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CABLE ADDRESS: OFSANPAN

TELEPHONE 223-4700

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INTER-AMERICAN INVESTIGATION OF MORTALITY IN CHILDHOOD

Study of Causes of Mortality of Infants  
and Children of Latin America

Ruth R. Puffer, Dr.P.H.  
Carlos V. Serrano, M.D.

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## INTER-AMERICAN INVESTIGATION OF MORTALITY IN CHILDHOOD\*

### Study of Causes of Mortality of Infants and Children of Latin America\*\*

Ruth R. Puffer, Dr.P.H., Principal Investigator  
Carlos V. Serrano, M.D., Co-Principal Investigator

The Inter-American Investigation of Mortality in Childhood is a continental, collaborative study whose overall objective is the development of accurate and comparable statistics of causes of death of children under 5 years of age in widely separated areas of the Americas<sup>(1)</sup>. Among the specific objectives are two involving nutrition, namely:

1. To investigate the effect of nutritional, socio-biological and environmental factors on mortality under 5 years of age.
2. To analyze the multiple causes of death (underlying and associated) and to study interrelationships such as those existing between infectious diseases, nutritional deficiency states, and socio-biological factors.

Multiple causes of death and contributing factors as well as important interrelationships have been determined using records from hospitals, private physicians and autopsies as well as family interviews as sources of information. The field work for the collection of data for the two-year period was completed in 13 projects in Latin America in 1970. The analysis of information for the first year (17,198 deaths) has been completed and a provisional report distributed<sup>(2)</sup>. In this document extensive use has been made of the material presented in that report with emphasis on nutritional deficiencies and other causes of death in children under 5 years of age.

The approach of comprehensive analysis including determination of the multiple causes and related factors involved in mortality constitutes an outstanding feature of this Investigation. It enables a detailed and full description of the morbid conditions leading to death in childhood and the recognition of high risk groups. This knowledge will make possible sound recommendations for actions needed to reduce mortality and improve the condition of survivors.

The comparison between urban, suburban and rural communities included in the Investigation is revealing important differences that will contribute to a better understanding of the causes and factors determining the patterns of mortality. These data indicate higher mortality in rural areas than in cities and the need for extension of health programs into rural areas.

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\*This research project was made possible by a contract with the Agency for International Development of the United States of America to the Pan American Health Organization.

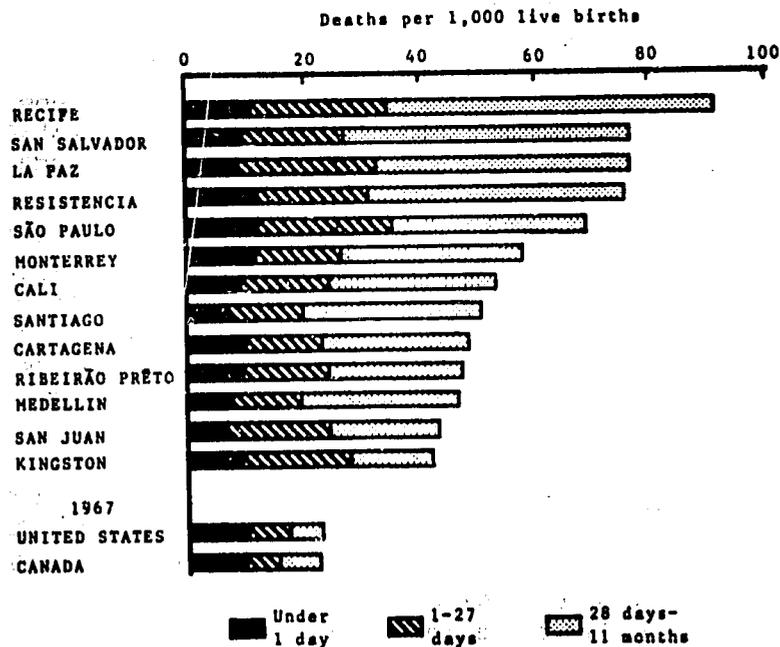
\*\*Report to be presented to the meeting of the Protein Advisory Group (PAG) on 26 October 1971.

### Mortality by Age Group

The first 5 years of life constitute a period of the utmost importance in which varied and intense experiences and transitions may seriously affect the state of health of the child. In spite of being a relatively short interval, the various age periods have marked differences and distinct patterns of causes of death, depending on the biological and environmental conditions. Mortality in childhood is excessive in Latin American countries, and its reduction is one of the goals set by the ministers of health and stated in the Charter of Punta del Este<sup>(3)</sup>. Relevant aspects in infant and early childhood mortality will be discussed, first by age and then by important causes.

Mortality in infancy (under 1 year of age) has been divided into the neonatal and postneonatal periods (Figures 1 and 2). Also, the death rate in the neonatal period is given for the first day of life and for the remainder of the neonatal period, 1-27 days. Although variations in neonatal death rates reflect to some extent the completeness of information, the postneonatal death rates indicate the size of health problems to be solved. The factors responsible for excessive postneonatal mortality will be clarified as material is analyzed and results presented.

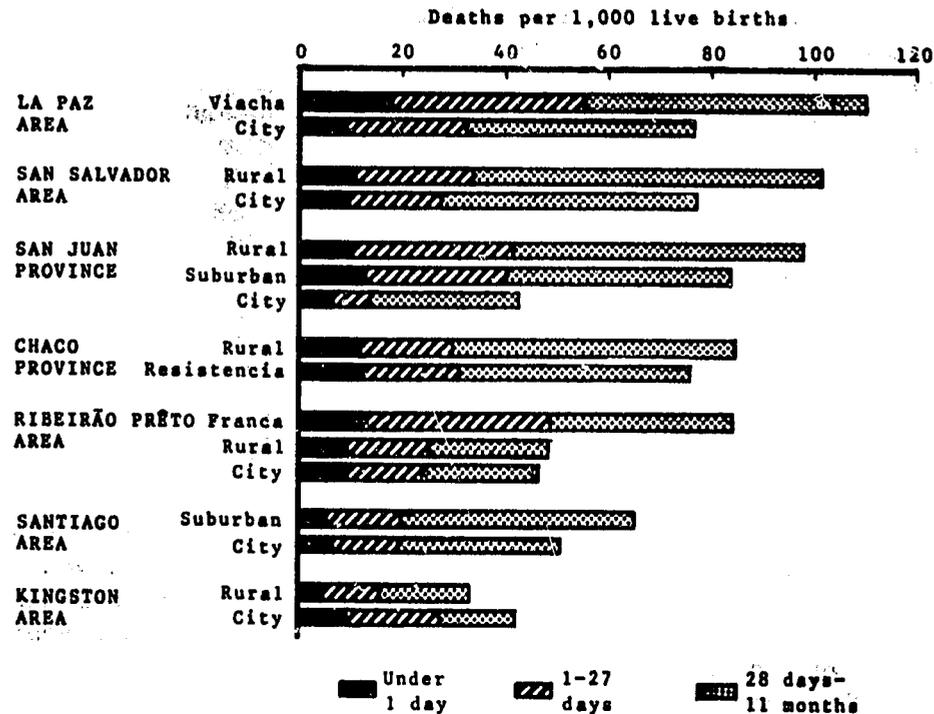
Figure 1  
INFANT MORTALITY BY AGE GROUP IN CENTRAL CITIES,  
FIRST YEAR OF INVESTIGATION



The infant death rates in the 13 cities vary from 41.9 in Kingston and 42.7 in San Juan to 91.5 in Recife (Figure 1). Even the lower rates are excessive when compared with those in the United States and Canada which are shown for reference in Figure 1. Infant mortality was generally higher in the rural and suburban portions of the projects (Figure 2). An exception is noted in the Kingston project where the infant death rate was slightly lower in rural St. Andrew than in the city.

Figure 2

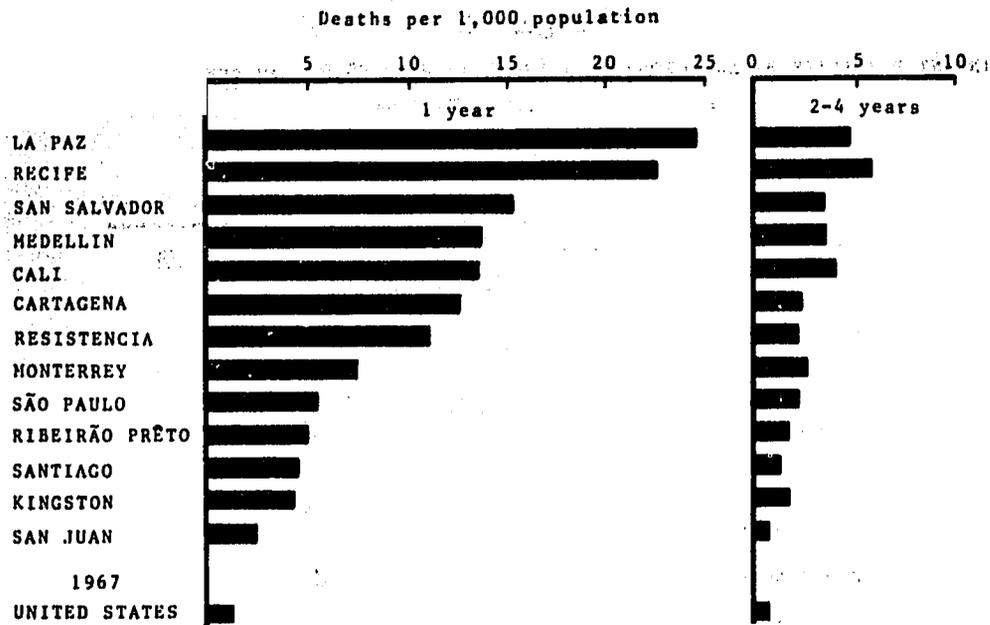
INFANT MORTALITY BY AGE GROUP IN 7 PROJECTS WITH URBAN AND RURAL AREAS,  
FIRST YEAR OF INVESTIGATION



Although variations are evident in the neonatal death rates, they are much smaller than the variations in the postneonatal rates. For example, the postneonatal death rate in Recife of 57.0 per 1,000 live births is nearly four times the rate in Kingston and eight times that in the United States. Reduction in infant mortality will be effected principally in the postneonatal period and the important role of nutritional, environmental, and other factors will be clarified in the sections which follow.

