490-519	6.6	23.6	-	23.6	11.8	-	2.2	11.8	-	11.8	-	-
Diseases of digestive system ... 520-577	5.5	23.6	17.7	5.9	-	1.7	6.6	23.6	17.7	5.9	5.9	1.7
Diseases of genito-urinary system ... 580-629	-	-	-	-	-	-	3.3	5.9	5.9	-	5.9	1.7
Diseases of skin and subcutaneous tissue ... 680-709	2.2	11.8	-	11.8	-	-	-	-	-	-	-	-
Diseases of musculoskeletal system ... 710-738	-	-	-	-	-	-	-	-	-	-	-	-
Congenital anomalies	115.3	577.5	383.0	194.5	17.6	7.0	93.3	477.3	371.2	106.1	5.9	5.2
Nervous system ... 740-743	40.6	212.1	153.2	58.9	-	1.7	7.7	35.4	35.4	-	-	1.7
Circulatory system ... 746,747	41.7	218.0	129.6	88.4	5.9	-	47.2	253.4	200.4	53.0	-	-
Respiratory system ... 748	-	-	-	-	-	-	8.8	47.1	41.2	5.9	-	-
Digestive system ... 749-751	11.0	58.9	23.6	35.4	-	-	9.9	47.1	35.4	11.8	-	1.7
Genito-urinary system . 752,753	6.6	35.4	35.4	-	-	-	7.7	35.4	29.5	5.9	3.9	-
Musculoskeletal system . 754-756	6.6	29.5	29.5	-	-	1.7	2.2	5.9	5.9	-	-	1.7
Down's disease ... 759.3	5.5	5.9	-	5.9	11.8	3.5	7.7	41.2	11.8	29.5	-	-
Other anomalies ... 744,745, 757,758, Rest of 759	3.3	17.7	11.8	5.9	-	-	2.2	11.8	11.8	-	-	-
Certain perinatal causes ... 760-778	166.9	895.7	895.7	-	-	-	310.8	1667.6	1661.8	5.9	-	-
Symptoms ... 780-789	-	-	-	-	-	-	5.5	17.7	-	17.7	5.9	1.7
Sudden death ... 795	6.6	35.4	-	35.4	-	-	-	-	-	-	-	-
Other ill-defined conditions ... 790-792,796	-	-	-	-	-	-	-	-	-	-	-	-
External causes ... E800-E999	40.6	53.0	5.9	47.1	35.3	38.4	8.8	35.4	11.8	23.6	5.9	1.7

DEATHS
CHILE—Santiago

Underlying and Associated Causes of Death in Children Under 5 Years, by Age Group, in Two-Year Period, 1968–1970,

Cause	Underlying cause						Associated cause					
	Under 5 years	Infant deaths			1 year	2-4 years	Under 5 years	Infant deaths			1 year	2-4 years
		Total	Under 28 days	28 days-11 mos.				Total	Under 28 days	28 days-11 mos.		
All causes	2489	2207	1094	1113	149	133	3983	3635	1913	1722	211	137
Infective and parasitic diseases	541	577	125	452	39	25	441	405	182	223	18	18
Amebiasis 006	-	-	-	-	-	-	-	-	-	-	-	-
Diarrheal disease 009	486	450	65	385	27	9	202	177	51	126	16	9
Other intestinal infectious diseases 000-005,007,008	32	30	7	23	-	2	4	4	1	3	-	-
Tuberculosis 010-019	7	3	-	3	1	3	6	2	-	2	1	3
Diphtheria 032	2	-	-	-	1	1	-	-	-	-	-	-
Whooping cough 033	4	4	-	4	-	-	-	-	-	-	-	-
Tetanus 037	-	-	-	-	-	-	-	-	-	-	-	-
Septicemia 038	60	58	45	13	1	1	209	202	126	76	1	6
Measles 055	20	9	-	9	5	6	2	2	-	2	-	-
Congenital syphilis 090	6	6	4	2	-	-	4	4	-	4	-	-
Moniliasis 112	-	-	-	-	-	-	7	7	4	3	-	-
Helminthiases 120-129	-	-	-	-	-	-	-	-	-	-	-	-
Other Rest of 000-136	24	17	4	13	4	3	7	7	-	7	-	-
Malignant neoplasms 140-209	21	2	-	2	1	18	-	-	-	-	-	-
Neoplasms, other 210-239	5	1	-	1	2	2	1	1	-	1	-	-
Nutritional deficiency	51	36	-	36	10	5	538	458	19	439	56	24
Vitamin deficiency 260-266	-	-	-	-	-	-	3	3	-	3	-	-
Protein malnutrition 267	11	1	-	1	7	3	7	1	-	1	4	2
Nutritional marasmus 268	36	32	-	32	3	1	120	99	-	99	13	8
Other 269	4	3	-	3	-	1	408	355	19	336	39	14
Endocrine and metabolic diseases 240-258,270-279	10	7	1	6	2	1	7	7	6	1	-	-
Deficiency anemias 280,281	-	-	-	-	-	-	15	8	7	1	2	5
Other diseases of blood and blood-forming organs 282-289	-	-	-	-	-	-	15	14	-	14	-	1
Inflammatory diseases of central nervous system 320-324	64	48	9	39	8	8	50	44	13	31	2	4
Other diseases of nervous system and sense organs 310-315,330-389	39	25	-	25	6	8	63	48	4	44	7	8
Diseases of circulatory system 390-458	-	-	-	-	-	-	69	41	5	36	16	12
Pneumonia and influenza 470-486	403	372	76	296	21	10	551	484	167	317	37	30
Other diseases of respiratory system 460-466,490-519	92	81	3	78	7	4	92	73	4	69	15	4
Diseases of digestive system 520-577	15	12	7	5	2	1	41	37	7	30	2	2
Diseases of genito-urinary system 580-629	9	8	1	7	1	-	42	36	2	34	3	3
Diseases of skin and subcutaneous tissue 680-709	12	12	10	2	-	-	34	32	7	25	2	-
Diseases of musculoskeletal system 710-738	3	1	1	-	-	2	-	-	-	-	-	-
Congenital anomalies	184	155	74	81	15	14	130	111	62	49	13	6
Nervous system 740-743	44	35	18	17	5	4	15	9	7	2	4	2
Circulatory system 746,747	64	55	22	33	5	4	52	47	23	24	3	2
Respiratory system 748	1	1	1	-	-	-	3	3	3	-	-	-
Digestive system 749-751	34	33	17	16	-	1	17	15	11	4	2	-
Genito-urinary system 752,753	2	-	-	-	1	1	4	3	1	2	-	1
Musculoskeletal system 754-756	10	9	6	3	1	-	6	6	2	4	-	-
Down's disease 759.3	15	11	3	8	1	3	28	24	11	13	3	1
Other anomalies 744,745, 757,758, Rest of 759	14	11	7	4	2	1	5	4	4	-	1	-
Certain perinatal causes 760-778	781	781	772	9	-	-	1408	1408	1374	34	-	-
Symptoms 780-789	2	2	-	2	-	-	424	384	38	346	27	13
Sudden death 795	48	47	5	42	1	-	-	-	-	-	-	-
Other ill-defined conditions 790-792,796	3	3	-	3	-	-	-	-	-	-	-	-
External causes E800-E999	106	37	10	27	34	35	62	44	16	28	11	7

DEATH RATES
Santiago—CHILE

Death Rates from Underlying and Associated Causes in Children Under 5 Years, by Age Group, in Two-Year Period, 1968-1970.

Cause	Underlying cause						Associated cause					
	Under 5 years	Infant deaths			1 year	2-4 years	Under 5 years	Infant deaths			1 year	2-4 years
		Total	Under 28 days	28 days-11 mos.				Total	Under 28 days	28 days-11 mos.		
All causes	1298.7	5492.8	2722.7	2770.0	401.3	113.3	2078.3	9046.8	4761.1	4285.7	568.3	116.7
Infective and parasitic diseases	334.5	1436.0	311.1	1124.9	105.0	21.3	230.1	1008.0	453.0	555.0	48.5	15.3
Amebiasis 006	-	-	-	-	-	-	-	-	-	-	-	-
Diarrheal disease 009	253.6	1120.0	161.8	958.2	72.7	7.7	105.4	440.5	126.9	313.6	43.1	7.7
Other intestinal infectious diseases 000-005,007,008	16.7	74.7	17.4	57.2	-	1.7	2.1	10.0	2.5	7.5	-	-
Tuberculosis 010-019	3.7	7.5	-	7.5	2.7	2.6	3.1	5.0	-	5.0	2.7	2.6
Diphtheria 032	1.0	-	-	-	2.7	0.9	-	-	-	-	-	-
Whooping cough 033	2.1	10.0	-	10.0	-	-	-	-	-	-	-	-
Tetanus 037	-	-	-	-	-	-	-	-	-	-	-	-
Septicemia 038	31.3	144.4	112.0	32.4	2.7	0.9	109.1	502.7	313.6	189.1	2.7	5.1
Measles 055	10.4	22.4	-	22.4	13.5	5.1	1.0	5.0	-	5.0	-	-
Congenital syphilis 090	3.1	14.9	10.0	5.0	-	-	2.1	10.0	-	10.0	-	-
Moniliasis 112	-	-	-	-	-	-	3.7	17.4	10.0	7.5	-	-
Helminthiases 120-129	-	-	-	-	-	-	-	-	-	-	-	-
Other Rest of 000-136	12.5	42.3	10.0	32.4	10.8	2.6	3.7	17.4	-	17.4	-	-
Malignant neoplasms 140-209	11.0	5.0	-	5.0	2.7	15.3	-	-	-	-	-	-
Neoplasms, other 210-239	2.6	2.5	-	2.5	5.4	1.7	0.5	2.5	-	2.5	-	-
Nutritional deficiency	26.6	89.6	-	89.6	26.9	4.3	280.7	1139.9	47.3	1092.6	150.8	20.4
Vitamin deficiency 260-266	-	-	-	-	-	-	1.6	7.5	-	7.5	-	-
Protein malnutrition 267	5.7	2.5	-	2.5	18.9	2.6	3.7	2.5	-	2.5	10.8	1.7
Nutritional marasmus 268	18.8	79.6	-	79.6	8.1	0.9	62.6	246.4	-	246.4	35.0	6.8
Other 269	2.1	7.5	-	7.5	-	0.9	212.9	883.5	47.3	836.2	105.0	11.9
Endocrine and metabolic diseases 240-258,270-279	5.2	17.4	2.5	14.9	5.4	0.9	3.7	17.4	14.9	2.5	-	-
Deficiency anemias 280,281	-	-	-	-	-	-	7.8	19.9	17.4	2.5	5.4	4.3
Other diseases of blood and blood-forming organs 282-289	-	-	-	-	-	-	7.8	34.8	-	34.8	-	0.9
Inflammatory diseases of central nervous system 320-324	33.4	119.5	22.4	97.1	21.5	6.8	26.1	109.5	32.4	77.2	5.4	3.4
Other diseases of nervous system and sense organs 310-315,330-389	20.3	62.2	-	62.2	16.2	6.8	32.9	119.5	10.0	109.5	18.9	6.8
Diseases of circulatory system 390-458	-	-	-	-	-	-	36.0	102.0	12.4	89.6	43.1	10.2
Pneumonia and influenza 470-486	210.3	925.8	189.1	736.7	56.6	8.5	287.5	1204.6	415.6	788.9	99.6	25.6
Other diseases of respiratory system 460-466,490-519	48.0	201.6	7.5	194.1	18.9	3.4	48.0	181.7	10.0	171.7	40.4	3.4
Diseases of digestive system 520-577	7.8	29.9	17.4	12.4	5.4	0.9	21.4	92.1	17.4	74.7	5.4	1.7
Diseases of genito-urinary system 580-629	4.7	19.9	2.5	17.4	2.7	-	21.9	89.6	5.0	84.6	8.1	2.6
Diseases of skin and subcutaneous tissue 680-709	6.3	29.9	24.9	5.0	-	-	17.7	79.6	17.4	62.2	5.4	-
Diseases of musculoskeletal system 710-738	1.6	2.5	2.5	-	-	1.7	-	-	-	-	-	-
Congenital anomalies	96.0	385.8	184.2	201.6	40.4	11.9	67.8	276.3	154.3	122.0	35.0	5.1
Nervous system 740-743	23.0	87.1	44.8	42.3	13.5	3.4	7.8	22.4	17.4	5.0	10.8	1.7
Circulatory system 746,747	33.4	136.9	54.8	82.1	13.5	3.4	27.1	117.0	57.2	59.7	8.1	1.7
Respiratory system 748	0.5	2.5	2.5	-	-	-	1.6	7.5	7.5	-	-	-
Digestive system 749-751	17.7	82.1	42.3	39.8	-	0.9	8.9	37.3	27.4	10.0	5.4	-
Genito-urinary system 752,753	1.0	-	-	-	2.7	0.9	2.1	7.5	2.5	5.0	-	0.9
Musculoskeletal system 754-756	5.2	22.4	14.9	7.5	2.7	-	3.1	14.9	5.0	10.0	-	-
Down's disease 759.3	7.8	27.4	7.5	19.9	2.7	2.6	14.6	59.7	27.4	32.4	8.1	0.9
Other anomalies 744,745, 757,758, Rest of 759	7.3	27.4	17.4	10.0	5.4	0.9	2.6	10.0	10.0	-	2.7	-
Certain perinatal causes 760-778	407.5	1943.8	1921.4	22.4	-	-	734.7	3504.2	3419.6	84.6	-	-
Symptoms 780-789	1.0	5.0	-	5.0	-	-	221.2	955.7	94.6	861.1	72.7	11.1
Sudden death 795	25.0	117.0	12.4	104.5	2.7	-	-	-	-	-	-	-
Other ill-defined conditions 790-792,796	1.6	7.5	-	7.5	-	-	-	-	-	-	-	-
External causes E800-E999	55.3	92.1	24.9	67.2	91.6	29.8	32.4	109.5	39.8	69.7	29.6	6.0

DEATHS
CHILE—*Comunas*

Underlying and Associated Causes of Death in Children Under 5 Years, by Age Group, in Two-Year Period, 1968–1970.

Cause	Underlying cause						Associated cause					
	Under 5 years	Infant deaths			1 year	2-4 years	Under 5 years	Infant deaths			1 year	2-4 years
		Total	Under 28 days	28 days-11 mos.				Total	Under 28 days	28 days-11 mos.		
All causes	225	197	66	131	17	11	345	303	96	207	25	17
Infective and parasitic diseases	88	77	11	66	7	4	35	32	7	25	2	1
Amebiasis 006	-	-	-	-	-	-	-	-	-	-	-	-
Diarrheal disease 009	58	48	6	42	7	3	14	12	2	10	1	1
Other intestinal infectious diseases 000-005,007,008	15	15	-	15	-	-	3	3	1	2	-	-
Tuberculosis 010-019	1	-	-	-	-	1	-	-	-	-	-	-
Diphtheria 032	-	-	-	-	-	-	-	-	-	-	-	-
Whooping cough 033	3	3	-	3	-	-	-	-	-	-	-	-
Tetanus 037	-	-	-	-	-	-	-	-	-	-	-	-
Septicemia 038	7	7	4	3	-	-	17	16	4	12	1	-
Measles 055	1	1	-	1	-	-	-	-	-	-	-	-
Congenital syphilis 090	-	-	-	-	-	-	-	-	-	-	-	-
Moniliasis 112	-	-	-	-	-	-	1	1	-	1	-	-
Helminthiases 120-129	-	-	-	-	-	-	-	-	-	-	-	-
Other Rest of 000-136	3	3	1	2	-	-	-	-	-	-	-	-
Malignant neoplasms 140-209	1	-	-	-	-	1	-	-	-	-	-	-
Neoplasms, other 210-239	-	-	-	-	-	-	-	-	-	-	-	-
Nutritional deficiency	4	4	-	4	-	-	76	62	3	59	9	5
Vitamin deficiency 260-266	-	-	-	-	-	-	-	-	-	-	-	-
Protein malnutrition 267	-	-	-	-	-	-	2	-	-	-	1	1
Nutritional marasmus 268	4	4	-	4	-	-	17	14	-	14	2	1
Other 269	-	-	-	-	-	-	57	48	3	45	6	3
Endocrine and metabolic diseases 240-258,270-279	1	1	1	-	-	-	2	1	1	-	-	1
Deficiency anemias 280,281	-	-	-	-	-	-	-	-	-	-	-	-
Other diseases of blood and blood-forming organs 282-289	-	-	-	-	-	-	-	-	-	-	-	-
Inflammatory diseases of central nervous system 320-324	8	6	-	6	1	1	7	6	2	4	1	-
Other diseases of nervous system and sense organs 310-315,330-389	5	5	-	5	-	-	6	5	-	5	1	-
Diseases of circulatory system 390-458	-	-	-	-	-	-	10	7	2	5	2	1
Pneumonia and influenza 470-486	40	36	9	27	2	2	56	47	8	39	7	2
Other diseases of respiratory system 460-466,490-519	6	5	1	4	1	-	9	6	1	5	-	3
Diseases of digestive system 520-577	1	1	-	1	-	-	13	12	4	8	-	1
Diseases of genito-urinary system 580-629	-	-	-	-	-	-	5	5	-	5	-	-
Diseases of skin and subcutaneous tissue 680-709	1	-	-	-	1	-	1	1	-	1	-	-
Diseases of musculoskeletal system 710-738	-	-	-	-	-	-	1	1	1	-	-	-
Congenital anomalies	14	13	5	8	1	-	13	11	4	7	-	2
Nervous system 740-743	2	2	1	1	-	-	-	-	-	-	-	-
Circulatory system 746,747	3	3	1	2	-	-	6	6	4	2	-	-
Respiratory system 748	-	-	-	-	-	-	-	-	-	-	-	-
Digestive system 749-751	3	3	1	2	-	-	2	2	-	2	-	-
Genito-urinary system 752,753	-	-	-	-	-	-	-	-	-	-	-	-
Musculoskeletal system 754-756	-	-	-	-	-	-	-	-	-	-	-	-
Down's disease 759.3	5	4	1	3	1	-	5	3	-	3	-	2
Other anomalies 744,745, 757,758, Rest of 759	1	1	1	-	-	-	-	-	-	-	-	-
Certain perinatal causes 760-778	39	39	38	1	-	-	69	69	60	9	-	-
Symptoms 780-789	-	-	-	-	-	-	39	36	2	34	2	1
Sudden death 795	3	3	-	3	-	-	-	-	-	-	-	-
Other ill-defined conditions 790-792,796	2	2	-	2	-	-	-	-	-	-	-	-
External causes E800-E999	12	5	1	4	4	3	3	2	1	1	1	-

DEATH RATES
Comunas—CHILE

Death Rates from Underlying and Associated Causes in Children Under 5 Years, by Age Group, in Two-Year Period, 1968–1970.

Cause	Underlying cause						Associated cause					
	Under 5 years	Infant deaths			1 year	2-4 years	Under 5 years	Infant deaths			1 year	2-4 years
		Total	Under 28 days	28 days-11 mos.				Total	Under 28 days	28 days-11 mos.		
11 causes	1395.8	5794.1	1941.2	3852.9	544.9	111.3	2140.2	8911.8	2823.5	6088.2	801.3	172.1
nfective and parasitic diseases	545.9	2264.7	323.5	1941.2	224.4	40.5	217.1	941.2	205.9	735.3	64.1	10.1
Amebiasis ... 006	-	-	-	-	-	-	-	-	-	-	-	-
Diarrheal disease ... 009	359.8	1411.8	176.5	1235.3	224.4	30.4	86.8	352.9	58.8	294.1	32.1	10.1
Other intestinal infectious diseases ... 000-005,007,008	93.1	441.2	-	441.2	-	-	18.6	88.2	29.4	58.8	-	-
Tuberculosis ... 010-019	6.2	-	-	-	-	10.1	-	-	-	-	-	-
Diphtheria ... 032	-	-	-	-	-	-	-	-	-	-	-	-
Whooping cough ... 033	18.6	88.2	-	88.2	-	-	-	-	-	-	-	-
Tetanus ... 037	-	-	-	-	-	-	-	-	-	-	-	-
Septicemia ... 038	43.4	205.9	117.6	88.2	-	-	105.5	470.6	117.6	352.9	32.1	-
Measles ... 055	6.2	29.4	-	29.4	-	-	-	-	-	-	-	-
Congenital syphilis ... 090	-	-	-	-	-	-	-	-	-	-	-	-
Moniliasis ... 112	-	-	-	-	-	-	6.2	29.4	-	29.4	-	-
Helminthiases ... 120-129	-	-	-	-	-	-	-	-	-	-	-	-
Other ... Rest of 000-136	18.6	88.2	29.4	58.8	-	-	-	-	-	-	-	-
alignant neoplasms ... 140-209	6.2	-	-	-	-	10.1	-	-	-	-	-	-
eoplasms, other ... 210-239	-	-	-	-	-	-	-	-	-	-	-	-
utritional deficiency	24.8	117.6	-	117.6	-	-	471.5	1823.5	88.2	1735.3	288.5	50.6
Vitamin deficiency ... 260-266	-	-	-	-	-	-	-	-	-	-	-	-
Protein malnutrition ... 267	-	-	-	-	-	-	12.4	-	-	-	32.1	10.1
Nutritional marasmus ... 268	24.8	117.6	-	117.6	-	-	105.5	411.8	-	411.8	64.1	10.1
Other ... 269	-	-	-	-	-	-	353.6	1411.8	88.2	1323.5	192.3	30.4
ndocrine and metabolic diseases ... 240-258,270-279	6.2	29.4	29.4	-	-	-	12.4	29.4	29.4	-	-	10.1
eficiency anemias ... 280,281	-	-	-	-	-	-	-	-	-	-	-	-
ther diseases of blood and blood-forming organs ... 282-289	-	-	-	-	-	-	-	-	-	-	-	-
nflammatory diseases of central nervous system ... 320-324	49.6	176.5	-	176.5	32.1	10.1	43.4	176.5	58.8	117.6	32.1	-
ther diseases of nervous system and sense organs ... 310-315,330-389	31.0	147.1	-	147.1	-	-	37.2	147.1	-	147.1	32.1	-
iseases of circulatory system ... 390-458	-	-	-	-	-	-	62.0	205.9	58.8	147.1	64.1	10.1
neumonia and influenza . 470-486	248.1	1058.8	264.7	794.1	64.1	20.2	347.4	1382.4	235.3	1147.1	224.4	20.2
ther diseases of respiratory system ... 460-466,490-519	37.2	147.1	29.4	117.6	32.1	-	55.8	176.5	29.4	147.1	-	30.4
iseases of digestive system ... 520-577	6.2	29.4	-	29.4	-	-	80.6	352.9	117.6	235.3	-	10.1
iseases of genito-urinary system ... 580-629	-	-	-	-	-	-	31.0	147.1	-	147.1	-	-
iseases of skin and subcutaneous tissue ... 680-709	6.2	-	-	-	32.1	-	6.2	29.4	-	29.4	-	-
iseases of musculoskeletal system ... 710-738	-	-	-	-	-	-	6.2	29.4	29.4	-	-	-
ongenital anomalies	86.8	382.4	147.1	235.3	32.1	-	80.6	323.5	117.6	205.9	-	20.2
Nervous system ... 740-743	12.4	58.8	29.4	29.4	-	-	-	-	-	-	-	-
Circulatory system ... 746,747	18.6	88.2	29.4	58.8	-	-	37.2	176.5	117.6	58.8	-	-
Respiratory system ... 748	-	-	-	-	-	-	-	-	-	-	-	-
Digestive system ... 749-751	18.6	88.2	29.4	58.8	-	-	12.4	58.8	-	58.8	-	-
Genito-urinary system . 752,753	-	-	-	-	-	-	-	-	-	-	-	-
Musculoskeletal system . 754-756	-	-	-	-	-	-	-	-	-	-	-	-
Down's disease ... 759.3	31.0	117.6	29.4	88.2	32.1	-	31.0	88.2	-	88.2	-	20.2
Other anomalies ... 744,745, 757,758, Rest of 759	6.2	29.4	29.4	-	-	-	-	-	-	-	-	-
ertain perinatal causes ... 760-778	241.9	1147.1	1117.6	29.4	-	-	428.0	2029.4	1764.7	264.7	-	-
ymptoms ... 780-789	-	-	-	-	-	-	241.9	1058.8	58.8	1000.0	64.1	10.1
udden death ... 795	18.6	88.2	-	88.2	-	-	-	-	-	-	-	-
ther ill-defined conditions ... 790-792,796	12.4	58.8	-	58.8	-	-	-	-	-	-	-	-
xternal causes ... E800-E999	74.4	147.1	29.4	117.6	128.2	30.4	18.6	58.8	29.4	29.4	32.1	-

DEATHS
COLOMBIA—Cali

Underlying and Associated Causes of Death in Children Under 5 Years, by Age Group, in Two-Year Period, 1968–1970.

