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9. ABSTRACT

The Inter-American Investigation of Mortality in Childhood carried out in 15 locations in the Americas between 1968 and 1972 was planned to explore in depth the causes of excessive mortality in infancy and early childhood. It emphasized the study of the interrelationships of multiple causes of death and the associated environmental and biologic factors. Special attention was to be directed to the study of nutritional deficiencies and their impact on survival of young children. The investigation had two principal parts. One was the investigation over a two year period of deaths of children under 5 years of age from the project areas. The second part of the study was a household survey in each project based on a probability sample of households. Its purpose was to provide information on the population in the areas in which the childhood deaths had occurred which would serve as a basis for determining death ratios associated with specific factors. Data were collected on housing characteristics, household composition, occupation and vital events in the twelve months preceding interviews. Additional data were gathered on parents' education and occupation, on the pregnancy histories of the mothers, on medical attention during pregnancy and at delivery, on the weight of the children at birth and at interview, on practices of breastfeeding and introduction of other foods, and on immunization and medical care provided. The analyses presented in this paper concern these household surveys and the comparison of living children in the SAMPLE with the DEATHS will respect to selected environmental or other factors which may influence the risk of death.

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Introduction

The Inter-American Investigation of Mortality in Childhood which was carried out in 15 locations in the Americas between 1968 and 1972 was planned to explore in depth the causes of excessive mortality in infancy and early childhood. It emphasized the study of the interrelationships of multiple causes of death and the associated environmental and biologic factors. Special attention was to be directed to the study of nutritional deficiencies and their impact on survival of young children.

Thirteen projects of the Investigation were located in eight countries of Latin America, one was in an area around San Francisco in the State of California in the United States of America and one was in the southeast part of Quebec Province in Canada.

The description of the 15 projects and the reasons for their selection have been presented in the publication, *Patterns of Mortality in Childhood*, by R. Puffer and C. Serrano. Only a brief summary will be given here.

The Investigation had two principal parts. One was the investigation over a two-year period of deaths of children under 5 years of age from the project areas. In 10 projects all deaths in this age group were studied

but in five, systematic samples of deaths were selected for investigation. As soon as information was received of the occurrence of a death (usually the death certificate at a registration office) project staff visited the home to obtain data on housing conditions, household composition, the mother's reproductive history and prenatal care, and on delivery, breast-feeding, the introduction of other food, and the medical care received by the child. Subsequently, a medical interviewer visited the source of medical attention (hospitals, health centers and offices of physicians) to obtain the clinical, laboratory and autopsy information from the records or from the providers of care. Whenever necessary - for example, if the child had died without medical attention or if medical records were unavailable or unsatisfactory - the medical interviewer visited the home to obtain a history of the illness and its course from the mother. The data on deaths have been analyzed in depth in *Patterns of Mortality in Childhood* and a series of journal papers.

A second part of the study was the conduct in each project of a household survey, based on a probability sample of households. The household survey covered essentially the same two-year period as the death investigation. Its purpose was to provide information on the population in the areas in which the childhood deaths had occurred which would serve as a basis for determining death ratios associated with specific factors. For each sample household, data were collected on housing characteristics, household composition, occupations and vital events in the 12 months preceding interviews (Appendix 1). In households with children under 5 years of age, additional data were gathered on parents' education and occupation, on the pregnancy histories of the mothers, on medical attention during pregnancy and at deliver-

on the weight of the children at birth and at interview; on practices of breastfeeding and introduction of other foods, on immunization and medical care provided.

The analyses which are being presented here concern these household surveys and the comparison of living children in the SAMPLE with the DEATHS with respect to selected environmental or other factors which may influence the risk of death.

### Project Areas

As stated earlier, the Investigation was conducted in 13 projects in Latin America, in one project in California in the United States and in one in Quebec Province in Canada. Six projects were urban only while nine also included rural or suburban areas.

Special attention was given in the analysis of the DEATH data to the findings in rural sectors. Unfortunately, the small size of the samples in rural areas has made it desirable to present most findings only for the entire project.

The distribution of the 15 projects can be seen in the map in Figure 1. A factor heavily influencing the selection of project sites was the availability of suitable principal collaborators and the interest of health services or of faculties of medical schools or public health schools in participating in the Investigation and in using the findings to effect change. Summary data on the 15 projects appear in Table 1.

In Argentina, the provinces included were Chaco and San Juan. In Chaco, the Department of San Fernando with its inhabitants living principally in the city of Resistencia comprised the urban area while the six Departments--

Comandante Fernandez, General Donovan, Libertad, Presidencia de la Plaza, 1<sup>o</sup> de Mayo and Quitilipi - made up the rural area. The entire province of San Juan was studied, divided into three sections - the city of San Juan, four suburban departments around the capital (Chimbas, Rawson, Rivadavia and Santa Lucia) and the remaining seven rural departments.

The city of La Paz in Bolivia was chosen in order to include in the study a population from a high altitude. The small city of Viacha, 32 km. from La Paz, which was also a part of this project is not included in analyses due to the small sample size and a differing definition of households.