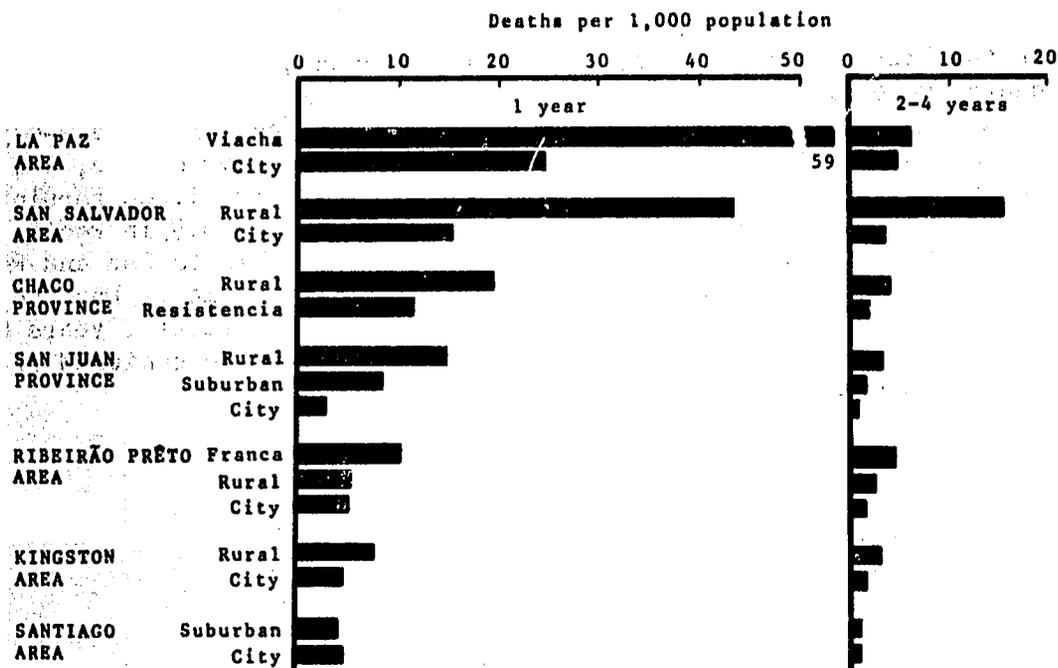
In the four-year age group, 1-4 years, in each area usually over half of the deaths were of children in the second year of life, that is, one year of age. The death rates for children one year of age and for those 2-4 years of age are shown for cities in Figure 3. For those one year of age, the variation in the cities is from 2.4 in San Juan to 24.4 per 1,000 population in La Paz, and for those 2-4 years from 0.7 in San Juan to 5.7 in Recife. Thus, death rates in early childhood continue to be high in La Paz and Recife and low in San Juan. However, of the deaths under 5 years in La Paz and Recife, 88 and 89 per cent, respectively, occurred in the first 2 years of life, and, thus, prevention of excessive mortality should be centered principally in infancy and the second year of life.

**Figure 3**  
**MORTALITY OF CHILDREN 1 YEAR AND 2-4 YEARS IN CENTRAL CITIES,**  
**FIRST YEAR OF INVESTIGATION**



In the suburban and rural areas shown for seven projects in Figure 4, the death rate of children 1 year of age, that is, in the second year of life, was very high in rural areas of the projects of La Paz and San Salvador. The death rate in the small community of Viacha of 59.4 in the second year of life was exceedingly high and nearly two and one-half times the rate in La Paz. Also, in the San Salvador project, the rate of 43.4 per 1,000 population for the rural communities was nearly three times the rate of 15.2 in the city of San Salvador. In Chaco Province, Ribierão Prêto Area and San Juan Province, the rates in the rural areas were higher than in the central cities. The death rate was also relatively high in the rural communities near San Salvador in the 2-4 year age group.

**Figure 4**  
**MORTALITY OF CHILDREN 1 YEAR AND 2-4 YEARS IN URBAN AND RURAL AREAS**  
**OF 7 PROJECTS, FIRST YEAR OF INVESTIGATION**



The section on mortality by age group has indicated excessive mortality in infancy and in the second year of life in several cities and especially in rural areas of projects of La Paz and San Salvador. In the following sections the principal causes of these high death rates will be analyzed.

### Infant Mortality by Cause

Efforts have been made to obtain a complete record of the past history and fatal illness of the child, results of laboratory and other examinations and autopsy findings in order to determine the multiple causes of death. This approach is permitting the establishment of important interrelationships as well as a precise measurement of high risk conditions such as immaturity and nutritional deficiencies.

All pertinent information collected in the study of each death is considered in the assignment of causes of death. The starting point is selection of the underlying cause for which the international rules of selection and modification of the International Classification of Diseases<sup>(4)</sup> are followed. The associated causes are assigned next in accordance with rules and coding procedures developed in the Investigation and presented in a previous document.<sup>(5)</sup> The International Classification of Diseases is being used to classify the causes of death and the groupings and nomenclature used throughout this analysis are based on that official document.

The underlying and also the associated causes of death are being analyzed in order to understand the interrelationships of diseases and conditions responsible for deaths. In Table 1 and Figures 5 and 6, causes are given in broad groups to indicate the problems and the geographic variations in infant mortality. Figure 5 gives the underlying and associated causes in six broad groups for nine cities, and Figure 6 gives similar data for urban and rural areas of four projects. For four other areas, i.e., suburban communities near Santiago, rural St. Andrew, rural communities near Ribeirão Preto, and Viacha, less than 100 infant deaths were recorded, and, thus, subdivision by cause is not justified for the first year.

The underlying causes of infant mortality in broad groups are considered first. Certain causes of perinatal mortality (760-778) as the underlying cause accounted for 13-27 deaths per 1,000 live births in these areas. The variation in mortality from these causes, which are present at birth or result from maternal conditions and, therefore, act mainly in the neonatal period, is less than that observed in death rates from causes influenced by the environment

Table 1. Underlying and Associated Causes of Infant Deaths in Broad Groups with Rates per 1,000 Live Births in Central Cities and Other Areas\*, First Year of Investigation