Cause	Underlying cause						Associated cause					
	Under 5 years	Infant deaths			1 year	2-4 years	Under 5 years	Infant deaths			1 year	2-4 years
		Total	Under 28 days	28 days-11 mos.				Total	Under 28 days	28 days-11 mos.		
All causes	1627	1153	536	617	271	203	2504	1723	780	943	441	340
Infective and parasitic diseases	701	440	57	383	174	87	404	206	61	145	102	96
Amebiasis 006	7	4	-	4	1	2	2	-	-	-	1	1
Diarrheal disease 009	511	362	25	337	118	31	190	82	6	76	52	56
Other intestinal infectious diseases 000-005,007,008	15	12	6	6	3	-	4	4	2	2	-	-
Tuberculosis 010-019	17	5	-	5	9	3	11	2	-	2	7	2
Diphtheria 032	9	-	-	-	2	7	-	-	-	-	-	-
Whooping cough 033	12	5	-	5	6	1	-	-	-	-	-	-
Tetanus 037	11	10	9	1	-	1	-	-	-	-	-	-
Septicemia 038	14	14	12	2	-	-	104	82	47	35	12	10
Measles 055	80	14	-	14	33	33	3	-	-	-	1	2
Congenital syphilis 090	5	5	4	1	-	-	2	2	-	2	-	-
Moniliasis 112	1	1	-	1	-	-	32	25	6	19	6	1
Helminthiases 120-129	5	-	-	-	2	3	51	8	-	8	20	23
Other Rest of 000-136	14	8	1	7	-	6	5	1	-	1	3	1
Malignant neoplasms 140-209	7	1	-	1	3	3	1	-	-	-	-	1
Neoplasms, other 210-239	1	-	-	-	-	1	-	-	-	-	-	-
Nutritional deficiency	129	44	-	44	39	46	464	262	6	256	130	72
Vitamin deficiency 260-266	-	-	-	-	-	-	2	1	-	1	-	1
Protein malnutrition 267	87	15	-	15	35	37	43	11	-	11	16	16
Nutritional marasmus 268	30	24	-	24	2	4	108	63	-	65	32	11
Other 269	12	5	-	5	2	5	311	185	6	179	82	44
Endocrine and metabolic diseases 240-258,270-279	5	3	1	2	1	1	2	1	1	-	1	-
Deficiency anemias 280,281	-	-	-	-	-	-	5	3	3	-	2	-
Other diseases of blood and blood-forming organs 282-289	3	1	1	-	1	1	17	9	1	8	2	6
Inflammatory diseases of central nervous system 320-324	31	18	5	13	9	4	35	22	5	17	5	8
Other diseases of nervous system and sense organs 310-315,330-389	15	8	-	8	2	5	19	6	1	5	5	8
Diseases of circulatory system 390-458	1	-	-	-	1	-	34	14	2	12	5	15
Pneumonia and influenza 470-486	153	131	52	79	14	8	464	280	77	203	109	75
Other diseases of respiratory system 460-466,490-519	50	30	2	28	11	9	20	10	-	10	2	8
Diseases of digestive system 520-577	10	9	3	6	1	-	32	21	5	16	4	7
Diseases of genito-urinary system 580-629	11	4	1	3	3	4	25	16	2	14	5	4
Diseases of skin and subcutaneous tissue 680-709	5	4	-	4	-	1	26	11	2	9	7	8
Diseases of musculoskeletal system 710-738	3	1	-	1	1	1	4	4	-	4	-	-
Congenital anomalies	67	56	27	29	4	7	64	52	29	23	5	7
Nervous system 740-743	14	12	6	6	1	1	5	3	1	2	1	1
Circulatory system 746,747	37	30	16	14	3	4	30	27	18	9	2	1
Respiratory system 748	-	-	-	-	-	-	-	-	-	-	-	-
Digestive system 749-751	14	13	5	8	-	1	5	5	3	2	-	-
Genito-urinary system 752,753	1	-	-	-	-	1	2	2	1	1	-	-
Musculoskeletal system 754-756	-	-	-	-	-	-	3	1	1	-	-	2
Down's disease 759.3	1	1	-	1	-	-	14	9	4	5	2	3
Other anomalies 744,745, 757,758, Rest of 759	-	-	-	-	-	-	5	5	1	4	-	-
Certain perinatal causes 760-778	377	377	375	2	-	-	578	578	563	15	-	-
Symptoms 780-789	3	2	1	1	-	1	277	206	15	191	52	19
Sudden death 795	14	14	6	8	-	-	-	-	-	-	-	-
Other ill-defined conditions 790-792,796	2	1	-	1	-	1	-	-	-	-	-	-
External causes E800-E999	39	9	5	4	7	23	33	22	7	15	5	6

DEATH RATES
Cali—COLOMBIA

Death Rates from Underlying and Associated Causes in Children Under 5 Years, by Age Group, in Two-Year Period, 1968–1970.

Cause	Underlying cause						Associated cause					
	Under 5 years	Infant deaths			1 year	2-4 years	Under 5 years	Infant deaths			1 year	2-4 years
		Total	Under 28 days	28 days-11 mos.				Total	Under 28 days	28 days-11 mos.		
All causes	1607.7	5464.5	2540.3	2924.2	1341.6	334.4	2474.3	8165.9	3696.7	4469.2	2183.2	560.1
Infective and parasitic diseases	692.7	2085.3	270.1	1815.2	861.4	143.3	399.2	976.3	289.1	687.2	505.0	158.2
Amebiasis 006	6.9	19.0	-	19.0	5.0	3.3	2.0	-	-	-	5.0	1.6
Diarrheal disease 009	504.9	1715.6	118.5	1597.2	584.2	51.1	187.7	388.6	28.4	360.2	257.4	92.3
Other intestinal infectious diseases 000-005,007,008	14.8	56.9	28.4	28.4	14.9	-	4.0	19.0	9.5	9.5	-	-
Tuberculosis 010-019	16.8	23.7	-	23.7	44.6	4.9	10.9	9.5	-	9.5	34.7	3.3
Diphtheria 032	8.9	-	-	-	9.9	11.5	-	-	-	-	-	-
Whooping cough 033	11.9	23.7	-	23.7	29.7	1.6	-	-	-	-	-	-
Tetanus 037	10.9	47.4	42.7	4.7	-	1.6	-	-	-	-	-	-
Septicemia 038	13.8	66.4	56.9	9.5	-	-	102.8	388.6	222.7	165.9	59.4	16.5
Measles 055	79.1	66.4	-	66.4	163.4	54.4	3.0	-	-	-	5.0	3.3
Congenital syphilis 090	4.9	23.7	19.0	4.7	-	-	2.0	9.5	-	9.5	-	-
Moniliasis 112	1.0	4.7	-	4.7	-	-	31.6	118.5	28.4	90.0	29.7	1.6
Helminthiases 120-129	4.9	-	-	-	9.9	4.9	50.4	37.9	-	37.9	99.0	37.9
Other Rest of 000-136	13.8	37.9	4.7	33.2	-	9.9	4.9	4.7	-	4.7	14.9	1.6
Malignant neoplasms 140-209	6.9	4.7	-	4.7	14.9	4.9	1.0	-	-	-	-	1.6
Neoplasms, other 210-239	1.0	-	-	-	-	1.6	-	-	-	-	-	-
Nutritional deficiency	127.5	208.5	-	208.5	193.1	75.8	458.5	1241.7	28.4	1213.3	643.6	118.6
Vitamin deficiency 260-266	-	-	-	-	-	-	2.0	4.7	-	4.7	-	1.6
Protein malnutrition 267	86.0	71.1	-	71.1	173.3	61.0	42.5	52.1	-	52.1	79.2	26.4
Nutritional marasmus 268	29.6	113.7	-	113.7	9.9	6.6	106.7	308.1	-	308.1	158.4	18.1
Other 269	11.9	23.7	-	23.7	9.9	8.2	307.3	876.8	28.4	848.3	405.9	72.5
Endocrine and metabolic diseases 240-258,270-279	4.9	14.2	4.7	9.5	5.0	1.6	2.0	4.7	4.7	-	5.0	-
Deficiency anemias 280,281	-	-	-	-	-	-	4.9	14.2	14.2	-	9.9	-
Other diseases of blood and blood-forming organs 282-289	3.0	4.7	4.7	-	5.0	1.6	16.8	42.7	4.7	37.9	9.9	9.9
Inflammatory diseases of central nervous system 320-324	30.6	85.3	23.7	61.6	44.6	6.6	34.6	104.3	23.7	80.6	24.8	13.2
Other diseases of nervous system and sense organs 310-315,330-389	14.8	37.9	-	37.9	9.9	8.2	18.8	28.4	4.7	23.7	24.8	13.2
Diseases of circulatory system 390-458	1.0	-	-	-	5.0	-	33.6	66.4	9.5	56.9	24.8	24.7
Pneumonia and influenza 470-486	151.2	620.9	246.4	374.4	69.3	13.2	458.5	1327.0	364.9	962.1	539.6	123.6
Other diseases of respiratory system 460-466,490-519	49.4	142.2	9.5	132.7	54.5	14.8	19.8	47.4	-	47.4	9.9	13.2
Diseases of digestive system 520-577	9.9	42.7	14.2	28.4	5.0	-	31.6	99.5	23.7	75.8	19.8	11.5
Diseases of genito-urinary system 580-629	10.9	19.0	4.7	14.2	14.9	6.6	24.7	75.8	9.5	66.4	24.8	6.6
Diseases of skin and subcutaneous tissue 680-709	4.9	19.0	-	19.0	-	1.6	25.7	52.1	9.5	42.7	34.7	13.2
Diseases of musculoskeletal system 710-738	3.0	4.7	-	4.7	5.0	1.6	4.0	19.0	-	19.0	-	-
Congenital anomalies	66.2	265.4	128.0	137.4	19.8	11.5	63.2	246.4	137.4	109.0	24.8	11.5
Nervous system 740-743	13.8	56.9	28.4	28.4	5.0	1.6	4.9	14.2	4.7	9.5	5.0	1.6
Circulatory system 746,747	36.6	142.2	75.8	66.4	14.9	6.6	29.6	128.0	85.3	42.7	9.9	1.6
Respiratory system 748	-	-	-	-	-	-	-	-	-	-	-	-
Digestive system 749-751	13.8	61.6	23.7	37.9	-	1.6	4.9	23.7	14.2	9.5	-	-
Genito-urinary system 752,753	1.0	-	-	-	-	1.6	2.0	9.5	4.7	4.7	-	-
Musculoskeletal system 754-756	-	-	-	-	-	-	3.0	4.7	4.7	-	-	3.3
Down's disease 759.3	1.0	4.7	-	4.7	-	-	13.8	42.7	19.0	23.7	9.9	4.9
Other anomalies 744,745, 757,758, Rest of 759	-	-	-	-	-	-	4.9	23.7	4.7	19.0	-	-
Certain perinatal causes 760-778	372.5	1786.7	1777.3	9.5	-	-	571.1	2739.3	2668.2	71.1	-	-
Symptoms 780-789	3.0	9.5	4.7	4.7	-	1.6	273.7	976.3	71.1	905.2	257.4	31.3
Sudden death 795	13.8	66.4	28.4	37.9	-	-	-	-	-	-	-	-
Other ill-defined conditions 790-792,796	2.0	4.7	-	4.7	-	1.6	-	-	-	-	-	-
External causes E800-E999	38.5	42.7	23.7	19.0	34.7	37.9	32.6	104.3	33.2	71.1	24.8	9.9

DEATHS
COLOMBIA—Cartagena

Underlying and Associated Causes of Death in Children Under 5 Years, by Age Group, in Two-Year Period, 1968–1970.

Cause	Underlying cause						Associated cause					
	Under 5 years	Infant deaths			1 year	2-4 years	Under 5 years	Infant deaths			1 year	2-4 years
		Total	Under 28 days	28 days-11 mos.				Total	Under 28 days	28 days-11 mos.		
All causes	1255	856	401	455	266	133	2557	1587	629	958	635	335
Infective and parasitic diseases	550	326	54	272	153	71	536	244	50	194	186	106
Amebiasis ... 006	32	21	-	21	5	6	18	5	-	5	6	7
Diarrheal disease ... 009	323	222	23	199	77	24	226	103	9	94	88	35
Other intestinal infectious diseases ... 000-005,007,008	6	4	-	4	-	2	27	9	1	8	11	7
Tuberculosis ... 010-019	9	5	-	5	1	3	4	-	-	-	2	2
Diphtheria ... 032	-	-	-	-	-	-	-	-	-	-	-	-
Whooping cough ... 033	10	7	-	7	6	5	3	-	-	-	2	1
Tetanus ... 037	19	17	15	2	-	2	-	-	-	-	-	-
Septicemia ... 038	19	18	16	2	-	1	98	75	30	45	19	4
Measles ... 055	105	24	-	24	60	21	4	-	-	-	3	1
Congenital syphilis ... 090	1	1	-	1	-	-	1	1	1	-	-	-
Moniliasis ... 112	-	-	-	-	-	-	32	27	9	18	4	1
Helminthiases ... 120-129	10	2	-	2	1	7	120	22	-	22	51	47
Other ... Rest of 000-136	8	5	-	5	3	-	3	2	-	2	-	1
Malignant neoplasms ... 140-209	7	-	-	-	1	6	3	-	-	-	-	3
Neoplasms, other ... 210-239	-	-	-	-	-	-	-	-	-	-	-	-
Nutritional deficiency	113	40	-	40	54	19	448	238	10	228	143	67
Vitamin deficiency ... 260-266	-	-	-	-	-	-	-	-	-	-	-	-
Protein malnutrition ... 267	90	20	-	20	51	19	111	38	-	38	55	18
Nutritional marasmus ... 268	15	13	-	13	2	-	84	51	2	49	23	10
Other ... 269	8	7	-	7	1	-	253	149	8	141	65	39
Endocrine and metabolic diseases ... 240-258,270-279	-	-	-	-	-	-	4	4	1	3	-	-
Deficiency anemias ... 280,281	1	-	-	-	-	1	13	7	5	2	1	5
Other diseases of blood and blood-forming organs ... 282-289	3	1	1	-	2	-	33	15	-	15	9	9
Inflammatory diseases of central nervous system ... 320-324	12	8	-	8	3	1	45	27	6	21	14	4
Other diseases of nervous system and sense organs ... 310-315,330-389	13	10	1	9	2	1	15	9	1	8	3	3
Diseases of circulatory system ... 390-458	2	1	-	1	-	1	47	24	3	21	8	15
Pneumonia and influenza . 470-486	74	59	24	35	9	6	389	207	43	164	130	52
Other diseases of respiratory system ... 460-466,490-519	49	23	1	22	17	9	51	24	2	22	15	12
Diseases of digestive system ... 520-577	13	10	3	7	1	2	75	37	12	25	26	12
Diseases of genito-urinary system ... 580-629	10	5	-	5	2	3	61	45	7	38	8	8
Diseases of skin and subcutaneous tissue ... 680-709	5	4	3	1	1	-	25	16	6	10	5	4
Diseases of musculoskeletal system ... 710-738	-	-	-	-	-	-	1	-	-	-	1	-
Congenital anomalies	71	57	23	34	9	5	68	54	34	20	10	4
Nervous system ... 740-743	15	11	6	5	3	1	4	4	1	3	-	-
Circulatory system ... 746,747	23	22	7	15	1	-	33	24	15	9	7	2
Respiratory system ... 748	1	-	-	-	-	1	-	-	-	-	-	-
Digestive system ... 749-751	18	14	8	6	4	-	8	7	6	1	1	-
Genito-urinary system . 752,753	2	2	1	1	-	-	4	4	4	-	-	-
Musculoskeletal system . 754-756	2	-	-	-	1	1	1	1	-	1	-	-
Down's disease ... 759.3	10	8	1	7	-	2	15	12	6	6	1	2
Other anomalies ... 744,745, 757,758, Rest of 759	-	-	-	-	-	-	3	2	2	-	1	-
Certain perinatal causes ... 760-778	282	281	280	1	1	-	435	435	429	6	-	-
Symptoms ... 780-789	-	-	-	-	-	-	285	185	13	172	71	29
Sudden death ... 795	9	9	-	9	-	-	-	-	-	-	-	-
Other ill-defined conditions ... 790-792,796	13	11	8	3	1	1	-	-	-	-	-	-
External causes ... E800-E999	28	11	3	8	10	7	23	16	7	9	5	2

DEATH RATES
Cartagena—COLOMBIA

Death Rates from Underlying and Associated Causes in Children Under 5 Years, by Age Group, in Two-Year Period, 1968–1970.

Cause	Underlying cause						Associated cause					
	Under 5 years	Infant deaths			1 year	2-4 years	Under 5 years	Infant deaths			1 year	2-4 years
		Total	Under 28 days	28 days-11 mos.				Total	Under 28 days	28 days-11 mos.		
All causes	1459.3	4782.1	2240.2	2541.9	1546.5	257.8	2973.3	8865.9	3514.0	5352.0	3691.9	649.2
Infective and parasitic diseases	639.5	1821.2	301.7	1519.6	889.5	137.6	623.3	1363.1	279.3	1083.8	1081.4	205.4
Amebiasis 006	37.2	117.3	-	117.3	29.1	11.6	20.9	27.9	-	27.9	34.9	13.6
Diarrheal disease 009	375.6	1240.2	128.5	1111.7	447.7	46.5	262.8	575.4	50.3	525.1	511.6	67.8
Other intestinal infectious diseases 000-005,007,008	7.0	22.3	-	22.3	-	3.9	31.4	50.3	5.6	44.7	64.0	13.6
Tuberculosis 010-019	10.5	27.9	-	27.9	5.8	5.8	4.7	-	-	-	11.6	3.9
Diphtheria 032	-	-	-	-	-	-	-	-	-	-	-	-
Whooping cough 033	20.9	39.1	-	39.1	34.9	9.7	3.5	-	-	-	11.6	1.9
Tetanus 037	22.1	95.0	83.8	11.2	-	3.9	-	-	-	-	-	-
Septicemia 038	22.1	100.6	89.4	11.2	-	1.9	114.0	419.0	167.6	251.4	110.5	7.8
Measles 055	122.1	134.1	-	134.1	348.8	40.7	4.7	-	-	-	17.4	1.9
Congenital syphilis 090	1.2	5.6	-	5.6	-	-	1.2	5.6	5.6	-	-	-
Moniliasis 112	-	-	-	-	-	-	37.2	150.8	50.3	100.6	23.3	1.9
Helminthiases 120-129	11.6	11.2	-	11.2	5.8	13.6	139.5	122.9	-	122.9	296.5	91.1
Other Rest of 000-136	9.3	27.9	-	27.9	17.4	-	3.5	11.2	-	11.2	-	1.9
Malignant neoplasms 140-209	8.1	-	-	-	5.8	11.6	3.5	-	-	-	-	5.8
Neoplasms, other 210-239	-	-	-	-	-	-	-	-	-	-	-	-
Nutritional deficiency	131.4	223.5	-	223.5	314.0	36.8	520.9	1329.6	55.9	1273.7	831.4	129.8
Vitamin deficiency 260-266	-	-	-	-	-	-	-	-	-	-	-	-
Protein malnutrition 267	104.7	111.7	-	111.7	296.5	36.8	129.1	212.3	-	212.3	319.8	34.9
Nutritional marasmus 268	17.4	72.6	-	72.6	11.6	-	97.7	284.9	11.2	273.7	133.7	19.4
Other 269	9.3	39.1	-	39.1	5.8	-	294.2	832.4	44.7	787.7	377.9	75.6
Endocrine and metabolic diseases 240-258,270-279	-	-	-	-	-	-	4.7	22.3	5.6	16.8	-	-
Deficiency anemias 280,281	1.2	-	-	-	-	1.9	15.1	39.1	27.9	11.2	5.8	9.7
Other diseases of blood and blood-forming organs 282-289	3.5	5.6	5.6	-	11.6	-	38.4	83.8	-	83.8	52.3	17.4
Inflammatory diseases of central nervous system 320-324	14.0	44.7	-	44.7	17.4	1.9	52.3	150.8	33.5	117.3	81.4	7.8
Other diseases of nervous system and sense organs 310-315,330-389	15.1	55.9	5.6	50.3	11.6	1.9	17.4	50.3	5.6	44.7	17.4	5.8
Diseases of circulatory system 390-458	2.3	5.6	-	5.6	-	1.9	54.7	134.1	16.8	117.3	46.5	29.1
Pneumonia and influenza 470-486	86.0	329.6	134.1	195.5	52.3	11.6	452.3	1156.4	240.2	916.2	755.8	100.8
Other diseases of respiratory system 460-466,490-519	57.0	128.5	5.6	122.9	98.8	17.4	59.3	134.1	11.2	122.9	87.2	23.3
Diseases of digestive system 520-577	15.1	55.9	16.8	39.1	5.8	3.9	87.2	206.7	67.0	139.7	151.2	23.3
Diseases of genito-urinary system 580-629	11.6	27.9	-	27.9	11.6	5.8	70.9	251.4	39.1	212.3	46.5	15.5
Diseases of skin and subcutaneous tissue 680-709	5.8	22.3	16.8	5.6	5.8	-	29.1	89.4	33.5	55.9	29.1	7.8
Diseases of musculoskeletal system 710-738	-	-	-	-	-	-	1.2	-	-	-	5.8	-
Congenital anomalies	82.6	318.4	128.5	189.9	52.3	9.7	79.1	301.7	189.9	111.7	58.1	7.8
Nervous system 740-743	17.4	61.5	33.5	27.9	17.4	1.9	4.7	22.3	5.6	16.8	-	-
Circulatory system 746,747	26.7	122.9	39.1	83.8	5.8	-	38.4	134.1	83.8	50.3	40.7	3.9
Respiratory system 748	1.2	-	-	-	-	1.9	-	-	-	-	-	-
Digestive system 749-751	20.9	78.2	44.7	33.5	23.3	-	9.3	39.1	33.5	5.6	5.8	-
Genito-urinary system 752,753	2.3	11.2	5.6	5.6	-	-	4.7	22.3	22.3	-	-	-
Musculoskeletal system 754-756	2.3	-	-	-	5.8	1.9	1.2	5.6	-	5.6	-	-
Down's disease 759.3	11.6	44.7	5.6	39.1	-	3.9	17.4	67.0	33.5	33.5	5.8	3.9
Other anomalies 744,745, 757,758, Rest of 759	-	-	-	-	-	-	3.5	11.2	11.2	-	5.8	-
Certain perinatal causes 760-778	327.9	1569.8	1564.2	5.6	5.8	-	505.8	2430.2	2396.6	33.5	-	-
Symptoms 780-789	-	-	-	-	-	-	331.4	1033.5	72.6	960.9	412.8	56.2
Sudden death 795	10.5	50.3	-	50.3	-	-	-	-	-	-	-	-
Other ill-defined conditions 790-792,796	15.1	61.5	44.7	16.8	5.8	1.9	-	-	-	-	-	-
External causes E800-E999	32.6	61.5	16.8	44.7	58.1	13.6	26.7	89.4	39.1	50.3	29.1	3.9

DEATHS
COLOMBIA—Medellín

Underlying and Associated Causes of Death in Children Under 5 Years, by Age Group, in Two-Year Period, 1968–1970.