In Brazil, there were three distinct widely separated projects: Recife in the Northeast and Ribeirão Preto and São Paulo in the South. The study in Recife covered the heavily populated districts of Beberibe, Encruzilhada and Casa Amarela in which socioeconomic and cultural characteristics were considered representative of the city. In the Ribeirão Preto project there were three sectors: the city of Ribeirão Preto, the city of Franca which is 200 kilometers from Ribeirão Preto and a sector composed of five smaller communities (Batatais, Brodosqui, Cravinhos, Jardinópolis and Sertãozinho). The project area in São Paulo was entirely urban, covering only the District of São Paulo.

The study 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.

The three projects in Colombia were designed to provide data for three distinct regions of the country: the Pacific, the Caribbean and the Central. The Investigation was conducted in the urban sectors of the cities of Cali, Cartagena and Medellín.

The study in El Salvador was carried out in the Municipio of San Salvador which is almost entirely urban and in three rural municipios (Apopa, Nejapa and Quezaltepeque).

In the Caribbean Island of Jamaica, the project included the capital city - metropolitan Kingston and the rural portion of St. Andrew Parish.

The project in Mexico was carried out in the entire Municipio of Monterrey, which includes the city itself and 40 surrounding localities.

In addition to these 13 Latin American projects, two were located in Northern America, one in the United States in California and one in Canada in Quebec Province. The Canadian project covered the Eastern Townships, south of the St. Lawrence River in southeastern Quebec. Since information on the California SAMPLE was not received and processed in a comparable manner to the rest of the projects, it will not be included in the subsequent analyses. Reference, however, will be made when possible to the Canadian data, although numbers are small for both the SAMPLE and the DEATH groups.

#### Selection of the SAMPLE

During the pilot testing and preparation for the Investigation, considerable attention was given to the design of a control group. Initially it was proposed to match each dead child with a living child from the immediate neighborhood and of the same age and sex. A second suggestion was to locate in the Registration Office the birth certificate of each dead child and to select as a control the first child of the same sex whose birth certificate followed in the Registry. The disadvantages and problems of such selection procedures were great. For example, in some areas birth certificates do not exist for many children, living or dead. Also, without considerable

searching there was no way to determine whether the selected controls were living or dead or their current addresses in the community.

For these and other reasons the decision was made to obtain information on a SAMPLE of living children under 5 years of age, identified in a household probability SAMPLE drawn from the project area. Since the investigation of DEATHS was to extend over a two-year period, the base population of children would be continually changing due to births, deaths and migration. Therefore, the household survey was also spread over a two-year period. For each month, a representative sample of the population currently living in the study area was chosen. The 24 samples together formed the SAMPLE for the two-year period.

In the planning stages, the problem arose as to whether equal or different sampling ratios should be used for the various age groups under 5 years. Since a high proportion of deaths occur in the first few days of life, it would be desirable to have more children in this age group in the SAMPLE than would be included if sampling ratios were equal by age. However, in view of the design and field problems which would be encountered, the decision was made to use a single sampling ratio for all age groups.

For each project, a multistage SAMPLE was designed. The original goal was to investigate in each project over the two-year period a sample of 2,000 children under 5 years of age. The sampling ratio was determined from the size of the sample desired (2,000 plus 5 or 10 per cent to compensate for non-responses) divided by the estimated number of children under 5 years of age. Sampling procedures were similar for most projects and were carried out in two stages. In the first stage, the area was divided into distinct well-defined geographic subareas consisting of one or more blocks

and a selection of subareas was made. The probability of selection was proportional to the number of dwelling units estimated to be in the subarea. For each subarea selected, a complete list of dwelling units was drawn up and at the second stage, equal size clusters of approximately 33 dwelling units per subarea were selected.

Advisory services were provided to local teams on procedures for drawing the sample as well as on the necessary steps in checking maps, selecting areas and verification of dwelling units.

In practice the samples did not approximate the 2,000 children as anticipated. In some projects, because of the limitation of funds, it was necessary to modify the sampling fractions and interview fewer households. In others, the number of children in households interviewed fell below the expected. In most projects population estimates derived from the sampling fractions and the completed interviews are below estimates of populations of the areas and of the children under 5 years as derived from local sources such as the 1970 censuses, births, deaths and migration data, which were used to calculate death rates in *Patterns of Childhood Mortality*. It is possible, too, that population estimates at the time the SAMPLES were designed may have been over or underestimated since approximately eight years had elapsed since the preceding census period.

For consistency with the previous publications, the following sections of this report will make use of the same total population estimates; distributions by subgroups will be based on sample proportions observed in the SAMPLES.

### Survey Response

Table 2 presents data on the response of households selected for interview. Of all dwelling units selected for study, 5.7 per cent were unoccupied.

By project, the percentages ranged from 17 per cent in Chaco Province, Argentina, to 2.5 per cent in La Paz, Bolivia, and 1.0 per cent in Sherbrooke, Canada. Of occupied households, information was obtained from 95 per cent. Household members provided the information for 91.7 per cent and a neighbor for 3.3 per cent. In only two projects, Chile and Jamaica, was the response less than 90 per cent (88.7 and 87.5 respectively). Overall, the refusal rate was 1.1 per cent, ranging from 3.7 per cent in Santiago and Cartagena to 0 per cent in Resistencia and in rural departments of San Juan Province, Argentina and rural municipios in El Salvador. For 3.9 per cent of households, no one was found at home on repeated visits. The percentages varied from 11.6 in Kingston, Jamaica, to 0.9 per cent in Recife, Brazil. In general, the household response was good, and it is unlikely that non-response significantly influences the findings.