Central city and other area and type of cause	All causes		Infectious diseases		Nutritional deficiency		Respiratory diseases		Certain perinatal causes				Other causes	
	Number	Rate	Number	Rate	Number	Rate	Number	Rate	Immaturity		Other		Number	Rate
									Number	Rate	Number	Rate		
<b>Cali</b>														
Underlying .....	659	53.1	261	21.0	37	3.0	86	6.9	7	0.6	194	15.6	74	6.0
Associated .....	1055	85.1	139	11.2	148	11.9	191	15.4	171	13.8	164	13.2	242	19.5
<b>Cartagena</b>														
Underlying .....	451	48.0	162	17.2	29	3.1	48	5.1	11	1.2	137	14.6	64	6.8
Associated .....	833	88.6	132	14.0	108	11.5	120	12.8	128	13.6	112	11.9	233	24.8
<b>Chaco, Resistencia</b>														
Underlying .....	380	75.0	164	32.8	11	2.2	46	9.2	12	2.4	101	20.2	46	9.2
Associated .....	505	101.0	44	8.8	135	27.0	74	14.8	83	16.6	42	8.4	127	25.4
<b>Chaco, rural</b>														
Underlying .....	330	84.6	144	36.9	5	1.3	68	17.4	13	3.3	49	12.6	51	13.1
Associated .....	302	77.4	35	9.0	98	25.1	38	9.7	39	10.0	21	5.4	71	18.2
<b>Kingston</b>														
Underlying .....	776	41.9	211	11.4	12	0.6	59	3.2	23	1.2	329	17.8	142	7.7
Associated .....	1324	71.6	157	8.5	92	5.0	117	6.3	360	19.5	310	16.8	288	15.6
<b>La Paz</b>														
Underlying .....	1297	76.3	391	23.0	26	1.5	452	26.6	22	1.3	270	15.9	136	8.0
Associated .....	1423	83.7	108	6.4	309	18.2	292	17.2	243	14.3	168	9.9	303	17.8
<b>Medellin</b>														
Underlying .....	463	46.3	176	17.6	15	1.5	50	5.0	4	0.4	137	13.7	81	8.1
Associated .....	830	83.0	91	9.1	140	14.0	123	12.3	124	12.4	144	14.4	208	20.8
<b>Monterrey</b>														
Underlying .....	1909	57.7	757	22.9	31	0.9	311	9.4	40	1.2	468	14.1	302	9.1
Associated .....	3476	105.0	432	13.1	540	16.3	551	16.6	411	12.4	489	14.8	1053	31.8
<b>Recife</b>														
Underlying .....	1500	91.5	745	45.4	31	1.9	192	11.7	32	2.0	345	21.0	155	9.5
Associated .....	2932	178.8	457	27.9	577	35.2	529	32.3	356	21.7	247	15.1	766	46.7
<b>Ribeirão Preto, city</b>														
Underlying .....	211	46.9	82	18.2	1	0.2	22	4.9	1	0.2	77	17.1	28	6.2
Associated .....	443	98.4	35	7.8	70	15.6	75	16.7	78	17.3	58	12.9	127	28.2
<b>Ribeirão Preto, Franca</b>														
Underlying .....	213	84.2	86	34.0	8	3.2	22	8.7	-	-	69	27.3	28	11.1
Associated .....	391	154.5	27	10.7	53	20.9	37	14.6	77	30.4	66	26.1	131	51.8
<b>San Juan, city</b>														
Underlying .....	122	42.7	37	12.9	2	0.7	16	5.6	1	0.3	50	17.5	16	5.6
Associated .....	268	93.7	43	15.0	23	8.0	32	11.2	40	14.0	65	22.7	65	22.7
<b>San Juan, suburban</b>														
Underlying .....	317	83.4	96	25.3	17	4.5	58	15.3	1	0.3	103	27.1	42	11.1
Associated .....	692	182.1	106	27.9	73	19.2	94	24.7	96	25.3	122	32.1	201	52.9
<b>San Juan, rural</b>														
Underlying .....	449	98.0	159	34.7	26	5.7	100	21.8	3	0.7	115	25.1	46	10.0
Associated .....	885	193.2	139	30.3	113	24.7	127	27.7	119	26.0	121	26.4	266	58.1
<b>San Salvador, city</b>														
Underlying .....	1020	76.7	517	38.9	20	1.5	153	11.5	2	0.2	222	16.7	106	8.0
Associated .....	1765	132.7	192	14.4	250	18.8	294	22.1	231	17.4	187	14.1	611	45.9
<b>San Salvador, rural</b>														
Underlying .....	284	101.4	169	60.4	9	3.2	38	13.6	1	0.4	40	14.3	27	9.6
Associated .....	406	145.0	64	22.9	79	28.2	68	24.3	33	11.8	21	7.5	141	50.4
<b>Santiago, city</b>														
Underlying .....	798	50.5	202	12.8	28	1.8	202	12.8	1	0.1	207	13.1	158	10.0
Associated .....	1453	92.0	194	12.3	203	12.8	220	13.9	193	12.2	252	15.9	391	24.7
<b>São Paulo</b>														
Underlying .....	1917	69.0	673	24.2	44	1.6	337	12.1	30	1.1	516	18.6	317	11.4
Associated .....	3818	137.3	535	19.2	516	18.6	506	18.2	560	20.1	473	17.0	1228	44.2

\*Excluding 4 areas with insufficient deaths for analysis at this time.

which are more important in the postneonatal period. The death rates from these perinatal causes may be seriously affected by registration practices and the failure to include deaths of infants of low birth weight.

Figure 5

UNDERLYING AND ASSOCIATED CAUSES OF INFANT DEATHS BY BROAD GROUPS IN  
9 CITIES, FIRST YEAR OF INVESTIGATION

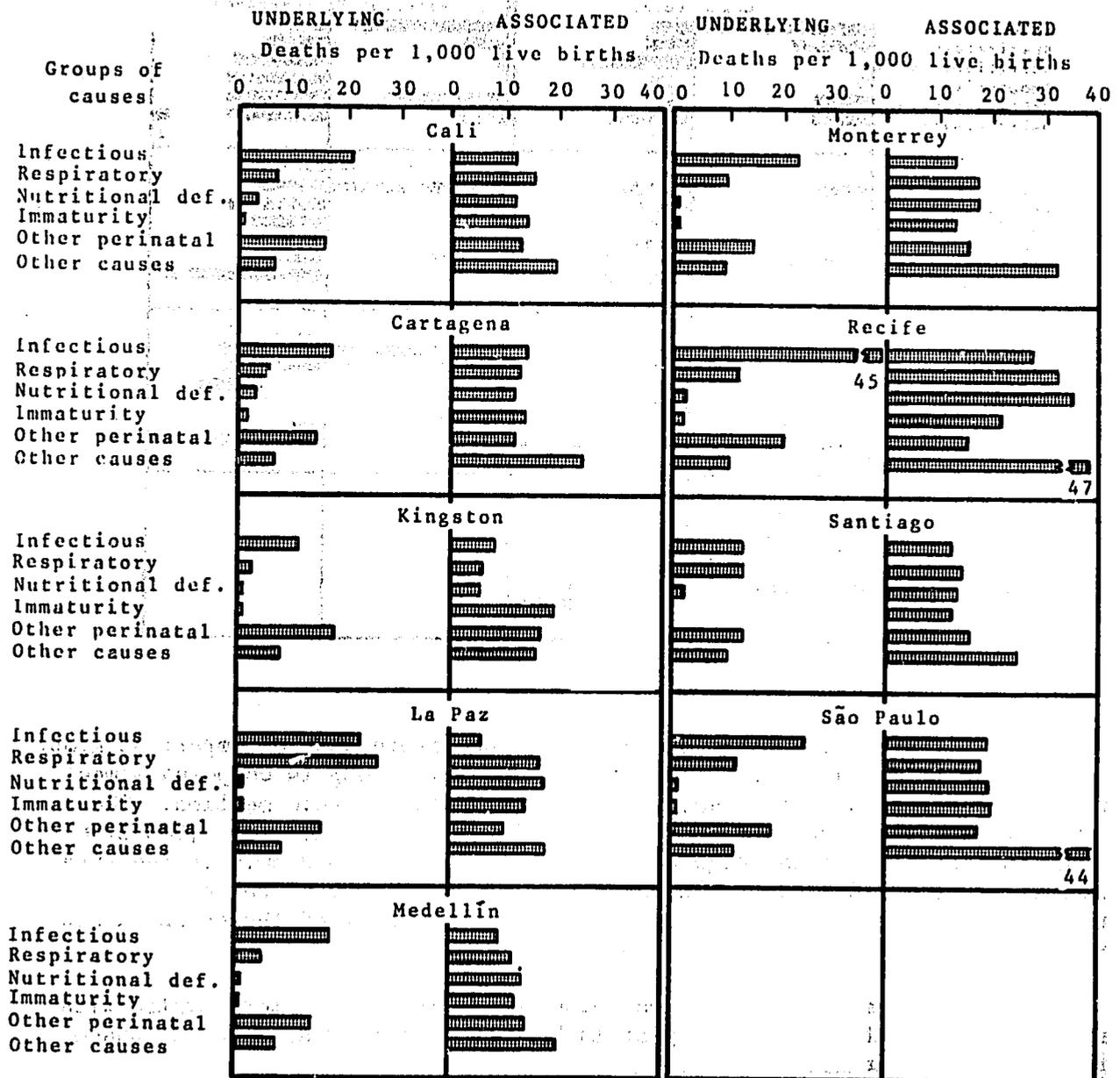
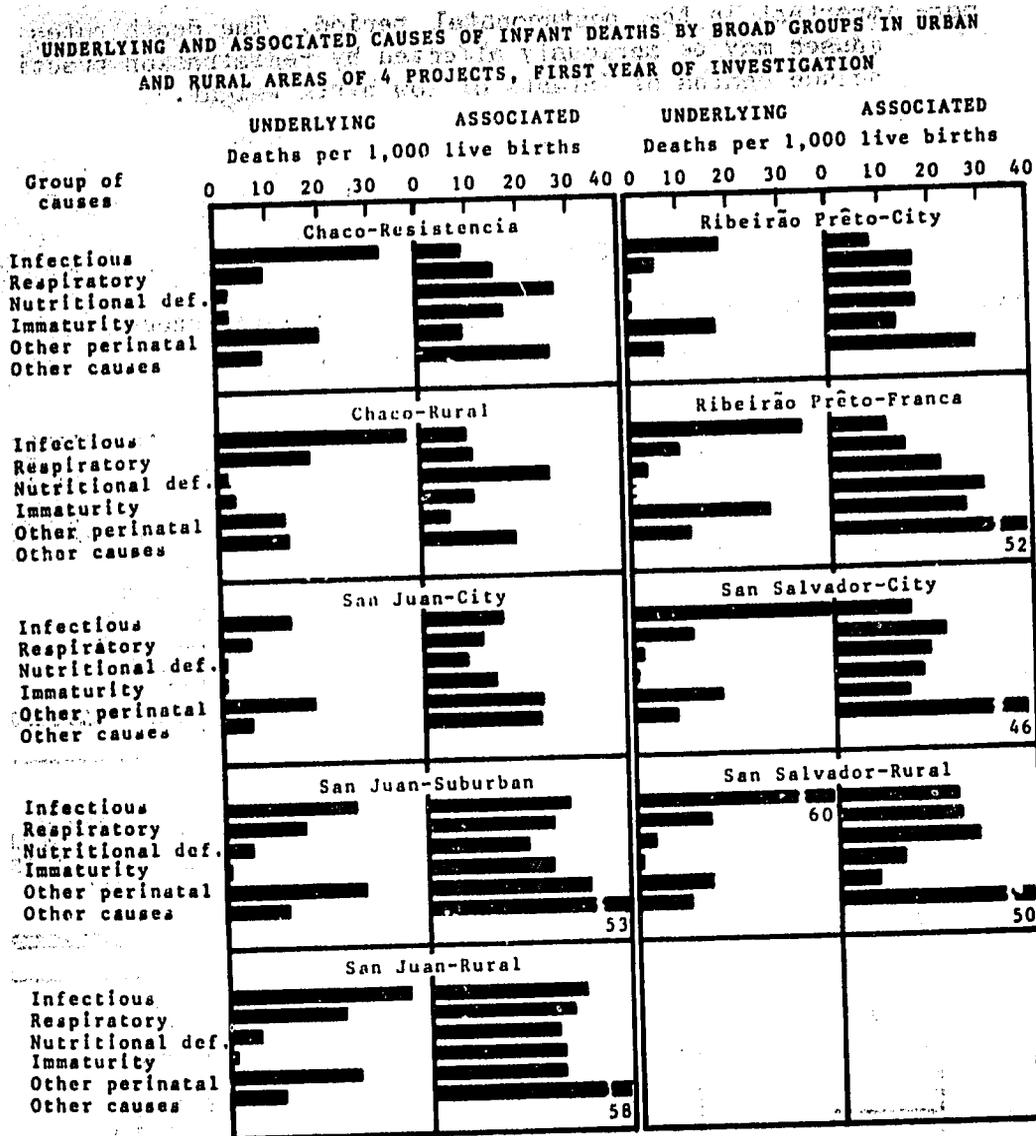