Cause	Underlying cause						Associated cause					
	Under 5 years	Infant deaths			1 year	2-4 years	Under 5 years	Infant deaths			1 year	2-4 years
		Total	Under 28 days	28 days-11 mos.				Total	Under 28 days	28 days-11 mos.		
All causes	1348	924	383	541	233	191	2441	1621	666	955	481	339
Infective and parasitic diseases	588	344	33	311	148	96	378	171	58	113	115	92
Amebiasis 006	17	6	-	6	5	6	7	-	-	-	5	2
Diarrheal disease 009	417	289	23	266	82	46	137	56	7	49	49	32
Other intestinal infectious diseases 000-005,007,008	10	9	-	9	1	-	18	6	-	6	6	6
Tuberculosis 010-019	15	1	-	1	7	7	10	1	-	1	2	7
Diphtheria 032	3	-	-	-	-	3	1	-	-	-	-	1
Whooping cough 033	3	3	-	3	-	-	-	-	-	-	-	-
Tetanus 037	1	1	1	-	-	-	-	-	-	-	-	-
Septicemia 038	8	8	7	1	-	-	109	88	50	38	15	6
Measles 055	89	17	-	17	46	26	3	-	-	-	2	1
Congenital syphilis 090	3	3	2	1	-	-	3	3	-	3	-	-
Moniliasis 112	-	-	-	-	-	-	15	11	1	10	4	1
Helminthiases 120-129	6	-	-	-	4	2	72	5	-	5	32	35
Other Rest of 000-136	16	7	-	7	3	6	2	1	-	1	-	1
Malignant neoplasms 140-209	8	-	-	-	1	7	2	-	-	-	-	2
Neoplasms, other 210-239	1	-	-	-	-	1	1	1	1	-	-	-
Nutritional deficiency	73	23	1	22	25	25	497	285	4	281	129	83
Vitamin deficiency 260-266	-	-	-	-	-	-	4	3	1	2	-	1
Protein malnutrition 267	44	5	-	5	20	19	50	3	-	3	21	26
Nutritional marasmus 268	15	13	-	13	2	-	92	75	-	75	13	4
Other 269	14	5	1	4	3	6	351	204	3	201	95	52
Endocrine and metabolic diseases 240-258,270-279	4	2	-	2	1	1	1	1	-	1	-	-
Deficiency anemias 280,281	-	-	-	-	-	-	9	7	4	3	1	1
Other diseases of blood and blood-forming organs 282-289	2	1	-	1	1	-	11	3	-	3	5	3
Inflammatory diseases of central nervous system 320-324	19	16	1	15	1	2	20	11	2	9	4	5
Other diseases of nervous system and sense organs 310-315,330-389	20	9	-	9	5	6	43	18	-	18	15	10
Diseases of circulatory system 390-458	3	3	-	3	-	-	53	28	2	26	9	16
Pneumonia and influenza 470-486	103	82	20	62	12	9	423	270	54	216	99	54
Other diseases of respiratory system 460-466,490-519	52	41	1	40	7	4	25	11	-	11	6	8
Diseases of digestive system 520-577	6	3	1	2	2	1	41	16	3	13	12	13
Diseases of genito-urinary system 580-629	5	5	-	5	-	-	38	17	-	17	12	9
Diseases of skin and subcutaneous tissue 680-709	10	10	-	10	-	-	25	18	-	18	4	3
Diseases of musculoskeletal system 710-738	1	-	-	-	1	-	2	2	-	2	-	-
Congenital anomalies	89	69	26	43	12	8	66	49	18	31	9	8
Nervous system 740-743	14	10	5	5	2	2	6	6	4	2	-	-
Circulatory system 746,747	32	26	9	17	2	4	20	12	6	6	2	6
Respiratory system 748	-	-	-	-	-	-	1	1	-	1	-	-
Digestive system 749-751	22	20	11	9	2	-	14	14	5	9	-	-
Genito-urinary system 752,753	2	-	-	-	2	-	1	-	-	-	1	-
Musculoskeletal system 754-756	3	1	-	1	2	-	4	3	-	3	1	-
Down's disease 759.3	12	9	1	8	2	1	16	10	2	8	4	2
Other anomalies 744,745, 757,758, Rest of 759	4	3	-	3	-	1	4	3	1	2	1	-
Certain perinatal causes 760-778	294	294	291	3	-	-	516	516	498	18	-	-
Symptoms 780-789	2	-	-	-	1	1	269	185	18	167	55	29
Sudden death 795	16	13	6	7	2	1	-	-	-	-	-	-
Other ill-defined conditions 790-792,796	1	-	-	-	-	1	-	-	-	-	-	-
External causes E800-E999	51	9	3	6	14	28	21	12	4	8	6	3

DEATH RATES
Medellín—COLOMBIA

Death Rates from Underlying and Associated Causes in Children Under 5 Years, by Age Group, in Two-Year Period, 1968–1970.

Cause	Underlying cause						Associated cause					
	Under 5 years	Infant deaths			1 year	2-4 years	Under 5 years	Infant deaths			1 year	2-4 years
		Total	Under 28 days	28 days-11 mos.				Total	Under 28 days	28 days-11 mos.		
All causes	1444.8	4762.9	1974.2	2788.7	1252.7	341.1	2616.3	8355.7	3433.0	4922.7	2586.0	605.4
Infective and parasitic diseases	630.2	1773.2	170.1	1603.1	795.7	171.4	405.1	881.4	299.0	582.5	618.3	164.3
Amebiasis 006	18.2	30.9	-	30.9	26.9	10.7	7.5	-	-	-	26.9	3.6
Diarrheal disease 009	446.9	1489.7	118.6	1371.1	440.9	82.1	146.8	288.7	36.1	252.6	263.4	57.1
Other intestinal infectious diseases 000-005,007,008	10.7	46.4	-	46.4	5.4	-	19.3	30.9	-	30.9	32.3	10.7
Tuberculosis 010-019	16.1	5.2	-	5.2	37.6	12.5	10.7	5.2	-	5.2	10.8	12.5
Diphtheria 032	3.2	-	-	-	-	5.4	1.1	-	-	-	-	1.8
Whooping cough 033	3.2	15.5	-	15.5	-	-	-	-	-	-	-	-
Tetanus 037	1.1	5.2	5.2	-	-	-	-	-	-	-	-	-
Septicemia 038	8.6	41.2	36.1	5.2	-	-	116.8	453.6	257.7	195.9	80.6	10.7
Measles 055	95.4	87.6	-	87.6	247.3	46.4	3.2	-	-	-	10.8	1.8
Congenital syphilis 090	3.2	15.5	10.3	5.2	-	-	3.2	15.5	-	15.5	-	-
Moniliasis 112	-	-	-	-	-	-	17.1	56.7	5.2	51.5	21.5	1.8
Helminthiases 120-129	6.4	-	-	-	21.5	3.6	77.2	25.8	-	25.8	172.0	62.5
Other Rest of 000-136	17.1	36.1	-	36.1	16.1	10.7	2.1	5.2	-	5.2	-	1.8
Malignant neoplasms 140-209	8.6	-	-	-	5.4	12.5	2.1	-	-	-	-	3.6
Neoplasms, other 210-239	1.1	-	-	-	-	1.8	1.1	5.2	5.2	-	-	-
Nutritional deficiency	78.2	118.6	5.2	113.4	134.4	44.6	532.7	1469.1	20.6	1448.5	693.5	148.2
Vitamin deficiency 260-266	-	-	-	-	-	-	4.3	15.5	5.2	10.3	-	1.8
Protein malnutrition 267	47.2	25.8	-	25.8	107.5	33.9	53.6	15.5	-	15.5	112.9	46.4
Nutritional marasmus 268	16.1	67.0	-	67.0	10.8	-	98.6	386.6	-	386.6	69.9	7.1
Other 269	15.0	25.8	5.2	20.6	16.1	10.7	376.2	1051.5	15.5	1036.1	510.8	92.9
Endocrine and metabolic diseases 240-258,270-279	4.3	10.3	-	10.3	5.4	1.8	1.1	5.2	-	5.2	-	-
Deficiency anemias 280,281	-	-	-	-	-	-	9.6	36.1	20.6	15.5	5.4	1.8
Other diseases of blood and blood-forming organs 282-289	2.1	5.2	-	5.2	5.4	-	11.8	15.5	-	15.5	26.9	5.4
Inflammatory diseases of central nervous system 320-324	20.4	82.5	5.2	77.3	5.4	3.6	21.4	56.7	10.3	46.4	21.5	8.9
Other diseases of nervous system and sense organs 310-315,330-389	21.4	46.4	-	46.4	26.9	10.7	46.1	92.8	-	92.8	80.6	17.9
Diseases of circulatory system 390-458	3.2	15.5	-	15.5	-	-	56.8	144.3	10.3	134.0	48.4	28.6
Pneumonia and influenza 470-486	110.4	422.7	103.1	319.6	64.5	16.1	453.4	1391.8	278.4	1113.4	532.3	96.4
Other diseases of respiratory system 460-466,490-519	55.7	211.3	5.2	206.2	37.6	7.1	26.8	56.7	-	56.7	32.3	14.3
Diseases of digestive system 520-577	6.4	15.5	5.2	10.3	10.8	1.8	43.9	82.5	15.5	67.0	64.5	23.2
Diseases of genito-urinary system 580-629	5.4	25.8	-	25.8	-	-	40.7	87.6	-	87.6	64.5	16.1
Diseases of skin and subcutaneous tissue 680-709	10.7	51.5	-	51.5	-	-	26.8	92.8	-	92.8	21.5	5.4
Diseases of musculoskeletal system 710-738	1.1	-	-	-	5.4	-	2.1	10.3	-	10.3	-	-
Congenital anomalies	95.4	355.7	134.0	221.6	64.5	14.3	70.7	252.6	92.8	159.8	48.4	14.3
Nervous system 740-743	15.0	51.5	25.8	25.8	10.8	3.6	6.4	30.9	20.6	10.3	-	-
Circulatory system 746,747	34.3	134.0	46.4	87.6	10.8	7.1	21.4	61.9	30.9	30.9	10.8	10.7
Respiratory system 748	-	-	-	-	-	-	1.1	5.2	-	5.2	-	-
Digestive system 749-751	23.6	103.1	56.7	46.4	10.8	-	15.0	72.2	25.8	46.4	-	-
Genito-urinary system 752,753	2.1	-	-	-	10.8	-	1.1	-	-	-	5.4	-
Musculoskeletal system 754-756	3.2	5.2	-	5.2	10.8	-	4.3	15.5	-	15.5	5.4	-
Down's disease 759.3	12.9	46.4	5.2	41.2	10.8	1.8	17.1	51.5	10.3	41.2	21.5	3.6
Other anomalies 744,745, 757,758, Rest of 759	4.3	15.5	-	15.5	-	1.8	4.3	15.5	5.2	10.3	5.4	-
Certain perinatal causes 760-778	315.1	1515.5	1500.0	15.5	-	-	553.1	2659.8	2567.0	92.8	-	-
Symptoms 780-789	2.1	-	-	-	5.4	1.8	288.3	953.6	92.8	860.8	295.7	51.8
Sudden death 795	17.1	67.0	30.9	36.1	10.8	1.8	-	-	-	-	-	-
Other ill-defined conditions 790-792,796	1.1	-	-	-	-	1.8	-	-	-	-	-	-
External causes E800-E999	54.7	46.4	15.5	30.9	75.3	50.0	22.5	61.9	20.6	41.2	32.3	5.4

DEATHS
EL SALVADOR—San Salvador

Underlying and Associated Causes of Death in Children Under 5 Years, by Age Group, in Two-Year Period, 1968–1970.

Cause	Underlying cause						Associated cause					
	Under 5 years	Infant deaths			1 year	2-4 years	Under 5 years	Infant deaths			1 year	2-4 years
		Total	Under 28 days	28 days-11 mos.				Total	Under 28 days	28 days-11 mos.		
All causes	2738	2094	722	1372	398	246	5007	3658	1239	2419	857	492
Infective and parasitic diseases	1584	1148	161	987	276	160	638	335	97	238	179	124
Amebiasis 006	65	38	-	38	20	7	10	4	-	4	4	2
Diarrheal disease 009	1240	961	105	856	184	95	293	161	18	143	87	45
Other intestinal infectious diseases 000-005,007,008	34	28	7	21	5	1	21	9	1	8	9	3
Tuberculosis 010-019	7	3	-	3	-	4	5	1	-	1	1	3
Diphtheria 032	19	1	-	1	5	13	-	-	-	-	-	-
Whooping cough 033	13	8	-	8	4	1	3	1	-	1	1	1
Tetanus 037	17	17	16	1	-	-	-	-	-	-	-	-
Septicemia 038	31	31	25	6	-	-	120	99	68	31	13	8
Measles 055	127	46	1	45	55	26	2	-	-	-	1	1
Congenital syphilis 090	6	6	4	2	-	-	3	1	-	1	2	-
Moniliasis 112	3	3	1	2	-	-	47	36	10	26	10	1
Helminthiases 120-129	10	-	-	-	2	8	127	19	-	19	50	58
Other Rest of 000-136	12	6	2	4	1	5	7	4	-	4	1	2
Malignant neoplasms 140-209	3	-	-	-	2	1	1	-	-	-	-	1
Neoplasms, other 210-239	-	-	-	-	-	-	-	-	-	-	-	-
Nutritional deficiency	91	29	-	29	44	18	927	568	22	546	218	141
Vitamin deficiency 260-266	-	-	-	-	-	-	-	-	-	-	-	-
Protein malnutrition 267	53	9	-	9	29	15	115	14	-	14	51	50
Nutritional marasmus 268	36	18	-	18	15	3	202	128	2	126	52	22
Other 269	2	2	-	2	-	-	610	426	20	406	115	69
Endocrine and metabolic diseases 240-258,270-279	4	1	-	1	2	1	3	3	1	2	-	-
Deficiency anemias 280,281	-	-	-	-	-	-	-	-	-	-	-	-
Other diseases of blood and blood-forming organs 282-289	2	1	-	1	-	1	88	54	3	51	18	16
Inflammatory diseases of central nervous system 320-324	19	14	2	12	4	1	36	24	6	18	9	3
Other diseases of nervous system and sense organs 310-315,330-389	16	6	-	6	6	4	39	24	10	14	8	7
Diseases of circulatory system 390-458	1	-	-	-	-	1	92	68	4	64	14	10
Pneumonia and influenza 470-486	223	194	47	147	18	11	757	555	164	391	137	65
Other diseases of respiratory system 460-466,490-519	118	89	4	85	23	6	72	48	2	46	18	6
Diseases of digestive system 520-577	8	4	1	3	2	2	136	101	20	81	24	11
Diseases of genito-urinary system 580-629	-	-	-	-	-	-	26	13	1	12	9	4
Diseases of skin and subcutaneous tissue 680-709	11	9	4	5	1	1	37	29	7	22	5	3
Diseases of musculoskeletal system 710-738	-	-	-	-	-	-	-	-	-	-	-	-
Congenital anomalies	105	92	47	45	4	9	69	62	31	31	4	3
Nervous system 740-743	35	32	23	9	1	2	13	11	9	2	1	1
Circulatory system 746,747	36	30	13	17	1	5	24	21	7	14	1	2
Respiratory system 748	1	-	-	-	1	-	1	1	1	-	-	-
Digestive system 749-751	21	20	10	10	-	1	7	5	2	3	2	-
Genito-urinary system 752,753	1	1	-	1	-	-	5	5	4	1	-	-
Musculoskeletal system 754-756	2	2	-	2	-	-	4	4	4	-	-	-
Down's disease 759.3	7	5	-	5	1	1	15	15	4	11	-	-
Other anomalies 744,745, 757,758, Rest of 759	2	2	1	1	-	-	-	-	-	-	-	-
Certain perinatal causes 760-778	446	446	443	3	-	-	824	824	802	22	-	-
Symptoms 780-789	3	3	1	2	-	-	1246	938	66	872	213	95
Sudden death 795	12	11	3	8	1	-	-	-	-	-	-	-
Other ill-defined conditions 790-792,796	57	36	7	29	9	12	-	-	-	-	-	-
External causes E800-E999	35	11	2	9	6	18	16	12	3	9	1	3

DEATH RATES
San Salvador—EL SALVADOR

Death Rates from Underlying and Associated Causes in Children Under 5 Years, by Age Group, in Two-Year Period, 1968–1970.