### The SAMPLE Population and Its Characteristics

#### Age and Sex

The distribution of the population in SAMPLE households by age and sex resembles that of the Latin American population in the 1970 census period. Close to 40 per cent are under 15 years of age, 3.6 per cent are 65 years or older, and 23.7 per cent are women in the childbearing ages. The distributions by age and sex are shown in Table 3 and Figure 2 for all projects combined. The detailed information by study project appears in Appendix 2a. The percentages under 15 years of age vary from 47.0 per cent in Cartagena to 31.6 in São Paulo (Figure 3). In only five (Chile project, San Juan project, Ribeirão Preto project, Sherbrooke and São Paulo) of the 14 projects was there less than 40 per cent under 15 years of age. Women

of childbearing ages constituted from 21.2 per cent of the population in Kingston and Sherbrooke up to 25.8 per cent in the El Salvador project. The elderly (65 years and over) represented only 1.8 per cent of the population in La Paz, but 7.7 per cent in Sherbrooke, Canada. The combined large percentages of children and women of childbearing ages together with the elderly produce a high dependency ratio with less than 1 of 3 persons in the labor force. These high percentages of children and women of childbearing ages clearly indicate that in both urban and rural populations, health and other services for these groups must have a high priority.

At the young ages (under 15 years) males were in excess of females for all projects combined, but in each age group above 15 years, the women were consistently more numerous. With certain variations, these differences were observed in most projects and are the consequence of a higher proportion of male births than of females and the current higher mortality risk for males throughout life.

Similar distributions by age and sex are presented for families with children under 5 in Table 3, Figures 2 and 3, and Appendix 2b. Forty-two per cent of households had children under 5 years of age. However, this percentage varied considerably between projects. In Cartagena and La Paz, over 53 per cent of households included children in this age group, but in Sherbrooke, Canada, only 23.0 per cent included children and in São Paulo, 29.8 per cent. Because of the basis for selection, the presence of a child under 5 years in the household, obviously there is a higher percentage of young children in these families (26.8 per cent under 5 years and 53.9 per cent under 15 years), and as a result lower percentages of persons in older age groups. By age, the differences between males and females are less consistent.

in the age groups between 15 and 34, there are more females, but from 35 to 54, more males, suggesting that fathers are on the average older than the mothers or absent from the households. In two projects, differences are most noticeable (El Salvador and Jamaica) with only 46 per cent of males among household members. In El Salvador, males of 15-34 years comprise only 12.6 per cent of the household population as compared with 19.4 for females. The corresponding percentages in these age groups for Jamaica are 9.9 per cent for males and 16.4 per cent for females. In addition, in both of these projects, there are also fewer males than females between 35 and 54 years of age.

#### Size of Households

In Figure 4 and Table 4, data are presented to show by project the average size of household. In all projects combined, there were 4.8 persons per household. By project, the variation was from 6.4 in Medellín to 3.9 in Sherbrooke. Families with children under 5 years of age were larger with an overall average of 6.0 persons per household and a range from 7.5 in Medellín to 5.0 in Sherbrooke. By project, the average size of household has a consistent relationship with that of households with children under 5 years.

#### Number of Children Under 5 Years in Households

Of the 12,298 families with children under 5 years of age, 55 per cent had a single child in this age group, 32 per cent had two young children, 11 per cent - 3 children, and 2 per cent included 4 or more under 5 years of age (Figure 5 and Table 5). Some of the households consisted of several nuclear families and the children referred to above were

not necessarily siblings. The families with 3 or more young children comprised 25.1 per cent of families with children under 5 years in Medellín, 21.6 per cent in Recife, and 21.4 in Monterrey. In Sherbrooke, households with 3 or more children under 5 made up only 2.4 per cent and in São Paulo and La Paz, 6.5 per cent.

### Environmental Conditions

Information was available for analysis on water and sewerage services and for indices of household crowding and general neighborhood assessment. Figure 6 presents data for the 14 projects ordered by percentage of homes with piped water within the house. Separate bars identify all families and those with children under 5 years of age. A positive correlation exists between water services, sewerage services, number of rooms and an inverse relationship with persons per room. Cali, San Juan Province and Recife did not fit the pattern of other projects with respect to the number of rooms or persons per room.

Households with children under 5 years consistently had poorer conditions, with lower percentages with piped water and sewerage services, fewer rooms and more persons per room. The data on these variables appear in Appendix 3 (a, b, c and d)

By project, the percentage with water piped into the dwelling ranged from 97 per cent in Sherbrooke, Canada, to 20 per cent in the project in Chaco Province, Argentina. In five projects, the percentages were below 50 (that is Chaco, Recife, El Salvador, Jamaica and La Paz). Chaco project the lowest, consists of the city of Resistencia and rural areas in six Departments.

Similarly, the percentages of households with sewerage services covered a wide span, from 18.5 per cent with flush toilets in Chaco Province to over 99 per cent in Sherbrooke, Canada. In six projects, the percentages were below 50 (Chaco and San Juan Provinces, La Paz, Recife, Cartagena and El Salvador).