Figure 6



The infective and parasitic diseases constitute another important group of causes of infant deaths. Since at this age this group is composed almost entirely of infectious diseases, it is so designated in this section. The death rate from this group varied from the low rate of 11.4 per 1,000 live births in Kingston, to the high rates of 45.4 in Recife and 60.4 in the rural communities of San Salvador. In these rural communities, 60 per cent of the infant deaths were in this group and in Recife, one-half of the infant deaths were attributed to infectious diseases.

The third important group was diseases of the respiratory system with relatively high rates in the city of La Paz and in the rural areas of Chaco and San Juan Provinces.

The associated as well as the underlying causes of death contribute to our knowledge of factors responsible for excessive mortality. The associated causes of death have a markedly different distribution than the underlying causes (as shown in Table 1 and Figures 5 and 6). According to the rules of the International Classification, immaturity as an underlying cause is "not to be used if any other cause of perinatal mortality is reported." Thus, usually, immaturity is coded as an associated cause of death. The sum of deaths due to immaturity as an underlying or associated cause gives the total deaths in which immaturity contributed directly or indirectly to mortality. In Recife, for example, immaturity was assigned as a cause for 388 deaths which gave a rate of 23.7 per 1,000 live births.

Another important cause responsible directly or indirectly for high infant death rates in developing countries is nutritional deficiency. The role of this cause in mortality has not been revealed in the past, principally because infectious diseases are usually assigned as underlying causes and also because in the previous Revision of the International Classification of Diseases,<sup>(6)</sup> deaths attributed to nutritional deficiency were coded in two sections. Often in the 1955 Revision of the Classification they were coded to the category of nutritional maladjustment (772) in the group of Other Diseases Peculiar to Early Infancy. Some deaths would have been coded in the section for Avitaminoses and Other Metabolic Diseases.

In the 1965 Revision of the Classification in use at the present time, nutritional deficiencies are brought together in one group entitled Avitaminoses and Other Nutritional Deficiency (260-269). Since deaths are rarely due to a specific avitaminosis in developing countries, in the reports of the Investigation the term nutritional deficiency is used for this group. In this report, thus, the term nutritional deficiency is essentially equivalent to the group of conditions referred to as protein-calorie malnutrition.

As with immaturity, nutritional deficiency is usually assigned as an associated cause. For example, in the city of San Salvador, nutritional deficiency was assigned as the underlying cause of 20 infant deaths and as associated cause of 250 deaths. As can be observed in Figures 5 and 6, nutritional deficiencies and immaturity appear as important associated causes and not as underlying causes of death. This is in marked contrast to the infections and to the other causes of perinatal mortality. Likewise, the death rates from diseases of the respiratory system are usually higher as associated than as underlying causes. Thus, the real magnitude of these health problems is measured by the use of the multiple causes approach.

Both immaturity and nutritional deficiency indicate a deficiency in weight and development of a child. If immaturity, 777, is assigned, a code for nutritional deficiency is not needed to describe the deficiency state of the child. In areas where birth weights are not obtained and clinical data are incomplete, the distinction between an immature baby and one with nutritional deficiency is difficult. Such deaths would be assigned to a nutritional deficiency category. Thus, the rules of the Investigation have been established to eliminate duplication and permit addition of these causes to

show their direct or indirect role in mortality. Table 2 gives the numbers of deaths with rates from these two causes, separately and combined. Also, the rates are shown in Figures 7 and 8.

Table 2. Immaturity and Nutritional Deficiency as Associated Causes of Infant Deaths with Rates per 1,000 Live Births in Central Cities and Other Areas, First Year of Investigation

Central city and other area	Total infant deaths		Underlying or associated cause					
			Immaturity or nutritional deficiency		Immaturity		Nutritional deficiency	
	Number	Rate	Number	Rate	Number	Rate	Number	Rate
Cali	659	53.1	363	29.3	178	14.4	185	14.9
Cartagena	451	48.0	276	29.4	139	14.8	137	14.6
Kingston	776	41.9	487	26.3	383	20.7	104	5.6
La Paz	1297	76.3	600	35.3	265	15.6	335	19.7
Medellin	463	46.3	283	28.3	128	12.8	155	15.5
Monterrey	1909	57.7	1022	30.9	451	13.6	571	17.3
Recife	1500	91.5	996	60.7	388	23.7	608	37.1
Resistencia	380	76.0	241	48.2	95	19.0	146	29.2
Ribeirao Preto	211	46.9	150	33.3	79	17.6	71	15.8
San Juan	122	42.7	66	23.1	41	14.3	25	8.7
San Salvador	1020	76.7	503	37.8	233	17.5	270	20.3
Santiago	798	50.5	424	26.8	194	12.3	230	14.6
Sao Paulo	1917	69.0	1149	41.3	590	21.2	559	20.1
Other area*								
Chaco, rural	330	84.6	155	39.7	52	13.3	103	26.4
Franca	213	84.2	138	54.5	77	30.4	61	24.1
San Juan, suburban	317	83.4	187	49.2	97	25.5	90	23.7
San Juan, rural	449	98.0	261	57.0	122	26.6	139	30.3
San Salvador, rural	284	101.4	122	43.6	34	12.1	88	31.4

\*Excluding 4 areas with insufficient deaths for analysis.

In the areas with high infant death rates such as Recife, rural San Salvador, and rural San Juan, the death rates from nutritional deficiency are high and account for a sizeable portion of the total death rate. The variation in the death rates from nutritional deficiency from 5.6 in Kingston to 37.1 in Recife is greater than the variation in the rates due to immaturity as an underlying or associated cause, from 12.1 in rural communities of San Salvador to 30.4 per 1,000 live births in Franca. Although the underlying cause of many of these deaths may be diarrheal disease or other infectious disease, preventive actions against these contributory causes may be as important or even more important than those directed toward the underlying cause. These immature and nutritionally deficient infants are highly susceptible to environmental hazards, mainly to infectious diseases. A significant reduction of infant mortality would thus require both the reduction of deaths in the highly vulnerable groups, immaturity and nutritional deficiency, as well as an efficient control of infective and parasitic diseases. The interrelationship of these causes will be presented later.

Figure 7

INFANT MORTALITY WITH IMMATURITY AND NUTRITIONAL DEFICIENCY AS UNDERLYING OR ASSOCIATED CAUSES IN CENTRAL CITIES, FIRST YEAR OF INVESTIGATION