Cause	Underlying cause						Associated cause					
	Under 5 years	Infant deaths			1 year	2-4 years	Under 5 years	Infant deaths			1 year	2-4 years
		Total	Under 28 days	28 days-11 mos.				Total	Under 28 days	28 days-11 mos.		
All causes	2636.2	8173.3	2818.1	5355.2	1741.8	430.1	4820.9	14277.9	4836.1	9441.8	3750.5	860.3
Infective and parasitic diseases	1525.1	4480.9	628.4	3852.5	1207.9	279.8	614.3	1307.6	378.6	929.0	783.4	216.8
Amebiasis ... 006	62.6	148.3	-	148.3	87.5	12.2	9.6	15.6	-	15.6	17.5	3.5
Diarrheal disease ... 009	1193.9	3751.0	409.8	3341.1	805.3	166.1	282.1	628.4	70.3	558.3	380.7	78.7
Other intestinal infectious diseases ... 000-005,007,008	32.7	109.3	27.3	82.0	21.9	1.7	20.2	35.1	3.9	31.2	39.4	5.2
Tuberculosis ... 010-019	6.7	11.7	-	11.7	-	7.0	4.8	3.9	-	3.9	4.4	5.2
Diphtheria ... 032	18.3	3.9	-	3.9	21.9	22.7	-	-	-	-	-	-
Whooping cough ... 033	12.5	31.2	-	31.2	17.5	1.7	2.9	3.9	-	3.9	4.4	1.7
Tetanus ... 037	16.4	66.4	62.5	3.9	-	-	-	-	-	-	-	-
Septicemia ... 038	29.8	121.0	97.6	23.4	-	-	115.5	386.4	265.4	121.0	56.9	14.0
Measles ... 055	122.3	179.5	3.9	175.6	240.7	45.5	1.9	-	-	-	4.4	1.7
Congenital syphilis ... 090	5.8	23.4	15.6	7.8	-	-	2.9	3.9	-	3.9	8.8	-
Moniliasis ... 112	2.9	11.7	3.9	7.8	-	-	45.3	140.5	39.0	101.5	43.8	1.7
Helminthiases ... 120-129	9.6	-	-	-	8.8	14.0	122.3	74.2	-	74.2	218.8	101.4
Other ... Rest of 000-136	11.6	23.4	7.8	15.6	4.4	8.7	6.7	15.6	-	15.6	4.4	3.5
Malignant neoplasms ... 140-209	2.9	-	-	-	8.8	1.7	1.0	-	-	-	-	1.7
Neoplasms, other ... 210-239	-	-	-	-	-	-	-	-	-	-	-	-
Nutritional deficiency	87.6	113.2	-	113.2	192.6	31.5	892.5	2217.0	85.9	2131.1	954.0	246.5
Vitamin deficiency ... 260-266	-	-	-	-	-	-	-	-	-	-	-	-
Protein malnutrition ... 267	51.0	35.1	-	35.1	126.9	26.2	110.7	54.6	-	54.6	223.2	87.4
Nutritional marasmus ... 268	34.7	70.3	-	70.3	65.6	5.2	194.5	499.6	7.8	491.8	227.6	38.5
Other ... 269	1.9	7.8		7.8	-	-	587.3	1662.8	78.1	1584.7	503.3	120.7
Endocrine and metabolic diseases ... 240-258,270-279	3.9	3.9	-	3.9	8.8	1.7	2.9	11.7	3.9	7.8	-	-
Deficiency anemias ... 280,281	-	-	-	-	-	-	-	-	-	-	-	-
Other diseases of blood and blood-forming organs ... 282-289	1.9	3.9	-	3.9	-	1.7	84.7	210.8	11.7	199.1	78.8	29.0
Inflammatory diseases of central nervous system ... 320-324	18.3	54.6	7.8	46.8	17.5	1.7	34.7	93.7	23.4	70.3	39.4	[illegible]
Other diseases of nervous system and sense organs ... 310-315,330-389	15.4	23.4	-	23.4	26.3	7.0	37.6	93.7	39.0	54.6	35.0	12.2
Diseases of circulatory system ... 390-458	1.0	-	-	-	-	1.7	88.6	265.4	15.6	249.8	61.3	17.5
Pneumonia and influenza . 470-486	214.7	757.2	183.5	573.8	78.8	19.2	728.9	2166.3	640.1	1526.2	599.6	113.7
Other diseases of respiratory system ... 460-466,490-519	113.6	347.4	15.6	331.8	100.7	10.5	69.3	187.4	7.8	179.5	78.8	10.5
Diseases of digestive system ... 520-577	7.7	15.6	3.9	11.7	8.8	3.5	130.9	394.2	78.1	316.2	105.0	19.2
Diseases of genito-urinary system ... 580-629	-	-	-	-	-	-	25.0	50.7	3.9	46.8	39.4	7.0
Diseases of skin and subcutaneous tissue ... 680-709	10.6	35.1	15.6	19.5	4.4	1.7	35.6	113.2	27.3	85.9	21.9	5.2
Diseases of musculoskeletal system ... 710-738	-	-	-	-	-	-	-	-	-	-	-	-
Congenital anomalies	101.1	359.1	183.5	175.6	17.5	15.7	66.4	242.0	121.0	121.0	17.5	5.2
Nervous system ... 740-743	33.7	124.9	89.8	35.1	4.4	3.5	12.5	42.9	35.1	7.8	4.4	1.7
Circulatory system ... 746,747	34.7	117.1	50.7	66.4	4.4	8.7	23.1	82.0	27.3	54.6	4.4	3.5
Respiratory system ... 748	1.0	-	-	-	4.4	-	1.0	3.9	3.9	-	-	-
Digestive system ... 749-751	20.2	78.1	39.0	39.0	-	1.7	6.7	19.5	7.8	11.7	8.8	-
Genito-urinary system . 752,753	1.0	3.9	-	3.9	-	-	4.8	19.5	15.6	3.9	-	-
Musculoskeletal system . 754-756	1.9	7.8	-	7.8	-	-	3.9	15.6	15.6	-	-	-
Down's disease ... 759.3	6.7	19.5	-	19.5	4.4	1.7	14.4	58.5	15.6	42.9	-	-
Other anomalies ... 744,745, 757,758, Rest of 759	1.9	7.8	3.9	3.9	-	-	-	-	-	-	-	-
Certain perinatal causes ... 760-778	429.4	1740.8	1729.1	11.7	-	-	793.4	3216.2	3130.4	85.9	-	-
Symptoms ... 780-769	2.9	11.7	3.9	7.8	-	-	1199.7	3661.2	257.6	3403.6	932.2	166.1
Sudden death ... 795	11.6	42.9	11.7	31.2	4.4	-	-	-	-	-	-	-
Other ill-defined conditions ... 790-792,796	54.9	140.5	27.3	113.2	39.4	21.0	-	-	-	-	-	-
External causes ... E800-E999	33.7	42.9	7.8	35.1	26.3	31.5	15.4	46.8	11.7	35.1	4.4	5.2

DEATHS
EL SALVADOR—Rural *municipios*

Underlying and Associated Causes of Death in Children Under 5 Years, by Age Group, in Two-Year Period, 1968–1970.

Cause	Underlying cause						Associated cause					
	Under 5 years	Infant deaths			1 year	2-4 years	Under 5 years	Infant deaths			1 year	2-4 years
		Total	Under 28 days	28 days-11 mos.				Total	Under 28 days	28 days-11 mos.		
All causes	1082	648	195	453	217	217	1818	942	223	719	431	445
Infective and parasitic diseases	711	416	61	355	158	137	362	104	22	82	112	146
Amebiasis 006	22	9	-	9	6	7	-	-	-	-	-	-
Diarrheal disease 009	559	337	27	310	115	107	168	58	9	49	45	65
Other intestinal infectious diseases 000-005,007,008	6	4	-	4	1	1	3	-	-	-	-	3
Tuberculosis 010-019	3	-	-	-	1	2	5	1	-	1	2	2
Diphtheria 032	5	-	-	-	5	-	-	-	-	-	-	-
Whooping cough 033	17	8	-	8	8	1	2	2	-	2	-	-
Tetanus 037	29	29	28	1	-	-	-	-	-	-	-	-
Septicemia 038	8	4	4	4	-	-	22	16	11	5	1	5
Measles 055	51	16	-	16	21	14	1	-	-	-	-	1
Congenital syphilis 090	-	-	-	-	-	-	1	1	1	-	-	-
Moniliasis 112	2	2	2	-	-	-	14	8	1	7	3	3
Helminthiases 120-129	4	1	-	1	-	3	141	15	-	15	60	66
Other Rest of 000-136	5	2	-	2	1	2	5	3	-	3	1	1
Malignant neoplasms 140-209	-	-	-	-	-	-	-	-	-	-	-	-
Neoplasms, other 210-239	1	-	-	-	-	1	-	-	-	-	-	-
Nutritional deficiency	88	13	-	13	25	50	419	185	7	178	122	112
Vitamin deficiency 260-266	-	-	-	-	-	-	1	1	-	1	-	-
Protein malnutrition 267	77	8	-	8	19	50	103	9	-	9	35	59
Nutritional marasmus 268	9	3	-	3	6	-	51	20	-	20	23	8
Other 269	2	2	-	2	-	-	264	155	7	148	64	45
Endocrine and metabolic diseases 240-258,270-279	-	-	-	-	-	-	-	-	-	-	-	-
Deficiency anemias 280,281	-	-	-	-	-	-	1	-	-	-	1	-
Other diseases of blood and blood-forming organs 282-289	1	-	-	-	-	1	17	5	-	5	2	10
Inflammatory diseases of central nervous system 320-324	7	4	-	4	-	3	9	8	4	4	1	-
Other diseases of nervous system and sense organs 310-315,330-389	5	1	-	1	2	2	8	6	1	5	2	-
Diseases of circulatory system 390-458	-	-	-	-	-	-	12	3	-	3	4	5
Pneumonia and influenza 470-486	66	52	17	35	10	4	219	105	16	89	64	50
Other diseases of respiratory system 460-466,490-519	37	26	1	25	7	4	42	30	3	27	5	7
Diseases of digestive system 520-577	3	3	1	2	-	-	43	17	3	14	12	14
Diseases of genito-urinary system 580-629	4	2	2	-	-	2	8	5	-	5	2	1
Diseases of skin and subcutaneous tissue 680-709	3	2	1	1	1	-	22	13	3	10	2	7
Diseases of musculoskeletal system 710-738	1	-	-	-	-	1	-	-	-	-	-	-
Congenital anomalies	29	24	15	9	2	3	23	18	7	11	2	3
Nervous system 740-743	16	15	11	4	1	-	4	4	2	2	-	-
Circulatory system 746,747	8	5	2	3	-	3	9	8	2	6	-	1
Respiratory system 748	-	-	-	-	-	-	-	-	-	-	-	-
Digestive system 749-751	2	2	1	1	-	-	3	2	-	2	-	1
Genito-urinary system 752,753	-	-	-	-	-	-	-	-	-	-	-	-
Musculoskeletal system 754-756	2	2	1	1	-	-	2	2	2	-	-	-
Down's disease 759.3	1	-	-	-	1	-	4	2	1	1	2	-
Other anomalies 744,745, 757,758, Rest of 759	-	-	-	-	-	-	1	-	-	-	-	1
Certain perinatal causes 760-778	94	94	94	-	-	-	139	139	133	6	-	-
Symptoms 780-789	8	5	1	4	2	1	489	302	24	278	98	89
Sudden death 795	-	-	-	-	-	-	-	-	-	-	-	-
Other ill-defined conditions 790-792,796	13	5	2	3	5	3	-	-	-	-	-	-
External causes E800-E999	11	1	-	1	5	5	5	2	-	2	2	1

DEATH RATES
Rural *municipios*—EL SALVADOR

Death Rates from Underlying and Associated Causes in Children Under 5 Years, by Age Group, in Two-Year Period, 1968–1970.

Cause	Underlying cause						Associated cause					
	Under 5 years	Infant deaths			1 year	2-4 years	Under 5 years	Infant deaths			1 year	2-4 years
		Total	Under 28 days	28 days-11 mos.				Total	Under 28 days	28 days-11 mos.		
All causes	5049.0	12000.0	3611.1	8388.9	4811.5	1802.3	8483.4	17444.4	4129.6	13314.8	9556.5	3696.0
Infective and parasitic diseases	3317.8	7703.7	1129.6	6574.1	3503.3	1137.9	1689.2	1925.9	407.4	1518.5	2483.4	1212.6
Amebiasis ... 006	102.7	166.7	-	166.7	133.0	58.1	-	-	-	-	-	-
Diarrheal disease ... 009	2608.5	6240.7	500.0	5740.7	2549.9	888.7	783.9	1074.1	166.7	907.4	997.8	539.9
Other intestinal infectious diseases ... 000-005,007,008	28.0	74.1	-	74.1	22.2	8.3	14.0	-	-	-	-	24.9
Tuberculosis ... 010-019	14.0	-	-	-	22.2	16.6	23.3	18.5	-	18.5	44.3	16.6
Diphtheria ... 032	23.3	-	-	-	110.9	-	-	-	-	-	-	-
Whooping cough ... 033	79.3	148.1	-	148.1	177.4	8.3	9.3	37.0	-	37.0	-	-
Tetanus ... 037	135.3	537.0	518.5	18.5	-	-	-	-	-	-	-	-
Septicemia ... 038	37.3	148.1	74.1	74.1	-	-	102.7	296.3	203.7	92.6	22.2	41.5
Measles ... 055	238.0	296.3	-	296.3	465.6	116.3	4.7	-	-	-	-	8.3
Congenital syphilis ... 090	-	-	-	-	-	-	4.7	18.5	18.5	-	-	-
Moniliasis ... 112	9.3	37.0	37.0	-	-	-	65.3	148.1	18.5	129.6	66.5	24.9
Helminthiases ... 120-129	18.7	18.5	-	18.5	-	24.9	658.0	277.8	-	277.8	1330.4	548.2
Other ... Rest of 000-136	23.3	37.0	-	37.0	22.2	16.6	23.3	55.6	-	55.6	22.2	8.3
Malignant neoplasms ... 140-209	-	-	-	-	-	-	-	-	-	-	-	-
Neoplasms, other ... 210-239	4.7	-	-	-	-	8.3	-	-	-	-	-	-
Nutritional deficiency	410.6	240.7	-	240.7	554.3	415.3	1955.2	3425.9	129.6	3296.3	2705.1	930.2
Vitamin deficiency ... 260-266	-	-	-	-	-	-	4.7	18.5	-	18.5	-	-
Protein malnutrition ... 267	359.3	148.1	-	148.1	421.3	415.3	480.6	166.7	-	166.7	776.1	490.0
Nutritional marasmus ... 268	42.0	55.6	-	55.6	133.0	-	238.0	370.4	-	370.4	510.0	66.4
Other ... 269	9.3	37.0	-	37.0	-	-	1231.9	2870.4	129.6	2740.7	1419.1	373.8
Endocrine and metabolic diseases ... 240-258,270-279	-	-	-	-	-	-	-	-	-	-	-	-
Deficiency anemias ... 280,281	-	-	-	-	-	-	4.7	-	-	-	22.2	-
Other diseases of blood and blood-forming organs ... 282-289	4.7	-	-	-	-	8.3	79.3	92.6	-	92.6	44.3	83.1
Inflammatory diseases of central nervous system ... 320-324	32.7	74.1	-	74.1	-	24.9	42.0	148.1	74.1	74.1	22.2	-
Other diseases of nervous system and sense organs ... 310-315,330-389	23.3	18.5	-	18.5	44.3	16.6	37.3	111.1	18.5	92.6	44.3	-
Diseases of circulatory system ... 390-458	-	-	-	-	-	-	56.0	55.6	-	55.6	88.7	41.5
Pneumonia and influenza . 470-486	308.0	963.0	314.8	648.1	221.7	33.2	1021.9	1944.4	296.3	1648.1	1419.1	415.3
Other diseases of respiratory system ... 460-466,490-519	172.7	481.5	18.5	463.0	155.2	33.2	196.0	555.6	55.6	500.0	110.9	58.1
Diseases of digestive system ... 520-577	14.0	55.6	18.5	37.0	-	-	200.7	314.8	55.6	259.3	266.1	116.3
Diseases of genito-urinary system ... 580-629	18.7	37.0	37.0	-	-	16.6	37.3	92.6	-	92.6	44.3	8.3
Diseases of skin and subcutaneous tissue ... 680-709	14.0	37.0	18.5	18.5	22.2	-	102.7	240.7	55.6	185.2	44.3	58.1
Diseases of musculoskeletal system ... 710-738	4.7	-	-	-	-	8.3	-	-	-	-	-	-
Congenital anomalies	135.3	444.4	277.8	166.7	44.3	24.9	107.3	333.3	129.6	203.7	44.3	24.9
Nervous system ... 740-743	74.7	277.8	203.7	74.1	22.2	-	18.7	74.1	37.0	37.0	-	-
Circulatory system ... 746,747	37.3	92.6	37.0	55.6	-	24.9	42.0	148.1	37.0	111.1	-	8.3
Respiratory system ... 748	-	-	-	-	-	-	-	-	-	-	-	-
Digestive system ... 749-751	9.3	37.0	18.5	18.5	-	-	14.0	37.0	-	37.0	-	8.3
Genito-urinary system . 752,753	-	-	-	-	-	-	-	-	-	-	-	-
Musculoskeletal system . 754-756	9.3	37.0	18.5	18.5	-	-	9.3	37.0	37.0	-	-	-
Down's disease ... 759.3	4.7	-	-	-	22.2	-	18.7	37.0	18.5	18.5	44.3	-
Other anomalies ... 744,745, 757,758, Rest of 759	-	-	-	-	-	-	4.7	-	-	-	-	8.3
Certain perinatal causes ... 760-778	438.6	1740.7	1740.7	-	-	-	648.6	2574.1	2463.0	111.1	-	-
Symptoms ... 780-789	37.3	92.6	18.5	74.1	44.3	8.3	2281.8	5592.6	444.4	5148.1	2172.9	739.2
Sudden death ... 795	-	-	-	-	-	-	-	-	-	-	-	-
Other ill-defined conditions ... 790-792,796	60.7	92.6	37.0	55.6	110.9	24.9	-	-	-	-	-	-
External causes ... E800-E999	51.3	18.5	-	18.5	110.9	41.5	23.3	37.0	-	37.0	44.3	8.3

DEATHS
JAMAICA—Kingston-St. Andrew

Underlying and Associated Causes of Death in Children Under 5 Years, by Age Group, in Two-Year Period, 1968–1970.

Cause	Underlying cause						Associated cause					
	Under 5 years	Infant deaths			1 year	2-4 years	Under 5 years	Infant deaths			1 year	2-4 years
		Total	Under 28 days	28 days-11 mos.				Total	Under 28 days	28 days-11 mos.		
All causes	1903	1589	990	599	175	139	2954	2510	1606	904	283	161
Infective and parasitic diseases	548	452	128	324	70	26	296	239	127	112	42	15
Amebiasis 006	-	-	-	-	-	-	-	-	-	-	-	-
Diarrheal disease 009	396	334	45	289	55	7	126	93	20	73	28	5
Other intestinal infectious diseases 000-005,007,008	11	11	4	7	-	-	4	3	-	3	1	-
Tuberculosis 010-019	4	-	-	-	2	2	2	-	-	-	1	1
Diphtheria 032	14	4	-	4	5	5	-	-	-	-	-	-
Whooping cough 033	18	11	1	10	4	3	3	1	-	1	2	-
Tetanus 037	17	16	16	-	-	1	-	-	-	-	-	-
Septicemia 038	61	61	57	4	-	-	117	107	87	20	3	7
Measles 055	9	4	-	4	2	3	2	1	-	1	1	-
Congenital syphilis 090	5	5	3	2	-	-	1	1	-	1	-	-
Monilias 112	4	4	2	2	-	-	33	31	19	12	2	-
Helminthiases 120-129	3	-	-	-	1	2	5	-	-	-	4	1
Other Rest of 000-136	6	2	-	2	1	3	3	2	1	1	-	1
Malignant neoplasms 140-209	20	6	1	5	3	11	5	3	2	1	-	2
Neoplasms, other 210-239	1	-	-	-	1	-	1	1	1	-	-	-
Nutritional deficiency	67	37	-	37	25	5	303	206	6	200	65	32
Vitamin deficiency 260-266	1	-	-	-	1	-	-	-	-	-	-	-
Protein malnutrition 267	42	18	-	18	19	5	16	7	-	7	7	2
Nutritional marasmus 268	21	17	-	17	4	-	62	42	2	40	14	6
Other 269	3	2	-	2	1	-	225	157	4	153	44	24
Endocrine and metabolic diseases 240-258,270-279	4	3	1	2	1	-	4	3	2	1	-	1
Deficiency anemias 280,281	1	-	-	-	1	-	22	16	4	12	5	1
Other diseases of blood and blood-forming organs 282-289	14	4	-	4	4	6	44	25	-	25	13	6
Inflammatory diseases of central nervous system 320-324	34	22	8	14	8	4	28	21	4	17	6	1
Other diseases of nervous system and sense organs 310-315,330-389	23	7	1	6	5	11	48	33	22	11	6	9
Diseases of circulatory system 390-458	4	-	-	-	-	4	98	57	11	46	24	17
Pneumonia and influenza 470-486	137	105	36	69	17	15	315	226	96	130	56	33
Other diseases of respiratory system 460-466,490-519	29	13	-	13	11	5	59	43	8	35	8	8
Diseases of digestive system 520-577	23	16	6	10	3	4	40	34	12	22	1	5
Diseases of genito-urinary system 580-629	3	1	-	1	1	1	17	14	1	13	-	3
Diseases of skin and subcutaneous tissue 680-709	7	4	2	2	1	2	17	11	4	7	4	2
Diseases of musculoskeletal system 710-738	1	1	-	1	-	-	1	-	-	-	-	1
Congenital anomalies	161	130	73	57	14	17	126	112	74	38	8	6
Nervous system 740-743	35	24	11	13	4	7	6	3	2	1	2	1
Circulatory system 746,747	59	51	27	24	5	3	53	50	36	14	1	2
Respiratory system 748	3	2	2	-	-	1	1	1	1	-	-	-
Digestive system 749-751	29	26	21	5	2	1	9	9	7	2	-	-
Genito-urinary system 752 753	10	9	2	7	-	1	16	15	11	4	-	1
Musculoskeletal system 754-756	8	7	7	-	1	-	5	5	4	1	-	-
Down's disease 759.3	12	6	2	4	2	4	28	21	9	12	5	2
Other anomalies 744,745, 757,758, Rest of 759	5	5	1	4	-	-	8	8	4	4	-	-
Certain perinatal causes 760-778	716	714	706	8	-	2	1227	1225	1193	32	-	2
Symptoms 780-789	5	5	1	4	-	-	264	210	27	183	42	12
Sudden death 795	36	35	12	23	1	-	-	-	-	-	-	-
Other ill-defined conditions 790-792,796	10	9	4	5	1	-	1	-	-	-	-	1
External causes E800-E999	59	25	11	14	8	26	38	31	12	19	3	4

DEATH RATES
Kingston-St. Andrew—JAMAICA

Death Rates from Underlying and Associated Causes in Children Under 5 Years, by Age Group, in Two-Year Period, 1968-1970.