The corresponding spread of percentages with piped water services for families with children under 5 years was from 15 to 96 and with sewerage services, from 14 to 99. Since some projects included both urban and rural areas, it would be reasonable to expect the overall project percentages to be lower. For example, in the Chaco project, only 15 per cent of families with children under 5 years had water piped into the dwelling. The corresponding percentage for Resistencia, the urban part, and the six rural Departments, were 31 and 9 respectively.

Wide variations existed between projects in the number of rooms in the dwellings. For example, in Sherbrooke, Canada, 97 per cent of households had at least three rooms and in Ribeirão Preto, Brazil, 91 per cent were of this size. By contrast, in El Salvador and Jamaica, only 31 and 35 per cent of households respectively had this living space. In 5 of the 14 projects, at least 50 per cent of households had fewer than 3 rooms. Size of units were almost always smaller for families with young children.

The percentages of households with more than three persons per room varied from 0.1 per cent in Sherbrooke to 54 per cent in El Salvador. In 6 of the 14 projects, at least 30 per cent lived under these overcrowded conditions. In 7 of the projects, this overcrowding index for families with young children was over 30 per cent reaching as high as 73 per cent in El Salvador.

Data assessing the neighborhood in which the families lived were available for all cities (Appendix 3e). Interproject comparisons are difficult to make since standards of levels of living vary from city to city and the neighborhood appraisals are subjective evaluations, influenced by interviewer judgement. The percentage of families living in neighborhoods classified locally as poor, varied from 1 per cent in Sherbrooke, Canada, to 87 per cent in Recife. In five projects, the percentage was above 50 per cent, including Cali, Cartagena, El Salvador and Jamaica in addition to Recife. In each project, the percentage of families with children under 5 years living in poor neighborhoods was higher than for all households in the SAMPLE.

#### Education

For each person in the SAMPLE, data were obtained on the highest level of education reached and the numbers of completed years. In Figure 7, the percentages are shown by age and sex for all projects combined in two groups, those with no education and those with at least some secondary. Separate bars are presented for males and females by age group. The percentage with no education increases from 4 per cent of males and 6 per cent of females at 20-24 years of age to 29 and 32 per cent respectively for those 65 years and over. Percentages with some secondary education decrease from 46 and 40 per cent for males and females of ages 20-24 to 17 and 11 per cent at ages 65 and over. For individual projects, the corresponding change by age and sex appear in Figure 8 and Appendix 4.

At almost every group in each project, the percentage with no education is higher for females than for males. In some projects, such as La Paz,

a wide difference exists. The increase in the percentage with age confirms the improving school attendance and literacy levels over the past few decades. However, for Chaco, Recife, La Paz (females) and El Salvador (females) at least 10 per cent of persons 20-24 years of age at the time of interview had received no education. The percentages with no education reached over 40 per cent among females of 65 years of age in Chaco Province, La Paz, Recife, Ribeirão Preto, São Paulo, Cartagena and El Salvador. In the youngest age group (20-24 years) of males, only in Chaco, Recife, Cartagena and El Salvador was there more than 5 per cent with no education.

In every project, the increase in the more recent years of secondary school and university enrollment shows up clearly. In the youngest age group shown, 71 per cent of males in La Paz and 61 per cent in Chile have had at least some secondary education; the highest percentages for females were reached in Chile (57) and Medellín (50).

#### Occupation

As part of the household survey, employment status of each person was determined as well as information on his principal occupation. Overall, 78 per cent of males between 15 and 64 years of age in the Latin American projects were currently employed but only 32 per cent of females were economically active. By project, percentages for males varied from 60 in La Paz to 86 in São Paulo, falling in eleven of the 13 Latin American projects between 70 and 86. No apparent relationship exists between levels of male and female employment status, although the three lowest for males were also the lowest for females. The corresponding range for females was from 18 per cent in La Paz to 54 in El Salvador (Figure 9 and Table 6).

Comparison of occupations in these projects is based on a classification into 4 groups: A - professional and clerical; B - skilled workers; C - semi and unskilled workers; and D - service workers. Occupations were coded according to the International Standard Classification of Occupations and the same four broad groups used in the study of deaths in the Inter-American Investigation of Mortality in Childhood were formed. Figure 9 shows the percentage distribution for males in all households and in households with children under 5 years of age for all projects combined.

The grouping used places 35 per cent of all males, 15-64 years of age in A; 30 percent in B; 27 per cent in C; and 8 per cent in D. Of fathers of children under 5 years of age, only 29 per cent belonged to Group A and a slight excess appeared in each of the other three categories.

By project, there were wide variations (Table 7). For example, in Chaco, only 18 per cent were in Group A (professional and clerical) and 18 per cent in Group B (skilled workers). At the other extreme, in São Paulo, 47 per cent were in Group A and 33 per cent in Group B.

#### Estimation of Vital Events from Household Survey

To estimate birth and death rates in the study areas, the respondent in each SAMPLE household was queried on vital events occurring within the 12-month period preceding the household interview. Included was information on pregnancies, fetal deaths, live births and deaths of members of the household.

Based on responses to this retrospective survey consisting of a single visit to each SAMPLE household, estimated birth rates, fertility rates and death rates have been calculated for the various projects. The

findings support the hypothesis that a single survey interview for retrospective information is not sufficient to provide a valid estimate of relatively rare events such as births or deaths. Moreover, the small sample size in many projects results in high sampling variations.