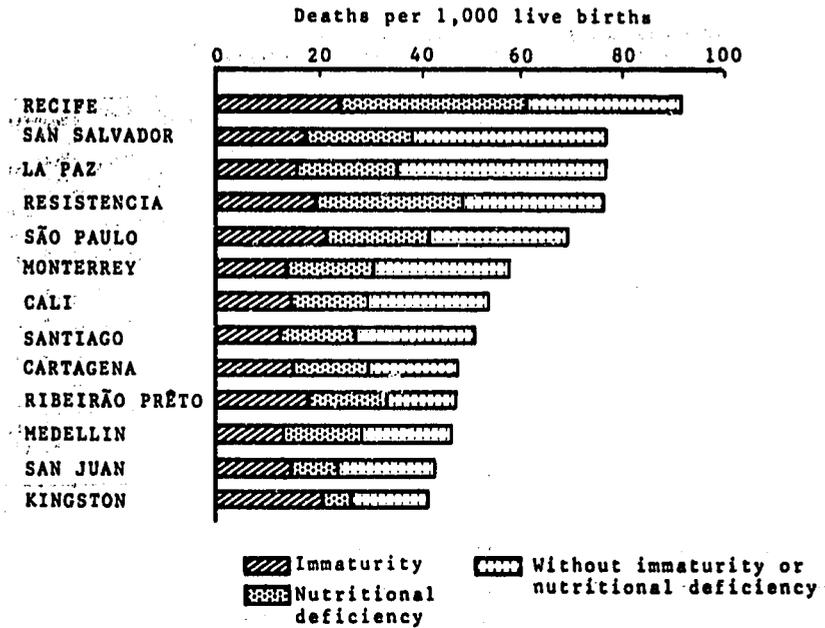
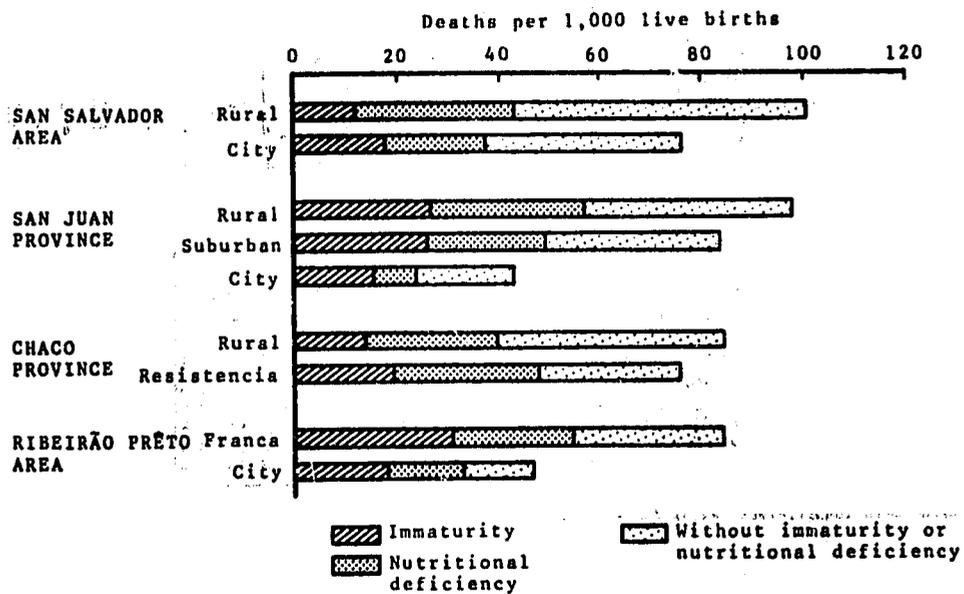


Figure 8

INFANT MORTALITY WITH IMMATURITY AND NUTRITIONAL DEFICIENCY AS UNDERLYING OR ASSOCIATED CAUSES IN URBAN AND RURAL AREAS OF 4 PROJECTS, FIRST YEAR OF INVESTIGATION



The underlying causes of neonatal and postneonatal mortality differ markedly as given in Table 3. The postneonatal death rates were higher than the neonatal rates in all of the cities except Kingston, San Juan and Ribeirão Prêto, which had the lowest infant death rates. The death rates from infectious diseases in the neonatal and postneonatal periods are shown in Figures 9 and 10. Diarrheal disease, which is shown in the figures, constitutes a high proportion of the deaths from infectious diseases in both age groups.

Table 3. Underlying Causes of Neonatal and Postneonatal Deaths with Rates per 1,000 Live Births in Central Cities and Other Areas\*, First Year of Investigation

Underlying cause	Neonatal		Post-neonatal		Neonatal		Post-neonatal		Neonatal		Post-neonatal		Neonatal		Post-neonatal					
	Num-ber	Rate	Num-ber	Rate	Num-ber	Rate	Num-ber	Rate	Num-ber	Rate	Num-ber	Rate	Num-ber	Rate	Num-ber	Rate				
	Cali		Cartagena		Chaco-Resistencia		Chaco-Rural		Kingston		La Paz		Medellin		Monterrey		Recife		Ribeirão Prêto-City	
All causes.....	297	24.0	362	29.2	218	23.2	233	24.8	154	30.8	226	45.2	115	29.5	215	55.1	507	27.4	269	14.5
Infective and parasitic diseases...000-136	40	3.2	221	17.8	35	3.7	127	13.5	19	3.8	145	29.0	21	5.4	123	31.5	74	4.0	137	7.4
Diarrheal disease.....009	19	1.5	192	15.5	12	1.3	96	10.2	12	2.4	125	25.0	8	2.1	102	26.2	30	1.6	121	6.5
Measles.....055	-	-	9	0.7	-	-	4	0.4	-	-	9	1.8	-	-	11	2.8	-	-	2	0.1
Other.....Rest of 000-136	21	1.7	20	1.6	23	2.4	27	2.9	7	1.4	11	2.2	13	3.3	2	0.5	44	2.4	14	0.8
Nutritional deficiency.....260-269	-	-	37	3.0	-	-	29	3.1	-	-	11	2.2	-	-	5	1.3	-	-	12	0.6
Diseases of respiratory system.....460-519	27	2.2	59	4.8	9	1.0	39	4.1	8	1.6	38	7.6	13	3.3	55	14.1	19	1.0	40	2.2
Congenital anomalies.....740-759	17	1.4	12	1.0	13	1.4	13	1.4	6	1.2	10	2.0	6	1.5	2	0.5	38	2.1	30	1.6
Certain perinatal causes.....760-778	199	16.0	2	0.2	148	15.7	-	-	113	22.6	-	-	61	15.6	1	0.3	349	18.9	3	0.2
All other causes.....	14	1.1	31	2.5	13	1.4	25	2.7	7	1.4	22	4.4	14	3.6	29	7.4	27	1.5	47	2.5
All causes.....	547	32.2	750	44.1	191	19.1	272	27.2	856	25.9	1053	31.8	564	34.4	936	57.1	108	24.0	103	22.9
Infective and parasitic diseases...000-136	60	3.5	331	19.5	20	2.0	156	15.6	139	4.2	618	18.7	95	5.8	650	39.6	15	3.3	67	14.9
Diarrheal disease.....009	43	2.5	223	13.1	12	1.2	136	13.6	76	2.3	441	13.3	75	4.6	500	30.3	11	2.4	40	8.9
Measles.....055	-	-	66	3.9	-	-	5	0.5	-	-	57	1.7	-	-	100	6.1	-	-	8	1.8
Other.....Rest of 000-136	17	1.0	42	2.5	8	0.8	15	1.5	63	1.9	120	3.6	20	1.2	50	3.0	4	0.9	19	4.0
Nutritional deficiency.....260-269	-	-	26	1.5	-	-	15	1.5	1	0.0	30	0.9	-	-	31	1.9	-	-	1	0.2
Diseases of respiratory system.....460-519	150	8.8	312	18.4	7	0.7	43	4.3	86	2.6	225	6.8	37	2.3	155	9.5	5	1.1	10	2.2
Congenital anomalies.....740-759	11	0.6	11	0.6	15	1.5	21	2.1	68	2.1	54	1.9	28	1.7	19	1.2	7	1.6	5	1.1
Certain perinatal causes.....760-778	288	16.9	4	0.2	140	14.0	1	0.1	502	15.2	6	0.2	375	22.9	2	0.1	78	17.3	-	-
All other causes.....	38	2.2	76	4.5	9	0.9	36	3.6	60	1.8	110	3.3	29	1.8	110	6.7	3	0.7	20	4.4
All causes.....	116	45.8	97	38.3	68	23.8	54	18.9	153	40.3	164	43.2	189	41.3	260	56.8	361	27.1	659	49.5
Infective and parasitic diseases...000-136	29	11.5	57	22.5	12	4.2	23	8.7	23	6.1	73	19.2	38	8.3	121	26.4	81	6.1	436	32.8
Diarrheal disease.....009	28	11.1	52	20.6	8	2.8	17	5.9	19	5.0	47	12.4	31	6.8	95	20.7	44	3.3	370	27.8
Measles.....055	-	-	1	0.4	-	-	3	1.0	-	-	13	3.4	-	-	15	3.5	1	0.1	33	2.5
Other.....Rest of 000-136	1	0.4	4	1.6	4	1.4	4	1.4	4	1.1	13	3.4	7	1.5	11	2.4	36	2.7	33	2.5
Nutritional deficiency.....260-269	-	-	8	3.2	-	-	2	0.7	-	-	17	4.5	2	0.4	24	5.4	-	-	20	1.5
Diseases of respiratory system.....460-519	7	2.8	15	5.9	4	1.4	12	4.2	10	2.6	48	12.6	22	4.8	77	16.8	22	1.7	131	9.8
Congenital anomalies.....740-759	6	2.4	4	1.6	1	0.3	4	1.4	10	2.6	4	1.1	4	0.9	8	1.7	22	1.7	25	1.9
Certain perinatal causes.....760-778	69	27.3	-	-	50	17.5	1	0.3	104	27.4	-	-	118	25.8	-	-	222	16.7	2	0.2
All other causes.....	5	2.0	13	5.1	1	0.3	10	3.5	6	1.6	22	5.8	5	1.1	30	6.6	14	1.1	45	3.4
All causes.....	94	33.6	190	67.9	309	19.6	489	30.9	968	34.8	949	34.1								
Infective and parasitic diseases...000-136	31	11.1	138	49.3	28	1.8	174	11.0	214	7.7	459	16.5								
Diarrheal disease.....009	12	4.3	115	41.1	12	0.8	154	9.7	171	6.2	375	13.5								
Measles.....055	-	-	11	3.9	-	-	4	0.3	-	-	25	0.9								
Other.....Rest of 000-136	29	10.4	12	4.3	16	1.0	16	1.0	43	1.5	59	2.1								
Nutritional deficiency.....260-269	-	-	9	3.2	-	-	28	1.8	2	0.1	42	1.5								
Diseases of respiratory system.....460-519	10	3.6	28	10.0	31	2.0	171	10.8	114	4.1	223	8.0								
Congenital anomalies.....740-759	7	2.5	6	2.1	25	1.6	37	2.3	55	2.0	50	1.8								
Certain perinatal causes.....760-778	41	14.6	-	-	206	13.0	2	0.1	536	19.3	10	0.4								
All other causes.....	5	1.8	9	3.2	19	1.2	77	4.9	47	1.7	165	5.9								

\*Excluding 4 areas with insufficient deaths for analysis.