Cause	Underlying cause						Associated cause					
	Under 5 years	Infant deaths			1 year	2-4 years	Under 5 years	Infant deaths			1 year	2-4 years
		Total	Under 28 days	28 days-11 mos.				Total	Under 28 days	28 days-11 mos.		
All causes	1038.5	3879.4	2417.0	1462.4	447.5	133.1	1612.1	6127.9	3920.9	2207.0	723.6	154.1
Infective and parasitic diseases	299.1	1103.5	312.5	791.0	179.0	24.9	161.5	583.5	310.1	273.4	107.4	14.4
Amebiasis 006	-	-	-	-	-	-	-	-	-	-	-	-
Diarrheal disease 009	216.1	815.4	109.9	705.6	140.6	6.7	68.8	227.1	48.8	178.2	71.6	4.8
Other intestinal infectious diseases 000-005,007,008	6.0	26.9	9.8	17.1	-	-	2.2	7.3	-	7.3	2.6	-
Tuberculosis 010-019	2.2	-	-	-	5.1	1.9	1.1	-	-	-	2.6	1.0
Diphtheria 032	7.6	9.8	-	9.8	12.8	4.8	-	-	-	-	-	-
Whooping cough 033	9.8	26.9	2.4	24.4	10.2	2.9	1.6	2.4	-	2.4	5.1	-
Tetanus 037	9.3	39.1	39.1	-	-	1.0	-	-	-	-	-	-
Septicemia 038	33.3	148.9	139.2	9.8	-	-	63.9	261.2	212.4	48.8	7.7	6.7
Measles 055	4.9	9.8	-	9.8	5.1	2.9	1.1	2.4	-	2.4	2.6	-
Congenital syphilis 090	2.7	12.2	7.3	4.9	-	-	0.5	2.4	-	2.4	-	-
Moniliasis 112	2.2	9.8	4.9	4.9	-	-	18.0	75.7	46.4	29.3	5.1	-
Helminthiases 120-129	1.6	-	-	-	2.6	1.9	2.7	-	-	-	10.2	1.0
Other Rest of 000-136	3.3	4.9	-	4.9	2.6	2.9	1.6	4.9	2.4	2.4	-	1.0
Malignant neoplasms 140-209	10.9	14.6	2.4	12.2	7.7	10.5	2.7	7.3	4.9	2.4	-	1.9
Neoplasms, other 210-239	0.5	-	-	-	2.6	-	0.5	2.4	2.4	-	-	-
Nutritional deficiency	36.6	90.3	-	90.3	63.9	4.8	165.4	502.9	14.6	488.3	166.2	30.6
Vitamin deficiency 260-266	0.5	-	-	-	2.6	-	-	-	-	-	-	-
Protein malnutrition 267	22.9	43.9	-	43.9	48.6	4.8	8.7	17.1	-	17.1	17.9	1.9
Nutritional marasmus 268	11.5	41.5	-	41.5	10.2	-	33.8	102.5	4.9	97.7	35.8	5.7
Other 269	1.6	4.9	-	4.9	2.6	-	122.8	383.3	9.8	373.5	112.5	23.0
Endocrine and metabolic diseases 240-258,270-279	2.2	7.3	2.4	4.9	2.6	-	2.2	7.3	4.9	2.4	-	1.0
Deficiency anemias 280,281	0.5	-	-	-	2.6	-	12.0	39.1	9.8	29.3	12.8	1.0
Other diseases of blood and blood-forming organs 282-289	7.6	9.8	-	9.8	10.2	5.7	24.0	61.0	-	61.0	33.2	5.7
Inflammatory diseases of central nervous system 320-324	18.6	53.7	19.5	34.2	20.5	3.8	15.3	51.3	9.8	41.5	15.3	1.0
Other diseases of nervous system and sense organs 310-315,330-389	12.6	17.1	2.4	14.6	12.8	10.5	26.2	80.6	53.7	26.9	15.3	8.6
Diseases of circulatory system 390-458	2.2	-	-	-	-	3.8	53.5	139.2	26.9	112.3	61.4	16.3
Pneumonia and influenza 470-486	74.8	256.3	87.9	168.5	43.5	14.4	171.9	551.8	234.4	317.4	143.2	31.6
Other diseases of respiratory system 460-466,490-519	15.8	31.7	-	31.7	28.1	4.8	32.2	105.0	19.5	85.4	20.5	7.7
Diseases of digestive system 520-577	12.6	39.1	14.6	24.4	7.7	3.8	21.8	83.0	29.3	53.7	2.6	4.8
Diseases of genito-urinary system 580-629	1.6	2.4	-	2.4	2.6	1.0	9.3	34.2	2.4	31.7	-	2.9
Diseases of skin and subcutaneous tissue 680-709	3.8	9.8	4.9	4.9	2.6	1.9	9.3	26.9	9.8	17.1	10.2	1.9
Diseases of musculoskeletal system 710-738	0.5	2.4	-	2.4	-	-	0.5	-	-	-	-	1.0
Congenital anomalies	87.9	317.4	178.2	139.2	35.8	16.3	68.8	273.4	180.7	92.8	20.5	5.7
Nervous system 740-743	19.1	58.6	26.9	31.7	10.2	6.7	3.3	7.3	4.9	2.4	5.1	1.0
Circulatory system 746,747	32.2	124.5	65.9	58.6	12.8	2.9	28.9	122.1	87.9	34.2	2.6	1.9
Respiratory system 748	1.6	4.9	4.9	-	-	1.0	0.5	2.4	2.4	-	-	-
Digestive system 749-751	15.8	63.5	51.3	12.2	5.1	1.0	4.9	22.0	17.1	4.9	-	-
Genito-urinary system 752,753	5.5	22.0	4.9	17.1	-	1.0	8.7	36.6	26.9	9.8	-	1.0
Musculoskeletal system 754-756	4.4	17.1	17.1	-	2.6	-	2.7	12.2	9.8	2.4	-	-
Down's disease 759.3	6.5	14.6	4.9	9.8	5.1	3.8	15.3	51.3	22.0	29.3	12.8	1.9
Other anomalies 744,745, 757,758, Rest of 759	2.7	12.2	2.4	9.8	-	-	4.4	19.5	9.8	9.8	-	-
Certain perinatal causes 760-778	390.7	1743.2	1723.6	19.5	-	1.9	669.6	2990.7	2912.6	78.1	-	1.9
Symptoms 780-789	2.7	12.2	2.4	9.8	-	-	144.1	512.7	65.9	446.8	107.4	11.5
Sudden death 795	19.6	85.4	29.3	56.2	2.6	-	-	-	-	-	-	-
Other ill-defined conditions 790-792,796	5.5	22.0	9.8	12.2	2.6	-	0.5	-	-	-	-	-
External causes E800-E999	32.2	61.0	26.9	34.2	20.5	24.9	20.7	75.7	29.3	46.4	7.7	3.8

DEATHS
JAMAICA—Metropolitan Kingston

Underlying and Associated Causes of Death in Children Under 5 Years, by Age Group, in Two-Year Period, 1968–1970.

Cause	Underlying cause						Associated cause					
	Under 5 years	Infant deaths			1 year	2-4 years	Under 5 years	Infant deaths			1 year	2-4 years
		Total	Under 28 days	28 days-11 mos.				Total	Under 28 days	28 days-11 mos.		
All causes	1754	1478	937	541	154	122	2716	2336	1526	810	240	140
Infective and parasitic diseases	513	429	121	308	60	24	265	219	124	95	33	13
Amebiasis 006	-	-	-	-	-	-	-	-	-	-	-	-
Diarrheal disease 009	370	317	43	274	46	7	109	80	20	60	25	4
Other intestinal infectious diseases 000-005,007,008	11	11	4	7	-	-	3	3	-	3	-	-
Tuberculosis 010-019	4	-	-	-	2	2	2	-	-	-	1	1
Diphtheria 032	14	4	-	4	5	5	-	-	-	-	-	-
Whooping cough 033	17	10	1	9	4	3	2	1	-	1	1	-
Tetanus 037	15	14	14	-	-	1	-	-	-	-	-	-
Septicemia 038	58	58	54	4	-	-	111	103	84	19	2	6
Measles 055	9	4	-	4	2	3	2	1	-	1	1	-
Congenital syphilis 090	5	5	3	2	-	-	1	1	-	1	-	-
Moniliasis 112	4	4	2	2	-	-	30	29	19	10	1	-
Helminthiases 120-129	-	-	-	-	-	-	3	-	-	-	2	1
Other Rest of 000-136	6	2	-	2	1	3	2	1	1	-	-	1
Malignant neoplasms 140-209	19	6	1	5	3	10	5	3	2	1	-	2
Neoplasms, other 210-239	1	-	-	-	1	-	1	1	1	-	-	-
Nutritional deficiency	46	21	-	21	20	5	261	185	5	180	52	24
Vitamin deficiency 260-266	-	-	-	-	-	-	-	-	-	-	-	-
Protein malnutrition 267	28	8	-	8	15	5	8	3	-	3	3	2
Nutritional marasmus 268	15	11	-	11	4	-	48	33	1	32	11	4
Other 269	3	2	-	2	1	-	205	149	4	145	38	18
Endocrine and metabolic diseases 240-258,270-279	3	2	1	1	1	-	4	3	2	1	-	1
Deficiency anemias 280,281	1	-	-	-	1	-	18	13	2	11	4	1
Other diseases of blood and blood-forming organs 282-289	14	4	-	4	4	6	41	22	-	22	13	6
Inflammatory diseases of central nervous system 320-324	29	20	8	12	6	3	25	19	3	16	5	1
Other diseases of nervous system and sense organs 310-315,330-389	22	7	1	6	5	10	46	33	22	11	4	9
Diseases of circulatory system 390-458	4	-	-	-	-	4	93	54	11	43	22	17
Pneumonia and influenza 470-486	118	90	35	55	16	12	287	206	87	119	51	30
Other diseases of respiratory system 460-466,490-519	28	12	-	12	11	5	50	35	8	27	8	7
Diseases of digestive system 520-577	22	15	5	10	3	4	36	31	12	19	1	4
Diseases of genito-urinary system 580-629	1	1	-	1	-	-	13	12	1	11	-	1
Diseases of skin and subcutaneous tissue 680-709	6	4	2	2	1	1	16	11	4	7	3	2
Diseases of musculoskeletal system 710-738	1	1	-	1	-	-	1	-	-	-	-	1
Congenital anomalies	145	120	68	52	12	13	114	102	66	36	7	5
Nervous system 740-743	32	23	11	12	4	5	6	3	2	1	2	1
Circulatory system 746,747	56	48	26	22	5	3	46	43	30	13	1	2
Respiratory system 748	3	2	2	-	-	1	1	1	1	-	-	-
Digestive system 749-751	24	22	17	5	1	1	9	9	7	2	-	-
Genito-urinary system 752,753	8	8	2	6	-	-	16	15	11	4	-	1
Musculoskeletal system 754-756	7	7	7	-	-	-	5	5	4	1	-	-
Down's disease 759.3	10	5	2	3	2	3	24	19	7	12	4	1
Other anomalies 744,745, 757,758, Rest of 759	5	5	1	4	-	-	7	7	4	3	-	-
Certain perinatal causes 760-778	682	680	672	8	-	2	1170	1168	1140	28	-	2
Symptoms 780-789	5	5	1	4	-	-	235	191	26	165	34	10
Sudden death 795	31	30	9	21	1	-	-	-	-	-	-	-
Other ill-defined conditions 790-792,796	10	9	4	5	1	-	-	-	-	-	-	-
External causes E800-E999	53	22	9	13	8	23	35	28	10	18	3	4

DEATH RATES
Metropolitan Kingston—JAMAICA

Death Rates from Underlying and Associated Causes in Children Under 5 Years, by Age Group, in Two-Year Period, 1968–1970.

Cause	Underlying cause						Associated cause					
	Under 5 years	Infant deaths			1 year	2-4 years	Under 5 years	Infant deaths			1 year	2-4 years
		Total	Under 28 days	28 days-11 mos.				Total	Under 28 days	28 days-11 mos.		
All causes	1047.0	3946.6	2502.0	1444.6	430.5	127.8	1621.2	6237.7	4074.8	2162.9	671.0	146.6
Infective and parasitic diseases	306.2	1145.5	323.1	822.4	167.7	25.1	158.2	584.8	331.1	253.7	92.3	13.6
Amebiasis 006	-	-	-	-	-	-	-	-	-	-	-	-
Diarrheal disease 009	270.9	846.5	114.8	731.6	128.6	7.3	65.1	213.6	53.4	160.2	69.9	4.2
Other intestinal infectious diseases 000-005,007,008	6.6	29.4	10.7	18.7	-	-	1.8	8.0	-	8.0	-	-
Tuberculosis 010-019	2.4	-	-	-	5.6	2.1	1.2	-	-	-	2.8	1.0
Diphtheria 032	8.4	10.7	-	10.7	14.0	5.2	-	-	-	-	-	-
Whooping cough 033	10.1	26.7	2.7	24.0	11.2	3.1	1.2	2.7	-	2.7	2.8	-
Tetanus 037	9.0	37.4	37.4	-	-	1.0	-	-	-	-	-	-
Septicemia 038	34.6	154.9	144.2	10.7	-	-	66.3	275.0	224.3	50.7	5.6	6.3
Measles 055	5.4	10.7	-	10.7	5.6	3.1	1.2	2.7	-	2.7	2.8	-
Congenital syphilis 090	3.0	13.4	8.0	5.3	-	-	0.6	2.7	-	2.7	-	-
Moniliasis 112	2.4	10.7	5.3	5.3	-	-	17.9	77.4	50.7	26.7	2.8	-
Helminthiases 120-129	-	-	-	-	-	-	1.8	-	-	-	5.6	1.0
Other Rest of 000-136	3.6	5.3	-	5.3	2.8	3.1	1.2	2.7	2.7	-	-	1.0
Malignant neoplasms 140-209	11.3	16.0	2.7	13.4	8.4	10.5	3.0	8.0	5.3	2.7	-	2.1
Neoplasms, other 210-239	0.6	-	-	-	2.8	-	0.6	2.7	2.7	-	-	-
Nutritional deficiency	27.5	56.1	-	56.1	55.9	5.2	155.8	494.0	13.4	480.6	145.4	25.1
Vitamin deficiency 260-266	-	-	-	-	-	-	-	-	-	-	-	-
Protein malnutrition 267	16.7	21.4	-	21.4	41.9	5.2	4.8	8.0	-	8.0	8.4	2.1
Nutritional marasmus 268	9.0	29.4	-	29.4	11.2	-	28.7	88.1	2.7	85.4	30.8	4.2
Other 269	1.8	5.3	-	5.3	2.8	-	122.4	397.9	10.7	387.2	106.2	18.9
Endocrine and metabolic diseases 240-258,270-279	1.8	5.3	2.7	2.7	2.8	-	2.4	8.0	5.3	2.7	-	1.0
Deficiency anemias 280,281	0.6	-	-	-	2.8	-	10.7	34.7	5.3	29.4	11.2	1.0
Other diseases of blood and blood-forming organs 282-289	8.4	10.7	-	10.7	11.2	6.3	24.5	58.7	-	58.7	36.3	6.3
Inflammatory diseases of central nervous system 320-324	17.3	53.4	21.4	32.0	16.8	3.1	14.9	50.7	8.0	42.7	14.0	1.0
Other diseases of nervous system and sense organs 310-315,330-389	13.1	18.7	2.7	16.0	14.0	10.5	27.5	88.1	58.7	29.4	11.2	9.4
Diseases of circulatory system 390-458	2.4	-	-	-	-	4.2	55.5	144.2	29.4	114.8	61.5	17.8
Pneumonia and influenza 470-486	70.4	240.3	93.5	146.9	44.7	12.6	171.3	550.1	232.3	317.8	142.6	31.4
Other diseases of respiratory system 460-466,490-519	16.7	32.0	-	32.0	30.8	5.2	29.8	93.5	21.4	72.1	22.4	7.3
Diseases of digestive system 520-577	13.1	40.1	13.4	26.7	8.4	4.2	21.5	82.8	32.0	50.7	2.8	4.2
Diseases of genito-urinary system 580-629	0.6	2.7	-	2.7	-	-	7.8	32.0	2.7	29.4	-	1.0
Diseases of skin and subcutaneous tissue 680-709	3.6	10.7	5.3	5.3	2.8	1.0	9.6	29.4	10.7	18.7	8.4	2.1
Diseases of musculoskeletal system 710-738	0.6	2.7	-	2.7	-	-	0.6	-	-	-	-	1.0
Congenital anomalies	86.6	320.4	181.6	138.9	33.5	13.6	68.0	272.4	176.2	96.1	19.6	5.2
Nervous system 740-743	19.1	61.4	29.4	32.0	11.2	5.2	3.6	8.0	5.3	2.7	5.6	1.0
Circulatory system 746,747	33.4	128.2	69.4	58.7	14.0	3.1	27.5	114.8	80.1	34.7	2.8	2.1
Respiratory system 748	1.8	5.3	5.3	-	-	1.0	0.6	2.7	2.7	-	-	-
Digestive system 749-751	14.3	58.7	45.4	13.4	2.8	1.0	5.4	24.0	18.7	5.3	-	-
Genito-urinary system 752,753	4.8	21.4	5.3	16.0	-	-	9.6	40.1	29.4	10.7	-	1.0
Musculoskeletal system 754-756	4.2	18.7	18.7	-	-	-	3.0	13.4	10.7	2.7	-	-
Down's disease 759.3	6.0	13.4	5.3	8.0	5.6	3.1	14.3	50.7	18.7	32.0	11.2	1.0
Other anomalies 744,745, 757,758, Rest of 759	3.0	13.4	2.7	10.7	-	-	4.2	18.7	10.7	8.0	-	-
Certain perinatal causes 760-778	407.1	1815.8	1794.4	21.4	-	2.1	698.4	3118.8	3044.1	74.8	-	2.1
Symptoms 780-789	3.0	13.4	2.7	10.7	-	-	140.3	510.0	69.4	440.6	95.1	10.5
Sudden death 795	18.5	80.1	24.0	56.1	2.8	-	-	-	-	-	-	-
Other ill-defined conditions 790-792,796	6.0	24.0	10.7	13.4	2.8	-	-	-	-	-	-	-
External causes E800-E999	31.6	58.7	24.0	34.7	22.4	24.1	20.9	74.8	26.7	48.1	8.4	4.2

DEATHS
JAMAICA—Rural St. Andrew

Underlying and Associated Causes of Death in Children Under 5 Years, by Age Group, in Two-Year Period, 1968–1970.

Cause	Underlying cause						Associated cause					
	Under 5 years	Infant deaths			1 year	2-4 years	Under 5 years	Infant deaths			1 year	2-4 years
		Total	Under 28 days	28 days-11 mos.				Total	Under 28 days	28 days-11 mos.		
All causes	149	111	53	58	21	17	238	174	80	94	43	21
Infective and parasitic diseases	35	23	7	16	10	2	31	20	3	17	9	2
Amebiasis 006	-	-	-	-	-	-	-	-	-	-	-	-
Diarrheal disease 009	26	17	2	15	9	-	17	13	-	13	3	1
Other intestinal infectious diseases 000-005,007,008	-	-	-	-	-	-	1	-	-	-	1	-
Tuberculosis 010-019	-	-	-	-	-	-	-	-	-	-	-	-
Diphtheria 032	-	-	-	-	-	-	-	-	-	-	-	-
Whooping cough 033	1	1	-	1	-	-	1	-	-	-	1	-
Tetanus 037	2	2	2	-	-	-	-	-	-	-	-	-
Septicemia 038	3	3	3	-	-	-	6	4	3	1	1	1
Measles 055	-	-	-	-	-	-	-	-	-	-	-	-
Congenital syphilis 090	-	-	-	-	-	-	-	-	-	-	-	-
Moniliasis 112	-	-	-	-	-	-	3	2	-	2	1	-
Helminthiases 120-129	3	-	-	-	1	2	2	-	-	-	2	-
Other Rest of 000-136	-	-	-	-	-	-	1	1	-	1	-	-
Malignant neoplasms 140-209	1	-	-	-	-	1	-	-	-	-	-	-
Neoplasms, other 210-239	-	-	-	-	-	-	-	-	-	-	-	-
Nutritional deficiency	21	16	-	16	5	-	42	21	1	20	13	8
Vitamin deficiency 260-266	1	-	-	-	1	-	-	-	-	-	-	-
Protein malnutrition 267	14	10	-	10	4	-	8	4	-	4	4	-
Nutritional marasmus 268	6	6	-	6	-	-	14	9	1	8	3	2
Other 269	-	-	-	-	-	-	20	8	-	8	6	6
Endocrine and metabolic diseases 240-258,270-279	1	1	-	1	-	-	-	-	-	-	-	-
Deficiency anemias 280,281	-	-	-	-	-	-	4	3	2	1	1	-
Other diseases of blood and blood-forming organs 282-289	-	-	-	-	-	-	3	3	-	3	-	-
Inflammatory diseases of central nervous system 320-324	5	2	-	2	2	1	3	2	1	1	1	-
Other diseases of nervous system and sense organs 310-315,330-389	1	-	-	-	-	1	2	-	-	-	2	-
Diseases of circulatory system 390-458	-	-	-	-	-	-	5	3	-	3	2	-
Pneumonia and influenza 470-486	19	15	1	14	1	3	28	20	9	11	5	3
Other diseases of respiratory system 460-466,490-519	1	1	-	1	-	-	9	8	-	8	-	1
Diseases of digestive system 520-577	1	1	1	-	-	-	4	3	-	3	-	1
Diseases of genito-urinary system 580-629	2	-	-	-	1	1	4	2	-	2	-	2
Diseases of skin and subcutaneous tissue 680-709	1	-	-	-	-	1	1	-	-	-	1	-
Diseases of musculoskeletal system 710-738	-	-	-	-	-	-	-	-	-	-	-	-
Congenital anomalies	16	10	5	5	2	4	12	10	8	2	1	1
Nervous system 740-743	3	1	-	1	-	2	-	-	-	-	-	-
Circulatory system 746,747	3	3	1	2	-	-	7	7	6	1	-	-
Respiratory system 748	-	-	-	-	-	-	-	-	-	-	-	-
Digestive system 749-751	5	4	4	-	1	-	-	-	-	-	-	-
Genito-urinary system 752,753	2	1	-	1	-	1	-	-	-	-	-	-
Musculoskeletal system 754-756	1	-	-	-	1	-	-	-	-	-	-	-
Down's disease 759.3	2	1	-	1	-	1	4	2	2	-	1	1
Other anomalies 744,745, 757,758, Rest of 759	-	-	-	-	-	-	1	1	-	1	-	-
Certain perinatal causes 760-778	34	34	34	-	-	-	57	57	53	4	-	-
Symptoms 780-789	-	-	-	-	-	-	29	19	1	18	8	2
Sudden death 795	5	5	3	2	-	-	-	-	-	-	-	-
Other ill-defined conditions 790-792,796	-	-	-	-	-	-	1	-	-	-	-	1
External causes E800-E999	6	3	2	1	-	3	3	3	2	1	-	-

DEATH RATES
Rural St. Andrew—JAMAICA

Death Rates from Underlying and Associated Causes in Children Under 5 Years, by Age Group, in Two-Year Period, 1968–1970.