Tables 8a and b show birth and fertility rates as estimated from the household survey. Also shown are birth rates for each of the projects as estimated from local population data and birth registration information; these were used in *Patterns of Mortality in Childhood* as a basis for obtaining denominators and calculation of infant mortality rates. In all but two project areas (Jamaica project and La Paz), the estimates based on the retrospective data from SAMPLE households were below those used in *Patterns of Mortality in Childhood*; in nine of 13 projects, birth rates from SAMPLE data were at least 10 per cent lower.

Fertility rates, births per 1,000 women of childbearing ages (15-44 years), as estimated from SAMPLE data were compared with national fertility rates based on birth registration data in the corresponding countries. Comparisons are crude and obviously reflect both the deficiency in birth information obtained in household interviews and the underregistration of births in the countries shown. The two projects in Argentina in the study (in Chaco and San Juan Provinces) had higher fertility rates than that registered for the entire country. This appears to be a reasonable result since the national average is highly affected by the large proportion of urban population in the country with lower fertility rates. In all other countries, with the exception of Jamaica, fertility rates based on the SAMPLE were lower than the national rate. However, since most of the projects consist largely of urban areas, it is not surprising to find in them

a lower level of fertility, particularly in countries where a large proportion of population is rural.

Despite the obvious deficiencies in the data, it is interesting to compare urban and rural fertility rates within projects (Figure 11 and Table 9). In four (Chaco, San Juan, Chile and El Salvador) of the five projects with urban and rural or suburban components, rates for fertility in the rural or suburban areas surpass those for the urban. The differences are consistent and marked, especially in the age groups between 20 and 30 years. In Ribeirão Preto, the two curves are similar. The "rural or suburban" in Ribeirão Preto consists of five smaller communities which in many aspects do not have the same rural characteristics.

In Table 10, estimated total death rates in the SAMPLE projects are compared with the national level of mortality as determined from DEATH registration systems. National data on mortality are not available for either Bolivia or Brazil.

In all but one project (Cartagena), the SAMPLE death rates are lower than the rates based on death registration systems for the entire country. Such findings are not unexpected since the projects are principally urban areas for which lower rates would be anticipated than for the remainder of the country. However, in two of the projects included in the study, San Juan and Chaco Provinces in Argentina, mortality is undoubtedly much higher than in the country as a whole. The low crude death rates observed in the SAMPLE may result not only from missing information on deaths but also be affected by a younger age distribution of the population in these two project areas. But in all projects underenumeration of deaths in the household survey probably occurred.

Estimated rates were also calculated by age. In general, under-reporting was apparent throughout the age span. Deficiencies could be expected even in the older age groups since some deaths may have resulted in abolition of the households, thus making information unavailable in a household survey.

Also shown in Table 10 are death rates under 5 years of age and under one year of age based on the retrospective SAMPLE data. The comparison with the DEATH rates for these age groups determined from the two-year study of deaths in the projects appears reasonable. In four projects, the two rates agreed within 10 per cent, with the SAMPLE rate the higher in 3 instances. In 3 other projects, the SAMPLE estimates were in excess of the rates from the Investigation of DEATHS by amounts ranging from 14 to 28 per cent. These latter three projects are the cities in which death rates found in the Investigation were highest (La Paz, Recife and El Salvador). In all three, it is reasonable to expect that there were additional unregistered deaths not occurring in institutions which were not located for study during the Investigation. However, in only one was the difference between the SAMPLE and DEATH Investigation statistically significant.

In the remaining six projects, the death rates from the Investigation exceeded the SAMPLE estimates by amounts ranging from 13 to 56 per cent. In three, the differences were statistically significant at the .05 level. In most projects, the number of deaths in the SAMPLE were small and resulting rates are subject to high sampling errors. For this reason, results of formal statistical tests are not presented.

Project death rates under 5 years of age based on the SAMPLE were also compared with official data for the country although the latter are not shown. Estimated rates are greater in 3 projects, that is, the two in Argentina and El Salvador. Registered death rates in the two Argentina provinces studied are in fact higher than in the more urbanized areas of the country. In El Salvador, underregistration is high in rural areas of the country and since a high proportion of population lives in rural areas, the national death rate for the population under 5 years is probably greatly understated.

Infant mortality rates in the two parts of the Investigation were also compared. The rates were greater in the SAMPLE in 6 projects and greater for the DEATH study in seven. Differences, though appearing large, are not statistically significant. Considering the small size of the household samples and the few deaths which would be expected in that population, it would not be anticipated that significant differences could be demonstrated. However, omission in both births and infant deaths may be compensating and may be responsible for some apparent similarities.

Comparison of Characteristics of SAMPLES of Living Children  
with Those of DEATHS Investigated

As stated earlier, the small size of the project SAMPLES made it difficult to produce reasonable estimates of populations of project areas especially when subdivided by various characteristics. Distributions of individual or household characteristics for children in the SAMPLE and DEATH groups are compared principally in two ways: 1) using tests of significance for differences in distributions or averages for the two study groups and, 2) comparison of ratios of deaths to estimated populations

derived from local estimates for the project areas distributed by characteristics in accordance with the proportion observed in SAMPLE households selected by probability sampling techniques.