The differences in death rates from these causes are great, especially in the postneonatal period, varying in the cities from 7.4 per 1,000 live births in Kingston to 39.6 in Recife and 49.3 in the rural communities of San Salvador.

Figure 9

NEONATAL AND POSTNEONATAL MORTALITY DUE TO INFECTIOUS DISEASES AS UNDERLYING CAUSE IN CENTRAL CITIES, FIRST YEAR OF INVESTIGATION

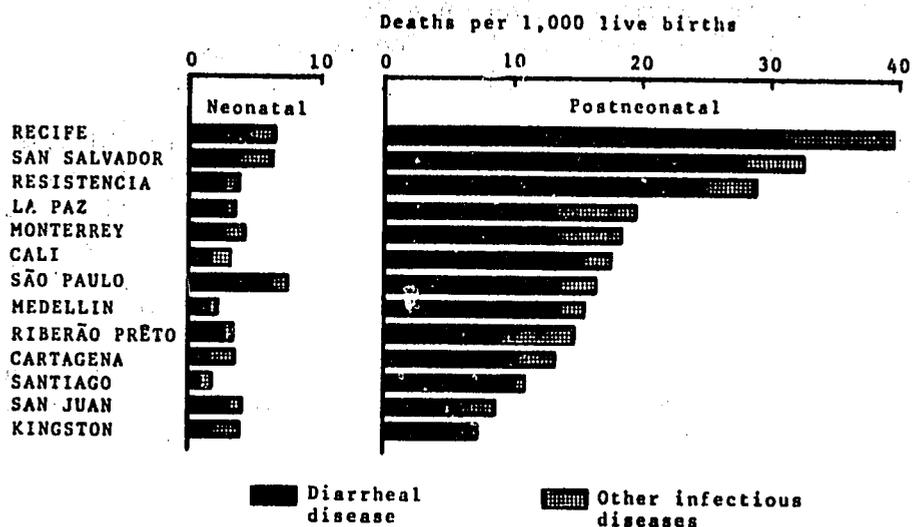
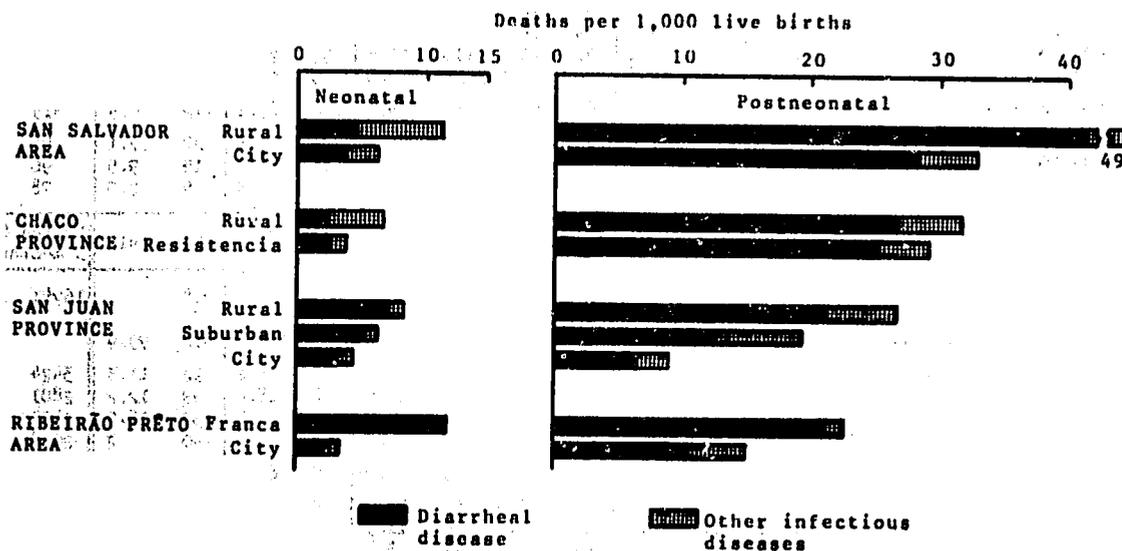


Figure 10

NEONATAL AND POSTNEONATAL MORTALITY DUE TO INFECTIOUS DISEASES AS UNDERLYING CAUSE IN URBAN AND RURAL AREAS OF 4 PROJECTS, FIRST YEAR OF INVESTIGATION



Birth weight is a valuable item to evaluate the general state of health of the newborn, to determine level of risk, and to define management. Low weight at birth, related or not to the duration of pregnancy, constitutes a serious high risk condition. By itself it could be considered as a state of nutritional and developmental deficit and, on the other hand, greatly increases vulnerability to environmental conditions and to nutritional deficiency.

Comparative study of the percentage distribution of neonatal deaths in 500-gram units of birth weight has revealed important results which are presented in Table 4 and Figure 11 together with similar data for the United States. The percentage of infants dying in the neonatal period who were born with body weights of 1,000 grams or less varies among the projects from 17.8 in Kingston to 5.2 in Santiago. San Juan Province and Monterrey also had low percentages, 8.2 and 8.5 respectively. The percentage for the United States was 20.5 in a special study on weight at birth and survival of the newborn<sup>(11)</sup>

Although the distribution of birth weights for live births is not known in the areas of the Investigation, it seems safe to assume that there is a deficit in inclusion of deaths of neonates with low weight in the areas in which the percentages have been found to be low. On the other hand, the percentages of neonatal deaths of infants born with weights over 2,500 grams also differ among the projects. In the Kingston Area, for example, only 21 per cent of the neonatal deaths belonged to this weight group, compared to 46 per cent in Monterrey and 36 per cent in the United States. Further investigation is needed to explain these different patterns of distribution of deaths by weight at birth.

Table 4. Distribution of Infants Dying in Neonatal Period by Weight at Birth in 13 Projects, First Year of Investigation, and United States, 1950

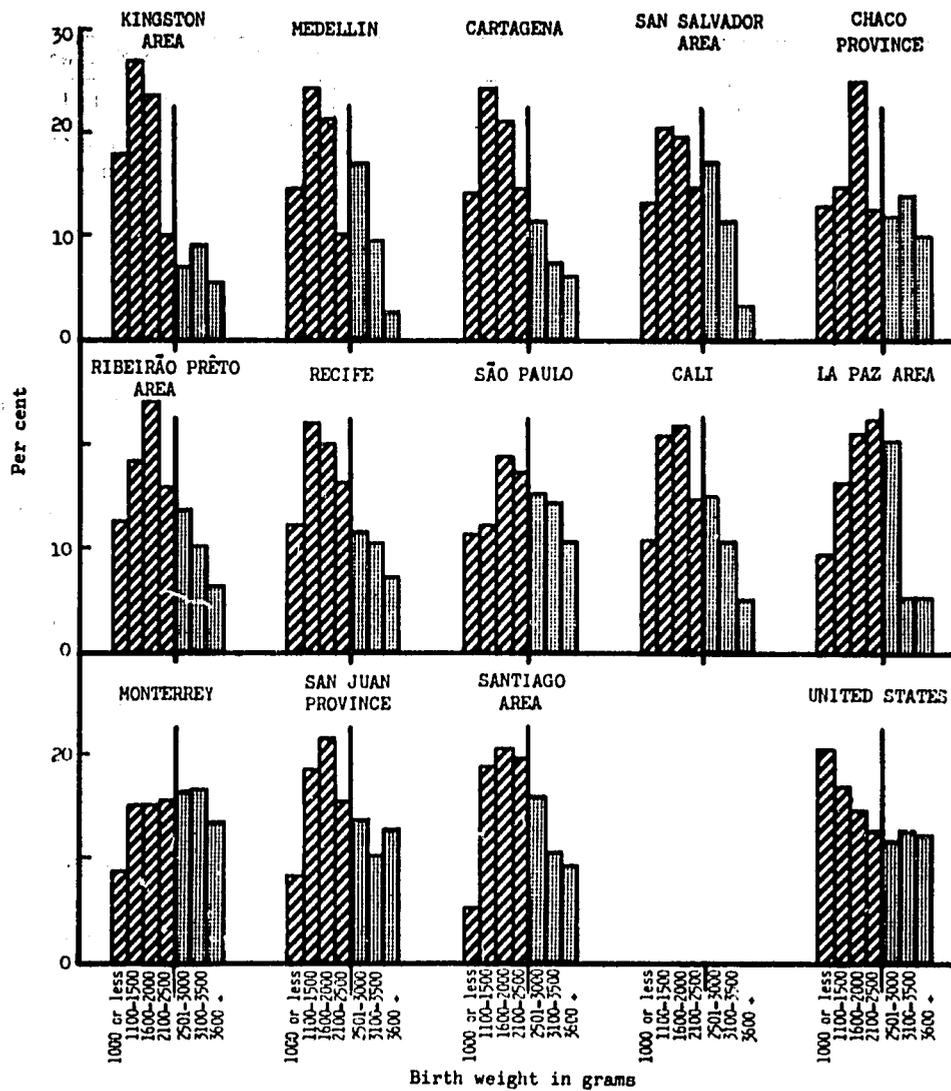
Birth weight in grams*	Num- ber	Per cent	Num- ber	Per cent	Num- ber	Per cent	Num- ber	Per cent	Num- ber	Per cent	Num- ber	Per cent		
	Cali		Cartagena		Chaco Province		Kingston Area		La Paz Area		Medellin		Monterrey	
Total deaths .....	297		218		269		534		569		191		856	
Weight stated .....	137	99.9	149	100.0	163	100.1	466	100.0	246	100.0	158	100.0	591	100.1
1000 or less .....	15	10.9	21	14.1	21	12.9	83	17.8	23	9.3	23	14.6	50	8.5
1100-1500 .....	29	21.2	36	24.2	24	14.7	126	27.0	40	16.3	39	24.7	89	15.1
1600-2000 .....	30	21.9	33	22.1	41	25.2	110	25.6	52	21.1	34	21.5	89	15.1
2100-2500 .....	20	14.6	22	14.8	20	12.3	46	9.9	55	22.4	16	10.1	91	15.4
2500 or less .....	94	68.6	112	75.2	106	65.0	365	78.3	170	69.1	112	70.9	319	54.0
2501-3000 .....	21	15.3	17	11.4	19	11.7	32	6.9	50	20.3	27	17.1	96	16.2
3100-3500 .....	15	10.9	11	7.4	22	13.5	43	9.2	13	5.3	15	9.5	98	16.6
3600 and over .....	7	5.1	9	6.0	16	9.8	26	5.6	13	5.3	4	2.5	78	13.2
	Recife		Ribeirão Preto Area		San Juan Province		San Salvador Area		Santiago Area		São Paulo		United States** 3 months, 1950	
Total deaths .....	564		269		410		455		337		968		16741	100.0
Weight stated .....	319	100.0	209	99.9	368	100.1	330	99.9	309	100.1	812	99.9		
1000 or less .....	39	12.2	26	12.4	30	8.2	43	13.0	16	5.2	92	11.3	3424	20.5
1100-1500 .....	70	21.9	38	18.2	68	18.5	68	20.6	58	18.8	99	12.2	2801	16.7
1600-2000 .....	64	20.1	50	23.9	80	21.7	65	19.7	64	20.7	152	18.7	2403	14.4
2100-2500 .....	52	16.3	33	15.8	57	15.5	49	14.8	61	19.7	140	17.2	2078	12.4
2500 or less .....	225	70.5	147	70.3	235	63.9	225	68.2	199	64.4	483	59.5	10706	64.0
2501-3000 .....	37	11.6	28	13.4	50	13.6	56	17.0	49	15.9	127	15.6	1912	11.4
3100-3500 .....	34	10.7	21	10.0	36	9.8	38	11.5	33	10.7	116	14.3	2112	12.6
3600 and over .....	23	7.2	13	6.2	47	12.8	11	3.3	28	9.1	86	10.6	2011	12.0