Cause	Underlying cause						Associated cause					
	Under 5 years	Infant deaths			1 year	2-4 years	Under 5 years	Infant deaths			1 year	2-4 years
		Total	Under 28 days	28 days-11 mos.				Total	Under 28 days	28 days-11 mos.		
All causes	948.4	3162.4	1510.0	1652.4	628.7	189.5	1515.0	4957.3	2279.2	2678.1	1287.4	234.1
Infective and parasitic diseases	222.8	655.3	199.4	455.8	299.4	22.3	197.3	569.8	85.5	484.3	269.5	22.3
Amebiasis 006	-	-	-	-	-	-	-	-	-	-	-	-
Diarrheal disease 009	165.5	484.3	57.0	427.4	269.5	-	108.2	370.4	-	370.4	89.8	11.1
Other intestinal infectious diseases 000-005,007,008	-	-	-	-	-	-	6.4	-	-	-	29.9	-
Tuberculosis 010-019	-	-	-	-	-	-	-	-	-	-	-	-
Diphtheria 032	-	-	-	-	-	-	-	-	-	-	-	-
Whooping cough 033	6.4	28.5	-	28.5	-	-	6.4	-	-	-	29.9	-
Tetanus 037	12.7	57.0	57.0	-	-	-	-	-	-	-	-	-
Septicemia 038	19.1	85.5	85.5	-	-	-	38.2	114.0	85.5	28.5	29.9	11.1
Measles 055	-	-	-	-	-	-	-	-	-	-	-	-
Congenital syphilis 090	-	-	-	-	-	-	-	-	-	-	-	-
Moniliasis 112	-	-	-	-	-	-	19.1	57.0	-	57.0	29.9	-
Helminthiases 120-129	19.1	-	-	-	29.9	22.3	12.7	-	-	-	59.9	-
Other Rest of 000-136	-	-	-	-	-	-	6.4	28.5	-	28.5	-	-
Malignant neoplasms 140-209	6.4	-	-	-	-	11.1	-	-	-	-	-	-
Neoplasms, other 210-239	-	-	-	-	-	-	-	-	-	-	-	-
Nutritional deficiency	133.7	455.8	-	455.8	149.7	-	267.3	598.3	28.5	569.8	389.2	89.2
Vitamin deficiency 260-266	6.4	-	-	-	29.9	-	-	-	-	-	-	-
Protein malnutrition 267	89.1	284.9	-	284.9	119.8	-	50.9	114.0	-	114.0	119.8	-
Nutritional marasmus 268	38.2	170.9	-	170.9	-	-	89.1	256.4	28.5	227.9	89.8	22.3
Other 269	-	-	-	-	-	-	127.3	227.9	-	227.9	179.6	66.9
Endocrine and metabolic diseases 240-258,270-279	6.4	28.5	-	28.5	-	-	-	-	-	-	-	-
Deficiency anemias 280,281	-	-	-	-	-	-	25.5	85.5	57.0	28.5	29.9	-
Other diseases of blood and blood-forming organs 282-289	-	-	-	-	-	-	19.1	85.5	-	85.5	-	-
Inflammatory diseases of central nervous system 320-324	31.8	57.0	-	57.0	59.9	11.1	19.1	57.0	28.5	28.5	29.9	-
Other diseases of nervous system and sense organs 310-315,330-389	6.4	-	-	-	-	11.1	12.7	-	-	-	59.9	-
Diseases of circulatory system 390-458	-	-	-	-	-	-	31.8	85.5	-	85.5	59.9	-
Pneumonia and influenza 470-486	120.9	427.4	28.5	398.9	29.9	33.4	178.2	569.8	256.4	313.4	149.7	33.4
Other diseases of respiratory system 460-466,490-519	6.4	28.5	-	28.5	-	-	57.3	227.9	-	227.9	-	11.1
Diseases of digestive system 520-577	6.4	28.5	28.5	-	-	-	25.5	85.5	-	85.5	-	11.1
Diseases of genito-urinary system 580-629	12.7	-	-	-	29.9	11.1	25.5	57.0	-	57.0	-	22.3
Diseases of in and subcutaneous tissue 680-709	6.4	-	-	-	-	11.1	6.4	-	-	-	29.9	-
Diseases of musculoskeletal system 710-738	-	-	-	-	-	-	-	-	-	-	-	-
Congenital anomalies	101.8	284.9	142.5	142.5	59.9	44.6	76.4	284.9	227.9	57.0	29.9	11.1
Nervous system 740-743	19.1	28.5	-	28.5	-	22.3	-	-	-	-	-	-
Circulatory system 746,747	19.1	85.5	28.5	57.0	-	-	44.6	199.4	170.9	28.5	-	-
Respiratory system 748	-	-	-	-	-	-	-	-	-	-	-	-
Digestive system 749-751	31.8	114.0	114.0	-	29.9	-	-	-	-	-	-	-
Genito-urinary system 752,753	12.7	28.5	-	28.5	-	11.1	-	-	-	-	-	-
Musculoskeletal system 754-756	6.4	-	-	-	29.9	-	-	-	-	-	-	-
Down's disease 759.3	12.7	28.5	-	28.5	-	11.1	25.5	57.0	57.0	-	29.9	11.1
Other anomalies 744,745, 757,758, Rest of 759	-	-	-	-	-	-	6.4	28.5	-	28.5	-	-
Certain perinatal causes 760-778	216.4	968.7	968.7	-	-	-	362.8	1623.9	1510.0	114.0	-	-
Symptoms 780-789	-	-	-	-	-	-	184.6	541.3	28.5	512.8	239.5	22.3
Sudden death 795	31.8	142.5	85.5	57.0	-	-	-	-	-	-	-	-
Other ill-defined conditions 790-792,796	-	-	-	-	-	-	6.4	-	-	-	-	11.1
External causes E800-E999	38.2	85.5	57.0	28.5	-	33.4	19.1	85.5	57.0	28.5	-	-

DEATHS
MEXICO—Monterrey

Underlying and Associated Causes of Death in Children Under 5 Years, by Age Group, in Two-Year Period, 1968–1970.

Cause	Underlying cause						Associated cause					
	Under 5 years	Infant deaths			1 year	2–4 years	Under 5 years	Infant deaths			1 year	2–4 years
		Total	Under 28 days	28 days–11 mos.				Total	Under 28 days	28 days–11 mos.		
All causes	3953	3220	1377	1843	421	312	7530	5859	2178	3681	967	704
Infective and parasitic diseases	1790	1364	226	1138	253	173	1216	770	207	563	250	196
Amebiasis 006	156	110	8	102	22	24	41	22	3	19	13	6
Diarrheal disease 009	1063	950	130	820	75	38	426	243	51	192	113	70
Other intestinal infectious diseases 000–005,007,008	56	50	14	36	3	3	30	19	4	15	6	5
Tuberculosis 010–019	62	17	-	17	21	24	42	13	-	13	12	17
Diphtheria 032	3	-	-	-	-	3	-	-	-	-	-	-
Whooping cough 033	26	14	-	14	8	4	1	-	-	-	1	-
Tetanus 037	14	14	14	-	-	-	-	-	-	-	-	-
Septicemia 038	68	65	55	10	2	1	450	367	129	238	47	36
Measles 055	297	120	-	120	113	64	35	9	-	9	15	11
Congenital syphilis 090	2	2	1	1	-	-	2	1	-	1	-	1
Moniliasis 112	4	4	4	-	-	-	84	77	19	58	3	4
Helminthiases 120–129	8	-	-	-	4	4	80	9	-	9	32	39
Other Rest of 000–136	31	18	-	18	5	8	25	10	1	9	8	7
Malignant neoplasms 140–209	12	1	-	1	2	9	1	-	-	-	-	1
Neoplasms, other 210–239	5	-	-	-	3	2	1	1	-	1	-	-
Nutritional deficiency	91	44	1	43	28	19	1337	959	49	910	219	159
Vitamin deficiency 260–266	-	-	-	-	-	-	-	-	-	-	-	-
Protein malnutrition 267	49	10	-	10	25	14	91	24	-	24	38	29
Nutritional marasmus 268	23	18	-	18	2	3	259	185	3	182	38	36
Other 269	19	16	1	15	1	2	987	750	46	704	143	94
Endocrine and metabolic diseases 240–258,270–279	3	2	-	2	-	1	5	5	3	2	-	-
Deficiency anemias 280,281	-	-	-	-	-	-	20	14	7	7	3	3
Other diseases of blood and blood-forming organs 282–289	2	-	-	-	1	1	68	42	2	40	13	13
Inflammatory diseases of central nervous system 320–324	59	48	5	43	8	3	143	105	31	74	31	7
Other diseases of nervous system and sense organs 310–315,330–389	38	26	2	24	5	7	93	60	9	51	18	15
Diseases of circulatory system 390–458	4	3	-	3	-	1	105	72	10	62	18	15
Pneumonia and influenza 470–486	481	415	133	282	46	20	1279	934	214	720	204	141
Other diseases of respiratory system 460–466,490–519	161	108	6	102	34	19	90	51	4	47	25	14
Diseases of digestive system 520–577	14	12	3	9	-	2	190	143	29	114	18	29
Diseases of genito-urinary system 580–629	19	11	-	11	1	7	115	95	10	85	10	10
Diseases of skin and subcutaneous tissue 680–709	19	15	7	8	4	-	56	43	15	28	10	3
Diseases of musculoskeletal system 710–738	-	-	-	-	-	-	1	1	-	1	-	-
Congenital anomalies	253	227	121	106	13	13	140	126	60	66	6	8
Nervous system 740–743	91	80	53	27	5	6	16	15	12	3	-	1
Circulatory system 746,747	82	74	25	49	5	3	41	36	12	24	2	3
Respiratory system 748	3	2	2	-	-	1	2	2	-	2	-	-
Digestive system 749–751	47	42	27	15	3	2	19	18	7	11	-	1
Genito-urinary system 752,753	3	3	1	2	-	-	8	7	5	2	-	1
Musculoskeletal system 754–756	4	4	3	1	-	-	8	7	5	2	1	-
Down's disease 759.3	13	12	2	10	-	1	40	35	14	21	3	2
Other anomalies 744,745, 757,758, Rest of 759	10	10	8	2	-	-	6	6	5	1	-	-
Certain perinatal causes 760–778	812	812	804	8	-	-	1390	1390	1354	36	-	-
Symptoms 780–789	13	11	4	7	1	1	1199	986	159	827	132	81
Sudden death 795	26	25	2	23	1	-	-	-	-	-	-	-
Other ill-defined conditions 790–792,796	82	72	57	15	4	6	1	1	-	1	-	-
External causes E800–E999	69	24	6	18	17	28	80	61	15	46	10	9

DEATH RATES
Monterrey—MEXICO

Death Rates from Underlying and Associated Causes in Children Under 5 Years, by Age Group, in Two-Year Period, 1968–1970.

Cause	Underlying cause						Associated cause					
	Under 5 years	Infant deaths			1 year	2-4 years	Under 5 years	Infant deaths			1 year	2-4 years
		Total	Under 28 days	28 days-11 mos.				Total	Under 28 days	28 days-11 mos.		
All causes	1813.8	6074.3	2597.6	3476.7	935.1	250.0	3455.1	11052.6	4108.7	6944.0	2147.9	564.1
Infective and parasitic diseases	821.3	2573.1	426.3	2146.8	562.0	138.6	558.0	1452.6	390.5	1062.1	555.3	157.1
Amebiasis 006	71.6	207.5	15.1	192.4	48.9	19.2	18.8	41.5	5.7	35.8	28.9	4.8
Diarrheal disease 009	487.7	1792.1	245.2	1546.9	166.6	30.4	195.5	458.4	96.2	362.2	251.0	56.1
Other intestinal infectious diseases 000-005,007,008	25.7	94.3	26.4	67.9	6.7	2.4	13.8	35.8	7.5	28.3	13.3	4.0
Tuberculosis 010-019	28.4	32.1	-	32.1	46.6	19.2	19.3	24.5	-	24.5	26.7	13.6
Diphtheria 032	1.4	-	-	-	-	2.4	-	-	-	-	-	-
Whooping cough 033	11.9	26.4	-	26.4	17.8	3.2	0.5	-	-	-	2.2	-
Tetanus 037	6.4	26.4	26.4	-	-	-	-	-	-	-	-	-
Septicemia 038	31.2	122.6	103.8	18.9	4.4	0.8	206.5	692.3	243.4	449.0	104.4	28.8
Measles 055	136.3	226.4	-	226.4	251.0	51.3	16.1	17.0	-	17.0	33.3	8.8
Congenital syphilis 090	0.9	3.8	1.9	1.9	-	-	0.9	1.9	-	1.9	-	0.8
Moniliasis 112	1.8	7.5	7.5	-	-	-	38.5	145.3	35.8	109.4	6.7	3.2
Helminthiases 120-129	3.7	-	-	-	8.9	3.2	36.7	17.0	-	17.0	71.1	31.2
Other Rest of 000-136	14.2	34.0	-	34.0	11.1	6.4	11.5	18.9	1.9	17.0	17.8	5.6
Malignant neoplasms 140-209	5.5	1.9	-	1.9	4.4	7.2	0.5	-	-	-	-	0.8
Neoplasms, other 210-239	2.3	-	-	-	6.7	1.6	0.5	1.9	-	1.9	-	-
Nutritional deficiency	41.8	83.0	1.9	81.1	62.2	15.2	613.5	1809.1	92.4	1716.7	486.5	127.4
Vitamin deficiency 260-266	-	-	-	-	-	-	-	-	-	-	-	-
Protein malnutrition 267	22.5	18.9	-	18.9	55.5	11.2	41.8	45.3	-	45.3	84.4	23.2
Nutritional marasmus 268	10.6	34.0	-	34.0	4.4	2.4	118.8	349.0	5.7	343.3	84.4	28.8
Other 269	8.7	30.2	1.9	28.3	2.2	1.6	452.9	1414.8	86.8	1328.1	317.6	75.3
Endocrine and metabolic diseases 240-258,270-279	1.4	3.8	-	3.8	-	0.8	2.3	9.4	5.7	3.8	-	-
Deficiency anemias 280,281	-	-	-	-	-	-	9.2	26.4	13.2	13.2	6.7	2.4
Other diseases of blood and blood-forming organs 282-289	0.9	-	-	-	2.2	0.8	31.2	79.2	3.8	75.5	28.9	10.4
Inflammatory diseases of central nervous system 320-324	27.1	90.5	9.4	81.1	17.8	2.4	65.6	198.1	58.5	139.6	68.9	5.6
Other diseases of nervous system and sense organs 310-315,330-389	17.4	49.0	3.8	45.3	11.1	5.6	42.7	113.2	17.0	96.2	40.0	12.0
Diseases of circulatory system 390-458	1.8	5.7	-	5.7	-	0.8	48.2	135.8	18.9	117.0	40.0	12.0
Pneumonia and influenza 470-486	220.7	782.9	250.9	532.0	102.2	16.0	586.9	1761.9	403.7	1358.2	453.1	113.0
Other diseases of respiratory system 460-466,490-519	73.9	203.7	11.3	192.4	75.5	15.2	41.3	96.2	7.5	88.7	55.5	11.2
Diseases of digestive system 520-577	6.4	22.6	5.7	17.0	-	1.6	87.2	269.8	54.7	215.1	40.0	23.2
Diseases of genito-urinary system 580-629	8.7	20.8	-	20.8	2.2	5.6	52.8	179.2	18.9	160.3	22.2	8.0
Diseases of skin and subcutaneous tissue 680-709	8.7	28.3	13.2	15.1	8.9	-	25.7	81.1	28.3	52.8	22.2	2.4
Diseases of musculoskeletal system 710-738	-	-	-	-	-	-	0.5	1.9	-	1.9	-	-
Congenital anomalies	116.1	428.2	228.3	200.0	28.9	10.4	64.2	237.7	113.2	124.5	13.3	6.4
Nervous system 740-743	41.8	150.9	100.0	50.9	11.1	4.8	7.3	28.3	22.6	5.7	-	0.8
Circulatory system 746,747	37.6	139.6	47.2	92.4	11.1	2.4	18.8	67.9	22.6	45.3	4.4	2.4
Respiratory system 748	1.4	3.8	3.8	-	-	0.8	0.9	3.8	-	3.8	-	-
Digestive system 749-751	21.6	79.2	50.9	28.3	6.7	1.6	8.7	34.0	13.2	20.8	-	0.8
Genito-urinary system 752,753	1.4	5.7	1.9	3.8	-	-	3.7	13.2	9.4	3.8	-	0.8
Musculoskeletal system 754-756	1.8	7.5	5.7	1.9	-	-	3.7	13.2	9.4	3.8	2.2	-
Down's disease 759.3	6.0	22.6	3.8	18.9	-	0.8	18.4	66.0	26.4	39.6	6.7	1.6
Other anomalies 744,745, 757,758, Rest of 759	4.6	18.9	15.1	3.8	-	-	2.8	11.3	9.4	1.9	-	-
Certain perinatal causes 760-778	372.6	1531.8	1516.7	15.1	-	-	637.8	2622.1	2554.2	67.9	-	-
Symptoms 780-789	6.0	20.8	7.5	13.2	2.2	0.8	550.2	1860.0	299.9	1560.1	293.2	64.9
Sudden death 795	11.9	47.2	3.8	43.4	2.2	-	-	-	-	-	-	-
Other ill-defined conditions 790-792,796	37.6	135.8	107.5	28.3	8.9	4.8	0.5	1.9	-	1.9	-	-
External causes E800-E999	31.7	45.3	11.3	34.0	37.8	22.4	36.7	115.1	28.3	86.8	22.2	7.2

DEATHS
UNITED STATES—California, San Francisco

Underlying and Associated Causes of Death in Children Under 5 Years, by Age Group, in One Year, 1969–1970.

Cause	Underlying cause						Associated cause					
	Under 5 years	Infant deaths			1 year	2-4 years	Under 5 years	Infant deaths			1 year	2-4 years
		Total	Under 28 days	28 days–11 mos.				Total	Under 28 days	28 days–11 mos.		
All causes	234	209	147	62	8	17	377	356	300	56	8	13
Infective and parasitic diseases	17	16	8	8	-	1	14	13	7	6	-	1
Amebiasis ... 006	-	-	-	-	-	-	-	-	-	-	-	-
Diarrheal disease ... 009	9	9	2	7	-	-	2	1	-	1	-	1
Other intestinal infectious diseases ... 000-005,007,008	-	-	-	-	-	-	-	-	-	-	-	-
Tuberculosis ... 010-019	-	-	-	-	-	-	-	-	-	-	-	-
Diphtheria ... 032	-	-	-	-	-	-	-	-	-	-	-	-
Whooping cough ... 033	-	-	-	-	-	-	-	-	-	-	-	-
Tetanus ... 037	-	-	-	-	-	-	-	-	-	-	-	-
Septicemia ... 038	2	2	2	-	-	-	11	11	7	4	-	-
Measles ... 055	1	-	-	-	-	1	-	-	-	-	-	-
Congenital syphilis ... 090	-	-	-	-	-	-	-	-	-	-	-	-
Moniliasis ... 112	-	-	-	-	-	-	1	1	-	1	-	-
Helminthiases ... 120-129	-	-	-	-	-	-	-	-	-	-	-	-
Other ... Rest of 000-136	5	5	4	1	-	-	-	-	-	-	-	-
Malignant neoplasms ... 140-209	3	-	-	-	-	3	-	-	-	-	-	-
Neoplasms, other ... 210-239	-	-	-	-	-	-	-	-	-	-	-	-
Nutritional deficiency	-	-	-	-	-	-	10	7	-	7	1	2
Vitamin deficiency ... 260-266	-	-	-	-	-	-	-	-	-	-	-	-
Protein malnutrition ... 267	-	-	-	-	-	-	-	-	-	-	-	-
Nutritional marasmus ... 268	-	-	-	-	-	-	-	-	-	-	-	-
Other ... 269	-	-	-	-	-	-	10	7	-	7	1	2
Endocrine and metabolic diseases ... 240-258,270-279	3	2	-	2	1	-	1	1	1	-	-	-
Deficiency anemias ... 280,281	-	-	-	-	-	-	-	-	-	-	-	-
Other diseases of blood and blood-forming organs ... 282-289	1	1	1	-	-	-	3	2	-	2	1	-
Inflammatory diseases of central nervous system ... 320-324	3	2	-	2	1	-	4	4	2	2	-	-
Other diseases of nervous system and sense organs ... 310-315,330-389	6	5	1	4	-	1	2	2	-	2	-	-
Diseases of circulatory system ... 390-458	-	-	-	-	-	-	7	4	1	3	1	2
Pneumonia and influenza . 470-486	34	32	6	26	1	1	26	21	11	10	2	3
Other diseases of respiratory system ... 460-466,490-519	2	1	-	1	-	1	5	3	-	3	-	2
Diseases of digestive system ... 520-577	1	1	1	-	-	-	5	4	4	-	-	1
Diseases of genito-urinary system ... 580-629	1	-	-	-	-	1	-	-	-	-	-	-
Diseases of skin and subcutaneous tissue ... 680-709	-	-	-	-	-	-	-	-	-	-	-	-
Diseases of musculoskeletal system ... 710-738	-	-	-	-	-	-	-	-	-	-	-	-
Congenital anomalies	34	32	24	8	1	1	59	57	43	14	2	-
Nervous system ... 740-743	11	10	9	1	-	1	4	4	4	-	-	-
Circulatory system ... 746,747	10	9	5	4	1	-	18	17	10	7	1	-
Respiratory system ... 748	4	4	4	-	-	-	2	2	2	-	-	-
Digestive system ... 749-751	3	3	2	1	-	-	5	5	4	1	-	-
Genito-urinary system . 752,753	2	2	2	-	-	-	13	13	12	1	-	-
Musculoskeletal system . 754-756	-	-	-	-	-	-	6	6	6	-	-	-
Down's disease ... 759.3	1	1	-	1	-	-	10	9	4	5	1	-
Other anomalies ... 744,745, 757,758, Rest of 759	3	3	2	1	-	-	1	1	1	-	-	-
Certain perinatal causes ... 760-778	106	106	106	-	-	-	231	231	229	2	-	-
Symptoms ... 780-789	-	-	-	-	-	-	2	2	-	2	-	-
Sudden death ... 795	-	-	-	-	-	-	-	-	-	-	-	-
Other ill-defined conditions ... 790-792,796	-	-	-	-	-	-	-	-	-	-	-	-
External causes ... E800-E999	23	11	-	11	4	8	8	5	2	3	1	2

DEATH RATES
San Francisco, California—UNITED STATES

Death Rates from Underlying and Associated Causes in Children Under 5 Years, by Age Group, in One Year, 1969–1970.