The basic differences in the age distributions of SAMPLE and DEATH children must be emphasized (Table 11) for they seriously influence interpretation of various comparisons.

### Family Composition

SAMPLE and DEATH families were compared as to total size of household, the number of children under 5 years in the household and the presence of parents in the household. All three variables could affect the care provided to the child, the socioeconomic conditions under which the family lives and the nutritional status of the child.

In 9 of the 14 projects, the average size of SAMPLE families was smaller than that of families studied because a child under 5 years had died. The deceased child was included as a household member in calculating average size. The difference in average size between SAMPLE and DEATH families was statistically significant for 7 of these 9 projects. Of the remaining five projects, there was no significant difference between the two groups for three but both La Paz and Cali had significantly larger SAMPLE families (Table 12).

The distributions of the two groups of families by number of children under five are given in Table 13. Values of  $\chi^2$  calculated for these distributions were significant at the .001 level for all projects as shown and also for study areas within the projects. Table 13 also presents for the 14 projects death rates per 1,000 estimated children according to the

number of children under 5 years of age in a household. A consistent pattern emerges with an increase in the death rate when a child is from a family with other children under 5 years. In six of the 14 projects, the increase with additional children is progressively upward. In six others, there is a higher death rate for children in families where there is a single child under 5 years than exists in families with two children under 5. In all but two projects, however, by far the highest risk is for children in families with 3 or more under 5 years. These rates by number of children probably result from a variety of circumstances. Since a high proportion of deaths are in fact in the neonatal period (35.1 per cent in all projects combined) the age of the mother could contribute to the high rate in the single child family in some projects. Higher death rates are observed for children born to mothers under 20 years of age and to mothers 35 years and over. The greater risk of infant death for children of higher birth order, particularly when related to the young age of mothers, has been pointed out and probably is one factor in higher death rates in these households with three or more children under 5 years of age.

The distributions of SAMPLE children and DEATHS were also compared by presence of parents in the household. In all projects and in fact, in all but one study area (the suburban-rural component of the Chile project),  $\chi^2$  values indicate significant differences between the SAMPLE and DEATH distributions (Table 14).

DEATH rates per 1,000 estimated children under 5 years when both parents are present in the household are almost always lower than overall

project rates. The only exception is Sherbrooke, Canada, where numbers are small and 97 per cent of SAMPLE and DEATH children live in households with both parents present. Rates are lower in 9 of the 14 projects when the parents are married, but in the remaining five death rates for common-law unions are the lower. Death rates for children are above the average when only the mother is present in the household. Child death rates in households with only the father or neither parent is present have a somewhat conflicting pattern. In some projects, rates are high but in others they are among the lowest suggesting that they represent selected groups of children to whom special non-parental attention has been directed. It should be pointed out that numbers in these groups are frequently small and represent only a small proportion of both SAMPLE and DEATH children. The "father only" group for all projects combined comprised 1.1 per cent of SAMPLE children and the group with neither parent present constitutes 3.3 per cent. The only project with a high percentage in this latter group was Jamaica where it included close to 10 per cent of SAMPLE children; the estimated death rate was only 2.2, a fifth of the death rate for the entire project. Percentages for the DEATHS are similar - only 0.9 per cent were from families with only the father present and only 1.9 per cent from households with neither parent present. These lower percentages for DEATHS as compared to the SAMPLE are understandable since a large proportion of deaths occur in the first few days of life and these as infants would probably be included as part of the mother's household group or of the two-parent household.

### Environmental Conditions

$\chi^2$  values were calculated to compare various environmental factors in households in the SAMPLE with those in DEATH households. For most factors statistically significant differences exist between the two groups for all projects and for subareas within projects. The main exception was Sherbrooke, Canada, where the environmental conditions were classified at a higher level than in the remaining projects. In addition, ratios of deaths to estimated households were calculated to show the relative changes as conditions varied.

Neighborhood in which the dwelling unit was located was classified in four groups: good, medium, poor and isolated (Table 15). Except for San Juan and Chaco Provinces in Argentina, relatively few households were located in isolated areas. However, 34 per cent in San Juan and 38 per cent of households in Chaco were labelled as isolated.

$\chi^2$  values were significant for all projects and for the special study area within projects. All were significant at the .001 probability level with the exception of Sherbrooke in Canada.

Death ratios per 1,000 estimated households in the projects increased progressively in all but three projects as the classification moved from good to poor. Exceptions were in the Chaco project, La Paz and in Cali. In both the Chaco project and La Paz ratios in good neighborhood were above those for the medium. However, two-thirds to three-fourths of DEATHS in these two projects were from poor neighborhood where ratios were twice as high as the totals for the projects. In Cali, the highest ratio was in the medium category and that in the poor was relatively low. In Cali, the SAMPLE enumeration classified 73 per cent of households as in

poor neighborhoods but only 59 per cent of DEATHS were classified in this category. In San Juan, by far, the highest death ratio occurred among the isolated households. It has been shown in previous publications that the death rate under 5 years in the rural departments of San Juan Province was twice that in the city of San Juan.

The associations between availability of piped water services with high mortality, particularly of young children, have been repeatedly emphasized in programs to extend water services and to improve the environmental conditions of the population. The data in this Investigation have confirmed these relationships. In all but one project (Sherbrooke, Canada), the differences in the distributions of households of SAMPLE and DEATH children are significantly different at the .001 level (Table 16). The differences were also sustained in the urban, suburban, rural subdivisions of the projects.