\*Rounded to hundreds of grams, except 2501-2549 grams.

\*\*Source: National Center for Health Statistics, Washington, PHS Pub. No. 1000, Series 21, No. 3, July, 1965.

Figure 11

PERCENTAGE DISTRIBUTION OF NEONATAL DEATHS\* BY BIRTH WEIGHT IN 13 PROJECTS, FIRST YEAR OF INVESTIGATION, AND UNITED STATES, 1950



\*Excluding those with weight not stated.

Causes of Mortality in Early Childhood

Mortality of children 1-4 years of age shows wide variation in developing countries due to effects of environment and social and cultural factors. With simultaneous improvement of conditions and provision of health services, death rates in this period have become very low, less than 1 per 1,000 population, in some countries.

The death rates from all causes for this age period are given in Table 5 for the cities and other areas and are shown in the left section of Figure 12

Table 5. Deaths from all Causes and with Nutritional Deficiency as Underlying or Associated Cause for Children 1-4 Years of Age with Rates per 1,000 Population in Central Cities and Other Areas, First Year of Investigation

Central city and other area	Deaths all cause		Deaths with nutritional deficiency		Nutritional deficiency							
					Underlying cause		Associated cause					
	Number	Rate	Number	Rate			Number	Rate	Total		Contributory	
Number					Rate	Number			Rate	Number	Rate	Number
Cali	305	6.2	188	3.8	69	1.4	119	2.4	94	1.9	25	0.5
Cartagena	170	4.7	115	3.2	45	1.3	70	1.9	47	1.3	23	0.6
Kingston	144	2.2	56	0.9	14	0.2	42	0.6	29	0.4	13	0.2
La Paz	616	9.6	304	4.8	24	0.4	280	4.4	181	2.8	99	1.5
Medellín	229	5.9	156	4.0	39	1.0	117	3.0	90	2.3	27	0.7
Monterrey	412	3.9	245	2.3	34	0.3	211*	2.0	136	1.3	75	0.7
Recife	535	10.1	376	7.1	53	1.0	323	6.1	279	5.2	44	0.8
Resistencia	72	4.4	45	2.7	9	0.5	36	2.2	27	1.6	9	0.5
Ribeirão Preto	40	2.4	28	1.7	2	0.1	26	1.6	24	1.4	2	0.1
San Juan	11	1.1	4	0.4	-	-	4	0.4	2	0.2	2	0.2
San Salvador	314	6.3	208	4.2	38	0.8	170	3.4	123	2.5	47	0.9
Santiago	117	1.8	46	0.7	8	0.1	38*	0.6	27	0.4	11	0.2
São Paulo	286	2.8	135	1.3	30	0.3	105**	1.0	70	0.7	35	0.3
Other area <sup>^</sup>												
Chaco, rural	103	7.6	61	4.5	4	0.3	57	4.2	44	3.2	13	1.0
Franca	44	6.1	23	3.2	4	0.6	19	2.7	18	2.5	1	0.1
San Juan, suburban	43	3.2	15	1.1	2	0.1	13	1.0	8	0.6	5	0.4
San Juan, rural	97	6.1	41	2.6	5	0.3	36	2.2	27	1.7	9	0.6
San Salvador, rural	202	23.0	145	16.5	47	5.3	98**	11.1	79	9.0	19	2.2

\* Excludes 1 associated cause with other type of nutritional deficiency.

<sup>^</sup> Excludes 4 other areas with insufficient deaths for analysis.

for the 13 cities. These death rates vary widely from the lowest of 1.1 for San Juan city to the highest for Recife and La Paz of 10.1 and 9.6 respectively. For the suburban and rural areas of four projects with sufficient deaths for analysis, marked variation is also seen in the rates, and the level of the rates is higher than that for the corresponding cities (Figure 13). The rural communities in the project of San Salvador exhibited extremely high mortality in this age period.

The underlying and associated causes by broad groups are given in Table 6 and shown in Figure 14. Since the numbers of deaths were less than 50 in several areas, subdivisions into causes were not advisable for such areas, and, thus, data in Table 6 are limited to 11 cities and three rural areas.

Figure 12

MORTALITY FROM ALL CAUSES AND WITH NUTRITIONAL DEFICIENCY OF CHILDREN 1-4 YEARS IN CENTRAL CITIES, FIRST YEAR OF INVESTIGATION

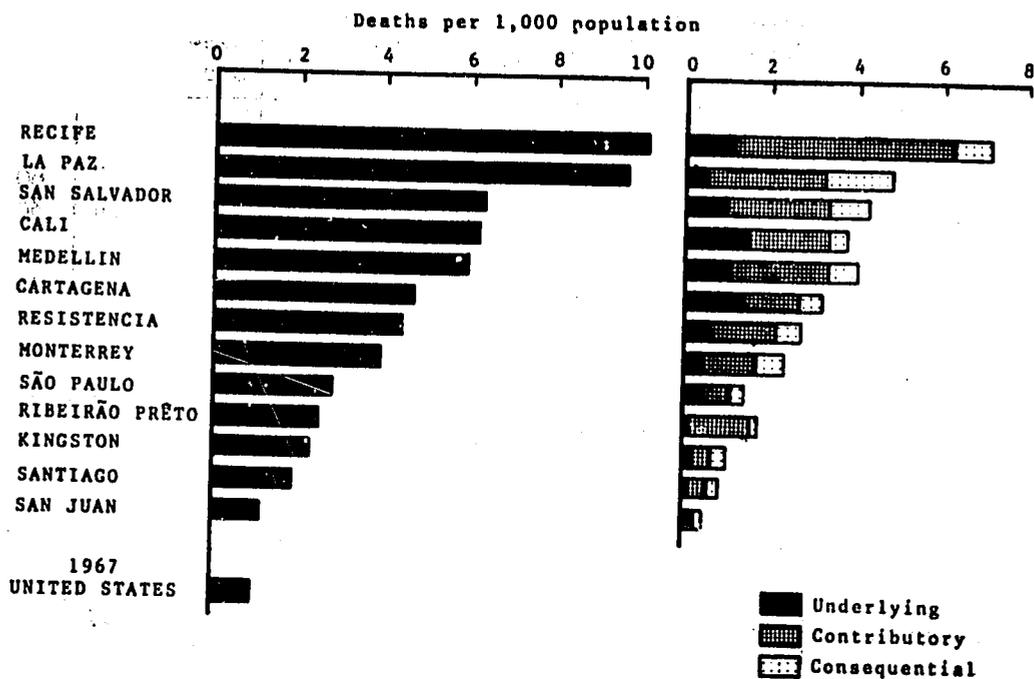


Figure 13

MORTALITY FROM ALL CAUSES AND WITH NUTRITIONAL DEFICIENCY OF CHILDREN 1-4 YEARS IN URBAN AND RURAL AREAS OF 4 PROJECTS, FIRST YEAR OF INVESTIGATION