Cause	Underlying cause						Associated cause					
	Under 5 years	Infant deaths			1 year	2-4 years	Under 5 years	Infant deaths			1 year	2-4 years
		Total	Under 28 days	28 days-11 mos.				Total	Under 28 days	28 days-11 mos.		
All causes	543.6	1847.9	1299.7	548.2	94.1	70.0	875.7	3147.7	2652.5	495.1	94.1	53.5
Infective and parasitic diseases	39.5	141.5	70.7	70.7	-	4.1	32.5	114.9	61.9	53.1	-	4.1
Amebiasis 006	-	-	-	-	-	-	-	-	-	-	-	-
Diarrheal disease 009	20.9	79.6	17.7	61.9	-	-	4.6	8.8	-	8.8	-	4.1
Other intestinal infectious diseases 000-005,007,008	-	-	-	-	-	-	-	-	-	-	-	-
Tuberculosis 010-019	-	-	-	-	-	-	-	-	-	-	-	-
Diphtheria 032	-	-	-	-	-	-	-	-	-	-	-	-
Whooping cough 033	-	-	-	-	-	-	-	-	-	-	-	-
Tetanus 037	-	-	-	-	-	-	-	-	-	-	-	-
Septicemia 038	4.6	17.7	17.7	-	-	-	25.6	97.3	61.9	35.4	-	-
Measles 055	2.3	-	-	-	-	4.1	-	-	-	-	-	-
Congenital syphilis 090	-	-	-	-	-	-	-	-	-	-	-	-
Moniliasis 112	-	-	-	-	-	-	2.3	8.8	-	8.8	-	-
Helminthiases 120-129	-	-	-	-	-	-	-	-	-	-	-	-
Other Rest of 000-136	11.6	44.2	35.4	8.8	-	-	-	-	-	-	-	-
Malignant neoplasms 140-209	7.0	-	-	-	-	12.3	-	-	-	-	-	-
Neoplasms, other 210-239	-	-	-	-	-	-	-	-	-	-	-	-
Nutritional deficiency	-	-	-	-	-		23.2	61.9	-	61.9	11.8	8.2
Vitamin deficiency 260-266	-	-	-	-	-	-	-	-	-	-	-	-
Protein malnutrition 267	-	-	-	-	-	-	-	-	-	-	-	-
Nutritional marasmus 268	-	-	-	-	-	-	-	-	-	-	-	-
Other 269	-	-	-	-	-	-	23.2	61.9	-	61.9	11.8	8.2
Endocrine and metabolic diseases 240-258,270-279	7.0	17.7	-	17.7	11.8	-	2.3	8.8	8.8	-	-	-
Deficiency anemias 280,281	-	-	-	-	-	-	-	-	-	-	-	-
Other diseases of blood and blood-forming organs 282-289	2.3	8.8	8.8	-	-	-	7.0	17.7	-	17.7	11.8	-
Inflammatory diseases of central nervous system 320-324	7.0	17.7	-	17.7	11.8	-	9.3	35.4	17.7	17.7	-	-
Other diseases of nervous system and sense organs 310-315,330-389	13.9	44.2	8.8	35.4	-	4.1	4.6	17.7	-	17.7	-	-
Diseases of circulatory system 390-458	-	-	-	-	-	-	16.3	35.4	8.8	26.5	11.8	8.2
Pneumonia and influenza 470-486	79.0	282.9	53.1	229.9	11.8	4.1	60.4	185.7	97.3	88.4	23.5	12.3
Other diseases of respiratory system 460-466,490-519	4.6	8.8	-	8.8	-	4.1	11.6	26.5	-	26.5	-	8.2
Diseases of digestive system 520-577	2.3	8.8	8.8	-	-	-	11.6	35.4	35.4	-	-	4.1
Diseases of genito-urinary system 580-629	2.3	-	-	-	-	4.1	-	-	-	-	-	-
Diseases of skin and subcutaneous tissue 680-709	-	-	-	-	-	-	-	-	-	-	-	-
Diseases of musculoskeletal system 710-738	-	-	-	-	-	-	-	-	-	-	-	-
Congenital anomalies	79.0	282.9	212.2	70.7	11.8	4.1	137.0	504.0	380.2	123.8	23.5	-
Nervous system 740-743	25.6	88.4	79.6	8.8	-	4.1	9.3	35.4	35.4	-	-	-
Circulatory system 746,747	23.2	79.6	44.2	35.4	11.8	-	41.8	150.3	88.4	61.9	11.8	-
Respiratory system 748	9.3	35.4	35.4	-	-	-	4.6	17.7	17.7	-	-	-
Digestive system 749-751	7.0	26.5	17.7	8.8	-	-	11.6	44.2	35.4	8.8	-	-
Genito-urinary system 752,753	4.6	17.7	17.7	-	-	-	30.2	114.9	106.1	8.8	-	-
Musculoskeletal system 754-756	-	-	-	-	-	-	13.9	53.1	53.1	-	-	-
Down's disease 759.3	2.3	8.8	-	8.8	-	-	23.2	79.6	35.4	44.2	11.8	-
Other anomalies 744,745, 757,758, Rest of 759	7.0	26.5	17.7	8.8	-	-	2.3	8.8	8.8	-	-	-
Certain perinatal causes 760-778	246.2	937.2	937.2	-	-	-	536.6	2042.4	2024.8	17.7	-	-
Symptoms 780-789	-	-	-	-	-	-	4.6	17.7	-	17.7	-	-
Sudden death 795	-	-	-	-	-	-	-	-	-	-	-	-
Other ill-defined conditions 790-792,796	-	-	-	-	-	-	-	-	-	-	-	-
External causes E800-E999	53.4	97.3	-	97.3	47.1	32.9	18.6	44.2	17.7	26.5	11.8	8.2

DEATHS
UNITED STATES—California, Suburban Counties

Underlying and Associated Causes of Death in Children Under 5 Years, by Age Group, in One Year, 1969–1970.

Cause	Underlying cause						Associated cause					
	Under 5 years	Infant deaths			1 year	2–4 years	Under 5 years	Infant deaths			1 year	2–4 years
		Total	Under 28 days	28 days–11 mos.				Total	Under 28 days	28 days–11 mos.		
All causes	664	575	423	152	25	64	1093	997	863	134	31	65
Infective and parasitic diseases	31	27	8	19	1	3	43	36	25	11	-	7
Amebiasis 006	-	-	-	-	-	-	-	-	-	-	-	-
Diarrheal disease 009	3	3	-	3	-	-	5	5	3	2	-	-
Other intestinal infectious diseases 000–005,007,008	-	-	-	-	-	-	-	-	-	-	-	-
Tuberculosis 010–019	-	-	-	-	-	-	-	-	-	-	-	-
Diphtheria 032	-	-	-	-	-	-	-	-	-	-	-	-
Whooping cough 033	1	1	-	1	-	-	-	-	-	-	-	-
Tetanus 037	-	-	-	-	-	-	-	-	-	-	-	-
Septicemia 038	10	10	6	4	-	-	37	30	21	9	-	7
Measles 055	-	-	-	-	-	-	-	-	-	-	-	-
Congenital syphilis 090	-	-	-	-	-	-	-	-	-	-	-	-
Moniliasis 112	-	-	-	-	-	-	1	1	1	-	-	-
Helminthiases 120–129	-	-	-	-	-	-	-	-	-	-	-	-
Other Rest of 000–136	17	13	2	11	1	3	-	-	-	-	-	-
Malignant neoplasms 140–209	14	1	-	1	2	11	-	-	-	-	-	-
Neoplasms, other 210–239	1	1	-	1	-	-	1	1	-	1	-	-
Nutritional deficiency	-	-	-	-	-	-	34	14	-	14	7	13
Vitamin deficiency 260–266	-	-	-	-	-	-	-	-	-	-	-	-
Protein malnutrition 267	-	-	-	-	-	-	-	-	-	-	-	-
Nutritional marasmus 268	-	-	-	-	-	-	5	2	-	2	2	1
Other 269	-	-	-	-	-	-	29	12	-	12	5	12
Endocrine and metabolic diseases 240–258,270–279	1	-	-	-	-	1	8	4	1	3	1	3
Deficiency anemias 280,281	-	-	-	-	-	-	-	-	-	-	-	-
Other diseases of blood and blood-forming organs 282–289	2	-	-	-	-	2	1	1	1	-	-	-
Inflammatory diseases of central nervous system 320–324	8	4	2	2	-	4	18	13	11	2	2	3
Other diseases of nervous system and sense organs 310–315,330–389	8	4	-	4	2	2	6	3	1	2	2	1
Diseases of circulatory system 390–458	2	1	-	1	1	-	29	19	3	16	3	7
Pneumonia and influenza 470–486	43	41	7	34	1	1	67	54	33	21	8	5
Other diseases of respiratory system 460–466,490–519	3	3	-	3	-	-	11	6	1	5	2	3
Diseases of digestive system 520–577	9	7	5	2	-	2	24	19	11	8	1	4
Diseases of genito-urinary system 580–629	1	1	1	-	-	-	9	4	2	2	2	3
Diseases of skin and subcutaneous tissue 680–709	-	-	-	-	-	-	1	1	-	1	-	-
Diseases of musculoskeletal system 710–738	-	-	-	-	-	-	-	-	-	-	-	-
Congenital anomalies	134	115	81	34	7	12	172	158	127	31	1	13
Nervous system 740–743	28	22	16	6	2	4	4	4	4	-	-	-
Circulatory system 746,747	55	47	30	17	2	6	100	93	72	21	-	7
Respiratory system 748	9	9	8	1	-	-	8	8	8	-	-	-
Digestive system 749–751	13	12	8	4	-	1	15	12	8	4	-	3
Genito-urinary system 752,753	9	8	6	2	1	-	26	25	21	4	-	1
Musculoskeletal system 754–756	8	8	7	1	-	-	7	7	6	1	-	-
Down's disease 759.3	3	2	1	1	1	1	5	3	2	1	1	1
Other anomalies 744,745, 757,758, Rest of 759	8	7	5	2	1	-	7	6	6	-	-	1
Certain perinatal causes 760–778	321	321	318	3	-	-	653	653	643	10	-	-
Symptoms 780–789	2	1	-	1	1	-	3	3	1	2	-	-
Sudden death 795	37	37	-	37	-	-	-	-	-	-	-	-
Other ill-defined conditions 790–792,796	1	-	-	-	-	1	-	-	-	-	-	-
External causes E800–E999	46	11	1	10	10	25	13	8	3	5	2	3

DEATH RATES
Suburban Counties, California—UNITED STATES

Death Rates from Underlying and Associated Causes in Children Under 5 Years, by Age Group, in One Year, 1969–1970.

Cause	Underlying cause						Associated cause					
	Under 5 years	Infant deaths			1 year	2-4 years	Under 5 years	Infant deaths			1 year	2-4 years
		Total	Under 28 days	28 days-11 mos.				Total	Under 28 days	28 days-11 mos.		
All causes	413.4	1720.0	1265.3	454.7	79.3	66.2	680.5	2982.4	2581.5	400.8	98.3	67.3
Infective and parasitic diseases	19.3	80.8	23.9	56.8	3.2	3.1	26.8	107.7	74.8	32.9	-	7.2
Amebiasis 006	-	-	-	-	-	-	-	-	-	-	-	-
Diarrheal disease 009	1.9	9.0	-	9.0	-	-	3.1	15.0	9.0	6.0	-	-
Other intestinal infectious diseases 000-005,007,008	-	-	-	-	-	-	-	-	-	-	-	-
Tuberculosis 010-019	-	-	-	-	-	-	-	-	-	-	-	-
Diphtheria 032	-	-	-	-	-	-	-	-	-	-	-	-
Whooping cough 033	0.6	3.0	-	3.0	-	-	-	-	-	-	-	-
Tetanus 037	-	-	-	-	-	-	-	-	-	-	-	-
Septicemia 038	6.2	29.9	17.9	12.0	-	-	23.0	89.7	62.8	26.9	-	7.2
Measles 055	-	-	-	-	-	-	-	-	-	-	-	-
Congenital syphilis 090	-	-	-	-	-	-	-	-	-	-	-	-
Moniliasis 112	-	-	-	-	-	-	0.6	3.0	3.0	-	-	-
Helminthiases 120-129	-	-	-	-	-	-	-	-	-	-	-	-
Other Rest of 000-136	10.6	38.9	6.0	32.9	3.2	3.1	-	-	-	-	-	-
Malignant neoplasms 140-209	8.7	3.0	-	3.0	6.3	11.4	-	-	-	-	-	-
Neoplasms, other 210-239	0.6	3.0	-	3.0	-	-	0.6	3.0	-	3.0	-	-
Nutritional deficiency	-	-	-	-	-	-	21.2	41.9	-	41.9	22.2	13.5
Vitamin deficiency 260-266	-	-	-	-	-	-	-	-	-	-	-	-
Protein malnutrition 267	-	-	-	-	-	-	-	-	-	-	-	-
Nutritional marasmus 268	-	-	-	-	-	-	3.1	6.0	-	6.0	6.3	1.0
Other 269	-	-	-	-	-	-	18.1	35.9	-	35.9	15.9	12.4
Endocrine and metabolic diseases 240-258,270-279	0.6	-	-	-	-	1.0	5.0	12.0	3.0	9.0	3.2	3.1
Deficiency anemias 280,281	-	-	-	-	-	-	-	-	-	-	-	-
Other diseases of blood and blood-forming organs 282-289	1.2	-	-	-	-	2.1	0.6	3.0	3.0	-	-	-
Inflammatory diseases of central nervous system 320-324	5.0	12.0	6.0	6.0	-	4.1	11.2	38.9	32.9	6.0	6.3	3.1
Other diseases of nervous system and sense organs 310-315,330-389	5.0	12.0	-	12.0	6.3	2.1	3.7	9.0	3.0	6.0	6.3	1.0
Diseases of circulatory system 390-458	1.2	3.0	-	3.0	3.2	-	18.1	56.8	9.0	47.9	9.5	7.2
Pneumonia and influenza 470-486	26.8	122.6	20.9	101.7	3.2	1.0	41.7	161.5	98.7	62.8	25.4	5.2
Other diseases of respiratory system 460-466,490-519	1.9	9.0	-	9.0	-	-	6.8	17.9	3.0	15.0	6.3	3.1
Diseases of digestive system 520-577	5.6	20.9	15.0	6.0	-	2.1	14.9	56.8	32.9	23.9	3.2	4.1
Diseases of genito-urinary system 580-629	0.6	3.0	3.0	-	-	-	5.6	12.0	6.0	6.0	6.3	3.1
Diseases of skin and subcutaneous tissue 680-709	-	-	-	-	-	-	0.6	3.0	-	3.0	-	-
Diseases of musculoskeletal system 710-738	-	-	-	-	-	-	-	-	-	-	-	-
Congenital anomalies	83.4	344.0	242.3	101.7	22.2	12.4	107.1	472.6	379.9	92.7	3.2	13.5
Nervous system 740-743	17.4	65.8	47.9	17.9	6.3	4.1	2.5	12.0	12.0	-	-	-
Circulatory system 746,747	34.2	140.6	89.7	50.9	6.3	6.2	62.3	278.2	215.4	62.8	-	7.2
Respiratory system 748	5.6	26.9	23.9	3.0	-	-	5.0	23.9	23.9	-	-	-
Digestive system 749-751	8.1	35.9	23.9	12.0	-	1.0	9.3	35.9	23.9	12.0	-	3.1
Genito-urinary system 752,753	5.6	23.9	17.9	6.0	3.2	-	16.2	74.8	62.8	12.0	-	1.0
Musculoskeletal system 754-756	5.0	23.9	20.9	3.0	-	-	4.4	20.9	17.9	3.0	-	-
Down's disease 759.3	2.5	6.0	3.0	3.0	3.2	1.0	3.1	9.0	6.0	3.0	3.2	1.0
Other anomalies 744,745, 757,758, Rest of 759	5.0	20.9	15.0	6.0	3.2	-	4.4	17.9	17.9	-	-	1.0
Certain perinatal causes 760-778	199.9	960.2	951.2	9.0	-	-	406.6	1953.3	1923.4	29.9	-	-
Symptoms 780-789	1.2	3.0	-	3.0	3.2	-	1.9	9.0	3.0	6.0	-	-
Sudden death 795	23.0	110.7	-	110.7	-	-	-	-	-	-	-	-
Other ill-defined conditions 790-792,796	0.6	-	-	-	-	1.0	-	-	-	-	-	-
External causes E800-E999	28.6	32.9	3.0	29.9	31.7	25.9	8.1	23.9	9.0	15.0	6.3	3.1

APPENDIX 3

LIVE BIRTHS AND NEONATAL DEATHS BY BIRTH WEIGHT, UNITED STATES, 1950 AND 1960

Weight in grams	Live births				Neonatal deaths					
	1950, 3 months		1960		1950, 3 months			1960		
	No.	%	No.	%	No.	Rate[a]	%	No.	Rate[a]	%
Total	837,786	100.0	4,257,850	100.0	16,741	20.0	100.0	78,259	18.4	100.0
1000 or less	3,928	0.5	24,323	0.6	3,424	871.7	20.5	22,202	912.8	28.4
1001-1500	5,081	0.6	27,756	0.7	2,801	551.3	16.7	14,475	521.5	18.5
1501-2000	11,388	1.4	61,905	1.5	2,403	211.0	14.4	11,180	180.6	14.3
2001-2500	41,240	4.9	217,436	5.1	2,078	50.4	12.4	9,002	41.4	11.5
2500 or less	61,637	7.4	331,420	7.8	10,706	173.7	64.0	56,859	171.6	72.7
2501-3000	151,808	18.1	787,037	18.5	1,912	12.6	11.4	7,792	9.9	10.0
3001-3500	315,629	37.7	1,616,543	38.0	2,112	6.7	12.6	7,598	4.7	9.7
3501 or more	308,712	36.8	1,522,850	35.8	2,011	6.5	12.0	6,010	3.9	7.7
2501 or more	776,149	92.6	3,926,430	92.2	6,035	7.8	36.0	21,400	5.4	27.3

[a] Deaths per 1,000 live births.

Sources: Shapiro, S. and J. Unger. *Weight at Birth and Its Effect on Survival of the Newborn.* National Center for Health Statistics, Series 21, No. 3, Washington, D.C., 1965.

Chase, H. C. Infant Mortality and Weight at Birth: 1960 United States Birth Cohort. *American Journal of Public Health*, September 1969. (Vol. 59, No. 9, pp. 1618-1628). The numbers of neonatal deaths were estimated from the data given.

APPENDIX 4

HOME INTERVIEWS OF FAMILIES OF DECEASED CHILDREN UNDER 5 YEARS, BY AGE GROUP, IN 23 AREAS OF 14 PROJECTS[a]

Area	Under 5 years			Neonatal			Postneonatal			1-4 years		
	Total deaths	Families interviewed		Total deaths	Families interviewed		Total deaths	Families interviewed		Total deaths	Families interviewed	
		No.	%		No.	%		No.	%		No.	%
Total	34,197	27,936	81.7	12,104	9,502	78.5	14,714	12,409	84.3	7,379	6,025	81.7
ARGENTINA												
Chaco Province												
Resistencia	864	829	95.9	327	304	93.0	420	409	97.4	117	116	99.1
Rural departments	837	816	97.5	241	235	97.5	422	410	97.2	174	171	98.3
San Juan Province												
San Juan (city)	326	286	87.7	172	149	86.6	123	107	87.0	31	30	96.8
Suburban departments	780	720	92.3	353	314	89.0	343	324	94.5	84	82	97.6
Rural departments	1,050	990	94.3	381	346	90.8	528	509	96.4	141	135	95.7
BOLIVIA												
La Paz	4,115	2,632	64.0	1,049	637	60.7	1,636	1,064	65.0	1,430	931	65.1
Viacha	161	134	83.2	42	38	90.5	63	55	87.3	56	41	73.2
BRAZIL												
Recife	3,635	3,116	85.7	1,073	893	83.2	1,700	1,463	86.1	862	760	88.2
Ribeirão Prêto												
Ribeirão Prêto (city)	464	417	89.9	223	202	90.6	177	160	90.4	64	55	85.9
Franca	434	364	83.9	188	162	86.2	176	143	81.2	70	59	84.3
Communities	228	209	91.7	104	94	90.4	91	83	91.2	33	32	97.0
São Paulo	4,312	3,705	85.9	1,958	1,714	87.5	1,830	1,555	85.0	524	436	83.2
CANADA												
Sherbrooke	371	329	88.7	229	203	88.6	81	73	90.1	61	53	86.9
CHILE												
Santiago	2,489	1,701	68.3	1,094	586	53.6	1,113	888	79.8	282	227	80.5
Comunas	225	195	86.7	66	57	86.4	131	113	86.3	28	25	89.3
COLOMBIA												
Cali	1,627	1,154	70.9	536	382	71.3	617	444	72.0	474	328	69.2
Cartagena	1,255	862	68.7	401	208	51.9	455	356	78.2	399	298	74.7
Medellín	1,348	988	73.3	383	263	68.7	541	398	73.6	424	327	77.1
EL SALVADOR												
San Salvador	2,738	2,650	96.8	722	690	95.6	1,372	1,338	97.5	644	622	96.6
Rural municipios	1,082	1,036	95.7	195	185	94.9	453	440	97.1	434	411	94.7
JAMAICA												
Metropolitan Kingston	1,754	1,565	89.2	937	830	88.6	541	491	90.8	276	244	88.4
St. Andrew, rural	149	147	98.7	53	52	98.1	58	58	100.0	38	37	97.4
MEXICO												
Monterrey	3,953	3,091	78.2	1,377	958	69.6	1,843	1,528	82.9	733	605	82.5

[a] Excludes California project, where procedures did not include home interviews.