Ratios of DEATHS per 1,000 estimated households with children under 5 years of age were in all projects, except Sherbrooke, Canada, higher for homes with piped water outside rather than within the home. Even higher death ratios were obtained in all but four projects for households without piped water. Exceptions were Cali, Jamaica, and Cartagena. In Sherbrooke, 95.6 per cent of SAMPLE households had piped water in the dwelling as did 94.7 per cent of households in which there was a death under 5 years of age.

Similarly, households in DEATH and SAMPLE groups are distributed by type of toilet facilities (Table 17).  $\chi^2$  values were again highly significant in all but two projects, Jamaica and Sherbrooke, Canada. In the latter, only 2 SAMPLE households and 11 for the DEATHS were without flush toilets.

Death ratios were lowest for households with flush toilets, and ratios for "other" and "none" groups were invariably several times higher. The only exceptions were undoubtedly related to the small frequencies in some classes such as "none". For the most part DEATH ratios for the "none" category were higher than for "other". But in some instances interviewer differences between SAMPLE and DEATH groups may have affected the relationship.

Another variable of environment considered was the size of the dwelling unit and the relation to the number of persons inhabiting it. In Table 18, distributions by number of rooms are shown for SAMPLE and DEATH groups. The differences are all significant at the .001 level. A wide variation exists among the projects in the size of dwelling. For example, in El Salvador, 63 per cent of households have a single room while in São Paulo, only 6 per cent of families are limited to a dwelling unit of this size and in Sherbrooke only one of 205 families with information available. But despite these wide differences, in each project the DEATH group of families lived in smaller units. Death ratios per 1,000 households (Table 18) showed a consistent decrease as the number of room increased, Cali being the only exception. In this factor, as in others, some bias may have been introduced by the interviewing teams.

Table 19 summarizes the overcrowding index, persons per room, for the two groups. In all projects combined 35.7 per cent of the SAMPLE population lived in units with 3 or more persons per room. The percentages ranged from 0.5 in Sherbrooke, Canada, to 69.6 per cent in San Salvador and 89.5 per cent in the neighboring rural municipios. In contrast among the DEATH group, 54.7 per cent of families had 3 or more persons per room

and the percentages ranged from 1 in Sherbrooke to 88 and 98 in the two sectors of the El Salvador project. In seven of the 14 projects, over 50 per cent of families in which a young child died lived under these conditions. Only in Cali did this percentage for the SAMPLE reach as high as for the DEATH group.

### Education of Mothers

Education of mothers is analyzed in greater detail in an attached paper in relation to other characteristics. In this section only distributions for SAMPLE and DEATH groups are presented together with the death rates for children under 5 for each of the following educational groups of the mothers (Table 20): none, one or two years of primary education, three or more years of primary education, some secondary or technical education and some university education. The group with no education presents some problems in interpretation. In only six of the 14 projects does the highest death rate occur in children of mothers with no education. In four projects, the death rates are as low as those for the groups with secondary or university education. It may be that in some projects, the categories "none" or "one or two years of primary" were not sufficiently well differentiated or that in some projects "not stated" and "none" may have been confused. In general, death rates decreased as level of education increased. Small numbers contribute to variations in a few projects, but overall, children of mothers with secondary or university education have a much better survival ratio than those of mothers with less education.

### Occupation of Fathers

In an earlier table, the percentages of males and females employed in the SAMPLE population were shown. The percentages for females were much lower and when analyzed by occupation, the greatest proportions fell in a few service categories such as household workers. Because of these limitations, comparisons will not be made of mothers' occupations. Table 21 presents for SAMPLE and DEATH groups the distributions of the father's occupation in the 4 categories used earlier to describe the total SAMPLE population and that of households with children under 5 years. Using the  $\chi^2$  test the distributions were significantly different, all but one at the .001 level. The percentage of SAMPLE fathers in the Group A, professional and clerical workers, varied from 18.0 in Chaco Province to 37.6 in São Paulo. On the other hand, the percentages in Group C, semi or unskilled workers, range from 18.0 in São Paulo to 62.0 in Chaco Province. These percentages reflect the varying occupations associated with urbanization. Both Chaco and San Juan Province included in the projects substantial populations in suburban and rural departments.

In Table 21, death rates for children under 5 years are also shown by occupational group of the fathers. In 11 of 14 projects the rates are lowest in Group A, the professional and clerical group. The exceptions were La Paz and Sherbrooke where the rates among skilled workers were the lowest and Cartagena where for the service worker group the rate was slightly lower. Death rates for the skilled worker group were always lower than for the unskilled, often by 25 to 50 per cent. The rate for service workers was sometimes among the lower, similar to the level for professional and clerical or skilled worker groups in many projects.

### Prenatal Care

The prenatal care received by the DEATHS studied in the Investigation has been described in *Patterns of Childhood Mortality*. Tables and graphs present the percentage with care, the stage of pregnancy at which care was first provided and the number of visits for care during pregnancy. It was concluded that the infant death rates and the percentage of mothers receiving prenatal care were negatively correlated.