APPENDIX 5

NUMBER OF DEATHS BY AGE AND SEX FOR 24 AREAS OF 15 PROJECTS

Age	ARGENTINA, Chaco Province						ARGENTINA, San Juan Province									BOLIVIA		
	Resistencia			Rural departments			San Juan (city)			Suburban departments			Rural departments			La Paz		
	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female
Total	864	456	408	837	430	407	326	169	157	780	412	368	1050	560	490	4115	2209	1906
Under 1 day	117	66	51	69	39	30	52	25	27	109	61	48	97	65	32	305	183	122
1 day	43	22	21	12	7	5	26	16	10	44	27	17	45	26	19	90	49	41
2 days	31	15	16	22	11	11	9	5	4	26	14	12	20	11	9	73	51	22
3 days	18	12	6	24	13	11	10	5	5	13	7	6	24	15	9	48	30	18
4 days	12	8	4	11	6	5	6	4	2	10	8	2	16	9	7	37	24	13
5 days	8	4	4	11	7	4	7	1	6	14	6	8	13	6	7	32	21	11
6 days	7	5	2	14	9	5	9	6	3	15	8	7	12	7	5	23	14	9
7-13 days	41	19	22	32	16	16	28	13	15	61	38	23	78	47	31	181	106	75
14-20 days	37	24	13	22	11	11	17	8	9	39	13	26	49	27	22	181	105	76
21-27 days	13	5	8	24	11	13	8	7	1	22	16	6	27	13	14	79	46	33
0-27 days	327	180	147	241	130	111	172	90	82	353	198	155	381	226	155	1049	629	420
28 days-1 month	60	32	28	51	23	28	34	18	16	48	27	21	81	35	46	277	135	142
2 month	65	33	32	69	32	37	22	14	8	56	30	26	86	39	47	210	109	101
3 months	77	38	39	52	28	24	24	13	11	53	25	28	87	45	42	196	102	94
4 months	44	26	18	52	20	32	13	9	4	47	27	20	81	46	35	144	73	71
5 months	46	28	18	38	17	21	11	3	8	37	13	24	55	31	24	103	59	44
6 months	35	16	19	37	17	20	9	3	6	27	16	11	32	20	12	141	86	55
7 months	26	14	12	28	19	9	3	1	2	23	12	11	30	13	17	115	56	59
8 months	17	6	11	38	20	18	1	-	1	18	9	9	25	15	10	119	58	61
9 months	22	12	10	18	10	8	-	-	-	13	8	5	15	9	6	110	61	49
10 months	16	9	7	23	12	11	4	1	3	9	5	4	20	8	12	113	62	51
11 months	12	7	5	16	12	4	2	1	1	12	4	8	16	5	11	108	61	47
12-14 months	36	19	17	48	21	27	5	2	3	15	4	11	31	19	12	342	170	172
15-17 months	22	9	13	27	17	10	7	5	2	13	8	5	25	12	13	244	115	129
18-20 months	13	7	6	22	12	10	6	3	3	14	8	6	17	9	8	193	103	90
21-23 months	12	6	6	17	8	9	2	1	1	8	1	7	10	5	5	120	56	64
2 years	24	12	12	28	13	15	6	2	4	17	7	10	32	12	20	288	159	129
3 years	7	-	7	14	12	2	3	2	1	13	9	4	16	5	11	155	68	87
4 years	3	2	1	18	7	11	2	1	1	4	1	3	10	6	4	88	47	41

Age	BOLIVIA			BRAZIL			BRAZIL, Ribeirão Prêto									BRAZIL		
	Viacha			Recife			Ribeirão Prêto (city)			Franca			Communities			São Paulo		
Total	161	89	72	3635	1934	1701	464	262	202	434	226	208	228	124	104	4312	2466	1846
Under 1 day	12	8	4	357	193	164	95	54	41	68	42	26	46	26	20	625	363	262
1 day	4	2	2	162	102	60	35	24	11	26	20	6	13	9	4	242	151	91
2 days	10	4	6	90	57	33	14	7	7	8	4	4	6	3	3	95	59	36
3 days	4	3	1	61	36	25	14	9	5	8	3	5	7	2	5	66	44	22
4 days	-	-	-	39	24	15	11	5	6	12	6	6	7	1	6	48	31	17
5 days	1	-	1	29	17	12	4	2	2	5	3	2	4	2	2	49	32	17
6 days	1	-	1	31	21	10	2	1	1	4	2	2	3	2	1	58	30	28
7-13 days	2	-	2	120	54	66	24	10	14	29	17	12	6	3	3	329	208	121
14-20 days	6	5	1	112	64	48	18	10	8	15	9	6	5	4	1	272	174	98
21-27 days	2	-	2	72	42	30	6	4	2	13	6	7	7	6	1	174	91	83
0-27 days	42	22	20	1073	610	463	223	126	97	188	112	76	104	58	46	1958	1183	775
28 days-1 month	8	3	5	304	168	136	48	32	16	33	16	17	14	5	9	450	268	182
2 months	9	5	4	253	136	117	30	16	14	25	11	14	18	11	7	348	205	143
3 months	6	4	2	212	116	96	28	16	12	28	10	18	16	10	6	273	144	129
4 months	4	3	1	161	88	73	18	12	6	22	13	9	17	12	5	196	102	94
5 months	6	5	1	155	83	72	10	5	5	17	10	7	5	4	1	147	83	64
6 months	3	3	-	137	70	67	14	9	5	11	4	7	5	1	4	99	50	49
7 months	6	6	-	100	46	54	9	4	5	15	8	7	5	3	2	98	53	45
8 months	3	1	2	133	65	68	3	3	-	8	3	5	1	-	1	77	41	36
9 months	6	3	3	87	41	46	8	3	5	8	3	5	3	2	1	58	24	34
10 months	4	1	3	84	44	40	3	1	2	4	3	1	2	2	-	45	28	17
11 months	8	4	4	74	39	35	6	5	1	5	2	3	5	1	4	39	21	18
12-14 months	16	9	7	174	83	91	9	4	5	11	5	6	4	1	3	114	59	55
15-17 months	11	6	5	162	76	86	18	10	8	4	1	3	3	-	3	72	36	36
18-20 months	6	3	3	108	62	46	4	2	2	10	5	5	5	3	2	54	21	33
21-23 months	3	2	1	71	35	36	3	1	2	7	1	6	1	-	1	42	19	23
2 years	14	7	7	200	100	100	13	6	7	19	12	7	7	5	2	137	72	65
3 years	6	2	4	96	47	49	11	3	8	11	3	8	8	3	5	66	40	26
4 years	-	-	-	51	25	26	6	4	2	8	4	4	5	3	2	39	17	22

APPENDIX 5 (*cont.*)

NUMBER OF DEATHS BY AGE AND SEX FOR 24 AREAS OF 15 PROJECTS

Age	CANADA			CHILE						COLOMBIA								
	Sherbrooke			Santiago			Commas			Cali			Cartagena			Medellín		
	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female
Total	371	209	162	2489	1426	1063	225	128	97	1627	894	733	1255	662	593	1348	724	624
Under 1 day	146	79	67	403	242	161	22	13	9	220	132	88	146	75	71	136	72	64
1 day	27	15	12	162	87	75	8	4	4	50	26	24	49	30	19	82	44	38
2 days	11	6	5	84	55	29	4	1	3	49	25	24	32	22	10	42	25	17
3 days	8	6	2	67	42	25	3	3	-	42	22	20	20	10	10	18	13	5
4 days	4	-	4	30	20	10	1	1	-	28	12	16	29	16	13	16	7	9
5 days	6	3	3	28	16	12	5	2	3	20	12	8	18	12	6	16	13	3
6 days	6	3	3	27	11	16	1	1	-	20	7	13	14	6	8	5	2	3
7-13 days	13	10	3	123	83	40	9	5	4	39	25	14	44	23	21	36	21	15
14-20 days	4	1	3	104	58	46	6	5	1	44	29	15	26	19	7	19	12	7
21-27 days	4	4	-	66	42	24	7	3	4	24	13	11	23	12	11	13	7	6
0-27 days	229	127	102	1094	656	438	66	38	28	536	303	233	401	225	176	383	216	167
28 days-1 month	17	12	5	243	143	100	26	17	9	91	54	37	64	33	31	71	40	31
2 months	11	6	5	234	142	92	16	9	7	61	31	30	44	21	23	63	30	33
3 months	10	6	4	180	100	80	21	9	12	63	35	28	35	15	20	69	38	31
4 months	15	7	8	133	77	56	19	12	7	61	33	28	50	33	17	54	27	27
5 months	6	5	1	79	43	36	11	8	3	65	43	22	32	18	14	45	22	23
6 months	10	6	4	73	37	36	14	8	6	54	29	25	40	28	12	48	24	24
7 months	2	1	1	66	33	33	6	2	4	58	31	27	53	26	27	39	26	13
8 months	1	1	-	37	15	22	7	5	2	48	28	20	34	14	20	44	23	21
9 months	5	2	3	31	18	13	3	-	3	45	24	21	34	18	16	43	24	19
10 months	3	2	1	12	8	4	5	3	2	37	16	21	34	11	23	36	18	18
11 months	1	-	1	25	11	14	3	2	1	34	17	17	35	17	18	29	9	20
12-14 months	5	3	2	56	25	31	13	5	8	131	62	69	122	67	55	103	61	42
15-17 months	7	5	2	40	23	17	2	1	1	71	35	36	62	30	32	56	27	29
18-20 months	4	1	3	31	16	15	2	1	1	44	35	9	46	23	23	47	26	21
21-23 months	4	1	3	22	9	13	-	-	-	25	13	12	36	17	19	27	10	17
2 years	18	10	8	59	31	28	5	3	2	110	58	52	69	34	35	89	49	40
3 years	10	7	3	39	19	20	5	4	1	57	28	29	34	15	19	66	31	35
4 years	13	7	6	35	20	15	1	1	-	36	19	17	30	17	13	36	23	13

	EL SALVADOR						JAMAICA			MEXICO			UNITED STATES					
	San Salvador			Rural municipios			Kingston-St. Andrew			Monterrey			San Francisco			California, suburban		
Total	2738	1472	1266	1082	587	495	1903	1049	854	3953	2191	1762	234	140	94	664	396	268
Under 1 day	237	146	91	68	45	23	323	189	134	563	349	214	81	50	31	246	148	98
1 day	105	61	44	17	7	10	130	61	69	153	91	62	16	9	7	52	30	22
2 days	53	29	24	6	1	5	90	51	39	76	48	28	4	2	2	17	12	5
3 days	42	24	18	7	4	3	59	41	18	68	40	28	14	7	7	19	13	6
4 days	21	13	8	5	2	3	55	36	19	51	31	20	7	4	3	15	12	3
5 days	16	7	9	7	6	1	41	21	20	36	19	17	1	-	1	15	9	6
6 days	17	6	11	4	1	3	31	14	17	35	20	15	5	4	1	4	2	2
7-13 days	111	66	45	45	26	19	139	70	69	146	85	61	10	8	2	25	18	7
14-20 days	73	34	39	23	14	9	83	44	39	144	77	67	5	4	1	16	9	7
21-27 days	47	29	18	13	7	6	39	21	18	105	59	46	4	1	3	14	8	6
0-27 days	722	415	307	195	113	82	990	548	442	1377	819	558	147	89	58	423	261	162
28 days-1 month	207	113	94	48	27	21	98	46	52	315	172	143	14	8	6	42	22	20
2 months	167	98	69	52	28	24	67	36	31	350	191	159	12	6	6	23	12	11
3 months	178	80	98	48	23	25	45	23	22	249	137	112	6	4	2	20	15	5
4 months	159	77	82	33	14	19	54	33	21	205	113	92	8	4	4	19	14	5
5 months	140	85	55	54	28	26	50	23	27	160	89	71	4	1	3	13	9	4
6 months	106	57	49	42	27	15	47	26	21	147	77	70	1	-	1	9	3	6
7 months	93	51	42	35	23	12	51	34	17	103	55	48	4	3	1	6	1	5
8 months	101	54	47	46	22	24	52	32	20	99	55	44	3	2	1	3	2	1
9 months	75	44	31	35	19	16	40	18	22	64	34	30	3	1	2	6	5	1
10 months	79	46	33	25	11	14	47	24	23	71	37	34	1	1	-	7	-	7
11 months	67	33	34	35	17	18	48	25	23	80	45	35	6	3	3	4	2	2
12-14 months	154	79	75	72	37	35	80	45	35	142	77	65	1	1	-	9	5	4
15-17 months	107	54	53	56	29	27	40	23	17	109	55	54	4	4	-	11	8	3
18-20 months	77	36	41	51	27	24	32	17	15	102	49	53	1	1	-	2	1	1
21-23 months	60	24	36	38	22	16	23	15	8	68	27	41	2	2	-	3	2	1
2 years	131	70	61	112	63	49	64	35	29	170	79	91	4	3	1	23	15	8
3 years	72	37	35	61	35	26	46	26	20	80	48	32	4	3	1	24	12	12
4 years	43	19	24	44	22	22	29	20	9	62	32	30	9	4	5	17	7	10

APPENDIX 6

PHYSICIANS, STATISTICIANS, NURSES, SOCIAL WORKERS, AND OTHER PERSONNEL WHO PARTICIPATED IN THE 15 FIELD PROJECTS

Physicians

Romeu Abdalla	São Paulo, Brazil
Rodrigo Alarcón	Medellín, Colombia
Roberto Coelho Alves	São Paulo, Brazil
Orlando Añamuro	Bolivia Project, Bolivia
Guillermo Aponte B.	Bolivia Project, Bolivia
Jorge Luis Arango	Medellín, Colombia
Magali María de Araújo	Ribeirão Prêto, Brazil
Vicente Antonio Araújo	São Paulo, Brazil
Fred Baker	Sherbrooke, Canada
Marco Antonio Barbieri	Ribeirão Prêto, Brazil
Olegario Barboza	Cartagena, Colombia
Ethel Barnoon	California Project, USA
Jorge A. Bassi	Chaco Province, Argentina
Alexandre Wolff Berger	São Paulo, Brazil
V. R. Boodhoo	Kingston-St. Andrew, Jamaica
A. Boyd-Patric	Kingston-St. Andrew, Jamaica
Elizabeth Caballero	Chile Project, Chile
Ary López Cardoso	São Paulo, Brazil
Carlos Castro S.	Bolivia Project, Bolivia
Georgina A. Castro C.	San Juan Province, Argentina
María G. Castro C.	San Juan Province, Argentina
Claudio H. Cerón	Medellín, Colombia
Denys Cloutier	Sherbrooke, Canada
Fischel Coodin	California Project, USA
Lupércio S. Cortez Jr.	Ribeirão Prêto, Brazil
Roger Côté	Sherbrooke, Canada
Rolando Cruz Izaguirre	Monterrey, Mexico
Osvaldo Danús	Chile Project, Chile
Samuel Dooley	California Project, USA
Alma E. Dyer	Kingston-St. Andrew, Jamaica
Halmond C. Dyer	Kingston-St. Andrew, Jamaica
Victor Eisner	California Project, USA
Jorge Escobar M.	Cali, Colombia
Hernando Espitia	Cali, Colombia
Christian Fisch	Sherbrooke, Canada
Pedro E. Florez	Cali, Colombia
Roberto Florez Quiñonez	El Salvador Project, El Salvador
Darcy de Freitas	Recife, Brazil

collaborators are given on pp. ii-iii of this publication.

Miguel A. García	El Salvador Project, El Salvador
Cesar Augusto Giraldo	Medellín, Colombia
Edwin Gold	California Project, USA
Uilho Antonio Gomes	Ribeirão Prêto, Brazil
Alvaro Gómez	Cali, Colombia
Miguel Gueri	Kingston-St. Andrew, Jamaica
Ney Guzmán	Cali, Colombia
Francisco Henao	Medellín, Colombia
Enrique Hering	Chile Project, Chile
Hilda Herrera	El Salvador Project, El Salvador
Luis Hurtado G.	Bolivia Project, Bolivia
Vicente Jiménez	Cali, Colombia
Anthea Kelly	Sherbrooke, Canada
R. Knight	Kingston-St. Andrew, Jamaica
Saúl León C.	Cali, Colombia
Miguel Licero	Cartagena, Colombia
Edésio Lima	Recife, Brazil
F. M. Lincoln	Kingtson-St. Andrew, Jamaica
Alide Machado	Recife, Brazil
Lumen Maldonado de Andrade	Bolivia Project, Bolivia
Raúl Martínez R.	Bolivia Project, Bolivia
Valois Martínez Colombres	San Juan Province, Argentina
William Mejía Vargas	Medellín, Colombia
José Morales Casas	Monterrey, Mexico
Hector A. Navas	San Juan Province, Argentina
Jarbas Leite Nogueira	Ribeirão Prêto, Brazil
Roberto Nunes	Recife, Brazil
Allan Oglesby	California Project, USA
Luiz Roberto de Oliveira	Ribeirão Prêto, Brazil
Joaquin Ortíz Torres	Monterrey, Mexico
Claudio Pérez	Cartagena, Colombia
Michel Perrier	Sherbrooke, Canada
Oscar H. Poletti	Chaco Province, Argentina
Nidia de Quiroga	Cali, Colombia
Rodolfo Quiroga Treviño	Monterrey, Mexico
Sergio Quiroga Treviño	Monterrey, Mexico
Guillermo Restrepo	Medellín, Colombia
Nicodemus Reyes U.	Bolivia Project, Bolivia
Luis del Río	Chile Project, Chile
Sergio P. Bueno da Rocha	São Paulo, Brazil
Victor Roel	San Juan Province, Argentina
José Rojas García	Cartagena, Colombia
E. Neri Romero de Domínguez	San Juan Province, Argentina
Gervasio Saúl Ruíz Rodas	El Salvador Project, El Salvador

Carlos A. Sagastume	El Salvador Project, El Salvador
Arturo Salgado	Medellín, Colombia
José Salgado	Cartagena, Colombia
Pastor Sangueza	Bolivia Project, Bolivia
Franklin Amorim Sayão	São Paulo, Brazil
Guy Schlaeder	Sherbrooke, Canada
Arnaldo A. Franco de Siqueira	São Paulo, Brazil
Luci M. da Silva	Ribeirão Prêto, Brazil
Miguel A. Simón	San Juan Province, Argentina
Giorgio Solimano	Chile Project, Chile
Miguel E. Soria	Chaco Province, Argentina
Antonio Soto	Cartagena, Colombia
Epitácio Souza	Recife, Brazil
Fernando Symon	Chile Project, Chile
Erica Taucher	Chile Project, Chile
M. Thorburn	Kingston-St. Andrew, Jamaica
Raúl Urioste C.	Bolivia Project, Bolivia
Lautaro Vargas	Chile Project, Chile
S. Veitch	Kingston-St. Andrew, Jamaica
Jitka Vobecky	Sherbrooke, Canada
Josef Vobecky	Sherbrooke, Canada
José Vogelmann	Chaco Province, Argentina
Wiktoria Winnicka	California Project, USA
Sérgio Zucoloto	Ribeirão Prêto, Brazil

Statisticians

Hernando Escobar	Medellín, Colombia
Hyman Goldstein	California Project, USA
Gustavo Pacheco	Cartagena, Colombia
Aurelio Pértile	San Juan Province, Argentina
Eunice Pinho de C. Silva	São Paulo, Brazil
Jean-Marie Romeder	Sherbrooke, Canada
Robert Sholtz	California Project, USA
Antonio Tapia	Bolivia Project, Bolivia
Raúl Tapia	Bolivia Project, Bolivia

Nurses, Social Workers, and Others

Miriam Abouhab	São Paulo, Brazil
Labib Jorge Abraão	Ribeirão Prêto, Brazil
S. Alleyne	Kingston-St. Andrew, Jamaica
Kimiye Assada	São Paulo, Brazil
Alcira Batista	Cartagena, Colombia
Adelina Bello	Chile Project, Chile
Marize Helena Bendine	Ribeirão Prêto, Brazil

Denise Bernier	Sherbrooke, Canada
Cleuza María Borges	Ribeirão Prêto, Brazil
Sonia M. R. Brigagão	Ribeirão Prêto, Brazil
Luciene Brito	Recife, Brazil
Susana Burton	Chile Project, Chile
Thelma Bustillo M.	Medellín, Colombia
Mélida S. de Calderón	El Salvador Project, El Salvador
Norha Castrillon	Medellín, Colombia
Alicia Castro	Chile Project, Chile
Esther S. de Castro	Chaco Province, Argentina
Sueli Pires Cintra	Ribeirão Prêto, Brazil
Mary Cors de Miguel	Bolivia Project, Bolivia
Isabel Borges Cunha	Ribeirão Prêto, Brazil
Beverly Cutler	California Project, USA
Maria A. A. Daneluzzi	Ribeirão Prêto, Brazil
Elisa B. de Danuzzo	Chaco Province, Argentina
María A. C. Días	Ribeirão Prêto, Brazil
Francyne Dufresne	Sherbrooke, Canada
Guillermo Echeverri	Medellín, Colombia
Amanda Espinoza	Chile Project, Chile
Nora Fardella	Chile Project, Chile
Teresa Figueroa	Bolivia Project, Bolivia
Blanca M. Flores de Maciel	Chaco Province, Argentina
Aussany França	Recife, Brazil
Mercedes Chacón de Fuentes	El Salvador Project, El Salvador
Rosa Elvira Galindo	Monterrey, Mexico
Celine Gendron	Sherbrooke, Canada
Lola H. de Giraldo	Medellín, Colombia
Isabel H. Gómez	San Juan Province, Argentina
Raquel Guerszcensveig	Chile Project, Chile
Emma Gumucio	Bolivia Project, Bolivia
Rosario de Guzmán	Cali, Colombia
N. Henriques	Kingston-St. Andrew, Jamaica
Regina Celia Hohenegger	São Paulo, Brazil
Marisa Iodice	São Paulo, Brazil
María del Carmen Isaac Briones	Monterrey, Mexico
Socorro Isaac Briones	Monterrey, Mexico
Amparo S. de Jaramillo	Medellín, Colombia
Liliam de Jiménez	Medellín, Colombia
Micheline Lapointe	Sherbrooke, Canada
Pierrette Larochelle	Sherbrooke, Canada
María del C. Leuzzi de Escudero	San Juan Province, Argentina

Aurora Limón Benavides	Monterrey, Mexico
Terezinha Lobo	Recife, Brazil
Ana Elvira López	Cartagena, Colombia
Gladys López	Cartagena, Colombia
Afsaneh Mahamedi	California Project, USA
María Maia	Recife, Brazil
María Mardini	Chile Project, Chile
Emelina Molina	El Salvador Project, El Salvador
Rosa Mora	Cartagena, Colombia
María M. Moreno de Brenes	Medellín, Colombia
Coralia Pantoja	São Paulo, Brazil
Marlene Pessoa	Recife, Brazil
Eunice Queiroz	Recife, Brazil
Celina Ramírez	Medellín, Colombia
Norma Ramos	San Juan Province, Argentina
A. Reid	Kingston-St. Andrew, Jamaica
Mary Rodríguez	Bolivia Project, Bolivia
Gemma Roy	Sherbrooke, Canada
Carlota Ruiz González	El Salvador Project, El Salvador
Niva Azevedo Ruiz	São Paulo, Brazil
Ana Salazar	Cali, Colombia
Isabel Santos	Recife, Brazil
Leila Haddad Sawaya	São Paulo, Brazil
C. Sewell	Kingston-St. Andrew, Jamaica
Zenilda M. Silva	Ribeirão Prêto, Brazil
María Helena de Mello Silveira	São Paulo, Brazil
María V. Silveira	Recife, Brazil
V. Skeffrey	Kingston-St. Andrew, Jamaica
Conceicão de A. Targa	Ribeirão Prêto, Brazil
Farailde Teles	Recife, Brazil
Gloria Telles	Recife, Brazil
Madeline Thresh	California Project, USA
Francine Vaillancourt	Sherbrooke, Canada
María Vergetti Melo	Recife, Brazil
Nora de Vogelmann	Chaco Province, Argentina

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