Comparisons of the SAMPLE and DEATH populations by the above characteristics of prenatal care are difficult to make since two distinct populations are involved. The SAMPLE has few young children under one month of age and only about one-fifth under one year of age. A high proportion of the DEATHS occurred in the first month of life and in fact, a large number in the first few days of life. These may include many of those with a shorter period of gestation and as a result with fewer visits during the prenatal period. However, comparing the distribution of SAMPLE and DEATH children according to whether the mothers had prenatal care (Table 22), there are significant differences in the majority of projects. Only in the rural departments of Chaco Province, the suburban departments of San Juan Province, La Paz, the small communities of the Ribeirão Preto project and Sherbrooke were differences not significant. Percentages of SAMPLE children whose mothers had no prenatal care ranged from 0.4 in Sherbrooke to 61.7 in the rural municipios of El Salvador. The corresponding range for DEATHS was from 2.8 to 68.3 per cent in the same study areas. In all but one area, the rural communities of Ribeirão Preto, a higher percentage of mothers of the DEATH group did not receive prenatal care. The projects rank in relatively the same order when rated by the percentage without care for the DEATHS and for the SAMPLE.

Comparison of the distributions of SAMPLE children under one year of age and the infant deaths by prenatal care of the mothers demonstrates no differences in the rural departments of Chaco, the suburban areas of San Juan Province, the three areas of the Ribeirão Preto project, Cartagena and Sherbrooke. In La Paz, significantly more mothers of the DEATHS were without care.

Analysis of the distribution of the two groups by the stage of the mother's pregnancy at first visit for care reveals significant differences in almost all projects and study areas (Table 23). The percentage receiving care in the first trimester among the SAMPLE ranges from 87 in Sherbrooke to 32 in Jamaica project. For the DEATH group the range was from 89 per cent in Sherbrooke to 24 per cent in Jamaica. In all areas with the exception of La Paz and Sherbrooke, higher percentages of SAMPLE mothers received care in the first trimester of pregnancy.

Similar comparisons for number of prenatal visits show that mothers of SAMPLE children received more care than those of the DEATHS (Table 24). Differences are statistically significant in all projects and in all but one study area. However, as previously mentioned, the two groups, SAMPLE and DEATHS, are not strictly comparable with respect to this variable.

#### Place of Birth

Proper care during labor and delivery should complement prenatal care and reduce the risk of fatal complications. It also serves as an indicator of levels of medical attention available in the project areas

Table 25 presents for all study areas the number and percentage of children in the SAMPLE and DEATH groups by place of birth. For all

projects combined, a slightly higher percentage of SAMPLE children was born in hospitals, but the relationship between the two groups varied by study area since in 12, the proportion born in hospitals was higher for the SAMPLE but in 9, it was higher for the DEATH group. The proportion of births occurring in hospitals covered a wide range from lows of 28 and 29 per cent for SAMPLE and DEATH populations in the rural municipios in El Salvador and 40 and 36 per cent for the two groups in La Paz to at least 95 per cent for the SAMPLE in San Juan City, Sherbrooke and Santiago. In 16 of the 21 study areas, percentages delivered in hospitals were above 70 per cent for both SAMPLE and DEATH children.

Table 26 presents the distributions of SAMPLE and DEATHS populations by attendant at birth. By project, the two distributions are usually significantly different. The proportions attended by physicians were higher in the SAMPLE population in 13 study areas. On the other hand, in 18 of 21 study areas the percentages of births without a physician or midwife in attendance was highest among the DEATH group, reaching as high as 49, 51 and 67 per cent in La Paz, the rural departments of Chaco and the rural municipios of El Salvador.

#### Birthweight

Comparisons of birthweight for the DEATH and SAMPLE groups are obviously difficult to make and has little meaning since the SAMPLE children are the survivors and undoubtedly represent those born with the more favorable weights. Distributions of birthweights of neonatal deaths in the Investigation compared with those for birthweights of living children as reported by the mothers or the respondents in the household surveys.

are shifted toward the lower weights. Of 9,279 neonatal deaths with data on birthweight available, 1,032 had weights of 1,000 grams or less and 1,639 were between 1,100 and 1,500 grams. Thus, 11.1 per cent were in the lowest weight group and 28.8 per cent 1,500 grams or less. Of 12,314 living children in the SAMPLE population for whom birthweight data were available, only 88 or 0.7 per cent were below this level of 1,500 grams. Based on a dividing point of 2,500 grams, which usually serves as an indicator of low birthweight and immaturity, the proportion with low birthweight increases to 65.3 per cent of the neonatal deaths as compared to 10 per cent for SAMPLE children.

#### Other Factors for Comparison

Inspection of Appendix 1, the questionnaire for the SAMPLE household inquiry reveals many factors for which additional comparisons can be made. Included are breastfeeding and weaning of the child, introduction of foods, medical care received including immunizations and incidence of selected diseases. Most of these factors need to be related to the age of the child and since the majority of the deaths occurred at early ages, sufficient survival months of experience are often not available for reliable comparisons. However, some of these factors will be considered in future papers prepared by the Organization.

In addition, in future papers, the relationships of death risks to a combination of factors will be explored. Unfortunately, many are also complicated by the limitations resulting from the differing age distributions and life-time experience of the SAMPLE and DEATH groups as well as by the recall factors in obtaining information from mothers of the SAMPLE children.