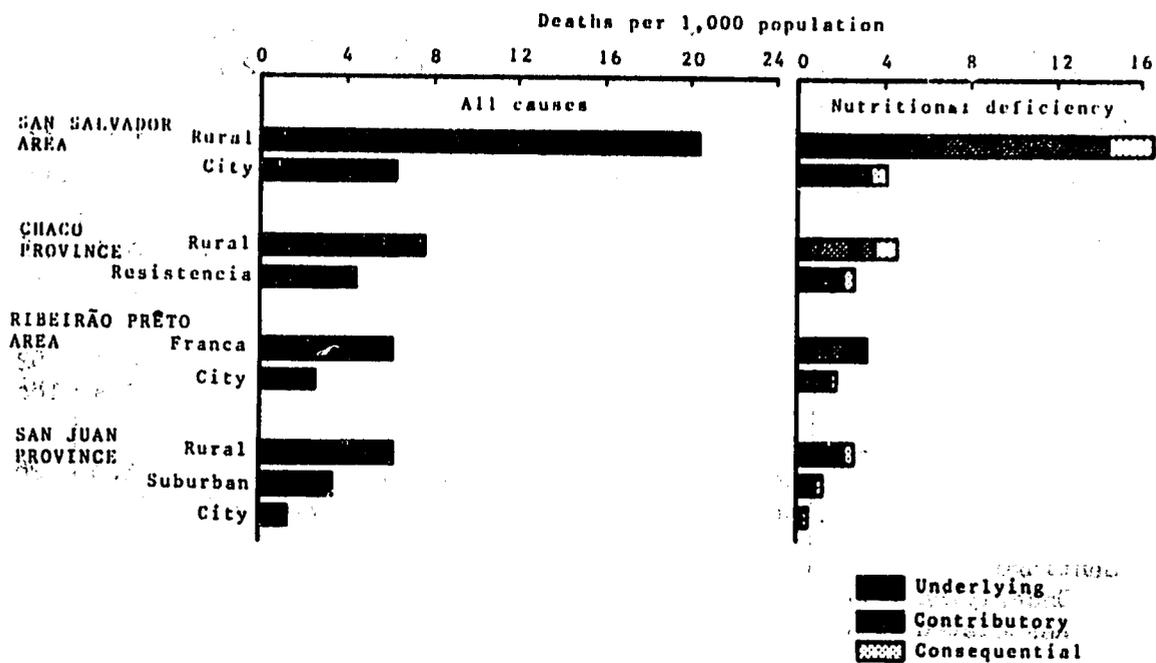


Table 6. Underlying and Associated Causes of Deaths of Children 1-4 Years  
in Broad Groups with Rates per 1,000 Population in 11 Cities and 3 Other  
Areas, First Year of Investigation

Central city and other area	Total		Infectious diseases		Respira- tory diseases		Nutri- tional deficiency		Other causes	
	Num- ber	Rate	Num- ber	Rate	Num- ber	Rate	Num- ber	Rate	Num- ber	Rate
Cali										
Underlying .....	305	6.2	152	3.1	24	0.5	69	1.4	60	1.2
Associated .....	533	10.9	148	3.0	136	2.8	119	2.4	130	2.6
Cartagena										
Underlying .....	170	4.7	64	1.8	22	0.6	45	1.3	39	1.1
Associated .....	369	10.3	122	3.4	79	2.2	70	1.9	98	2.7
Chaco - Resistencia										
Underlying .....	72	4.4	40	2.4	8	0.5	9	0.5	15	0.9
Associated .....	120	7.3	25	1.5	24	1.5	36	2.2	35	2.1
Chaco, rural										
Underlying .....	103	7.6	60	4.4	17	1.2	4	0.3	22	1.6
Associated .....	132	9.7	27	2.0	21	1.5	57	4.2	27	2.0
Kingston										
Underlying .....	144	2.2	34	0.5	23	0.3	14	0.2	73	1.1
Associated .....	220	3.3	31	0.5	51	0.8	42	0.6	96	1.5
La Paz										
Underlying .....	616	9.6	391	6.1	121	1.9	24	0.4	80	1.2
Associated .....	858	13.4	148	2.3	226	3.5	280	4.4	204	3.2
Medellin										
Underlying .....	229	5.9	127	3.3	12	0.3	39	1.0	51	1.3
Associated .....	478	12.4	126	3.3	90	2.3	117	3.0	145	3.7
Monterrey										
Underlying .....	412	3.9	236	2.2	66	0.6	34	0.3	76	0.7
Associated .....	972	9.1	269	2.5	208	2.0	212	2.0	283	2.7
Recife										
Underlying .....	535	10.1	343	6.4	77	1.4	53	1.0	62	1.2
Associated .....	1409	26.5	441	8.3	376	7.1	323	6.1	269	5.1
San Juan, rural										
Underlying .....	97	6.1	49	3.1	17	1.1	5	0.3	26	1.6
Associated .....	177	11.1	23	1.4	52	3.2	36	2.2	66	4.1
San Salvador, city										
Underlying .....	314	6.3	188	3.8	36	0.7	38	0.8	52	1.0
Associated .....	654	13.1	165	3.3	129	2.6	172	3.4	188	3.8
San Salvador, rural										
Underlying .....	202	23.0	119	13.5	10	1.1	47	5.3	26	3.0
Associated .....	406	46.1	155	17.6	67	7.6	100	11.4	84	9.5
Santiago										
Underlying .....	117	1.8	23	0.4	15	0.2	8	0.1	71	1.1
Associated .....	184	2.9	19	0.3	40	0.6	39	0.6	86	1.3
São Paulo										
Underlying .....	286	2.8	109	1.1	50	0.5	30	0.3	97	0.9
Associated .....	541	5.2	124	1.2	139	1.3	107	1.0	171	1.7

UNDERLYING AND ASSOCIATED CAUSES OF DEATHS OF CHILDREN 1-4 YEARS BY BROAD GROUPS IN 10 CITIES AND 2 RURAL AREAS: FIRST YEAR OF INVESTIGATION

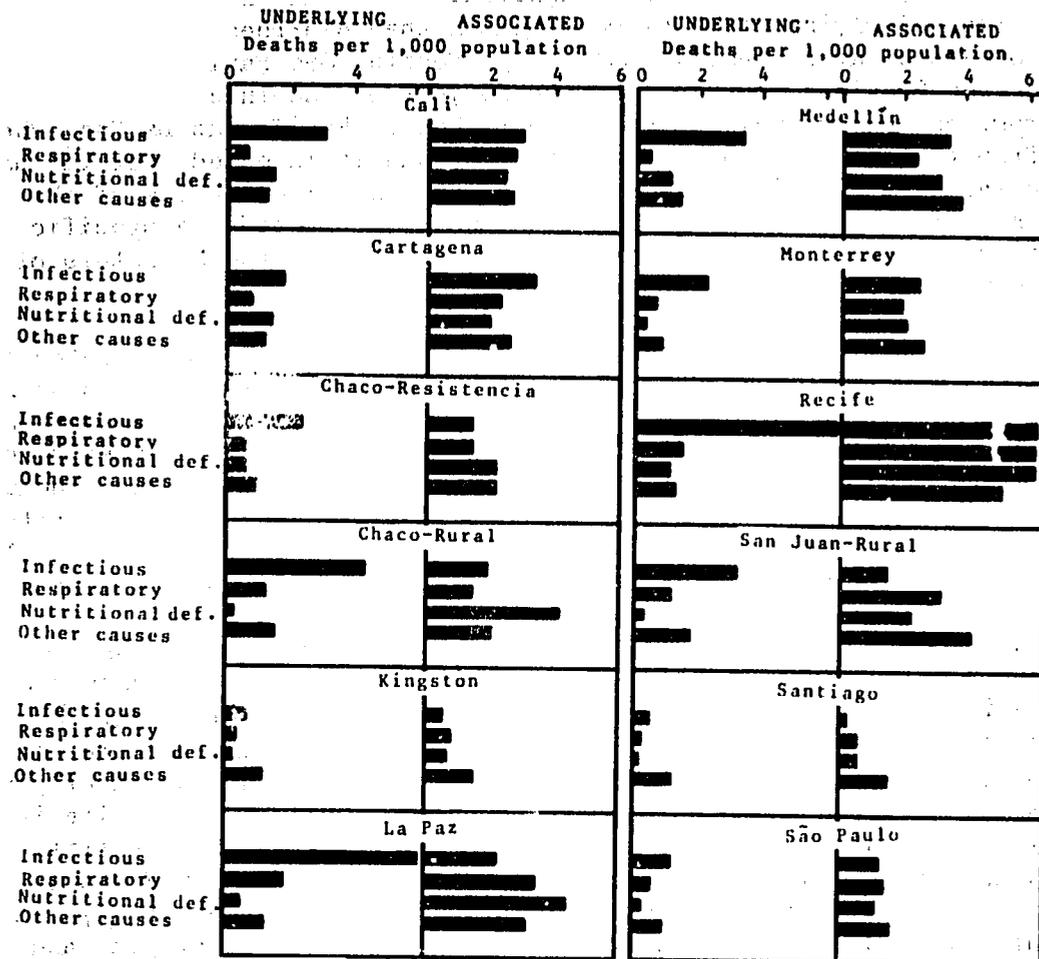
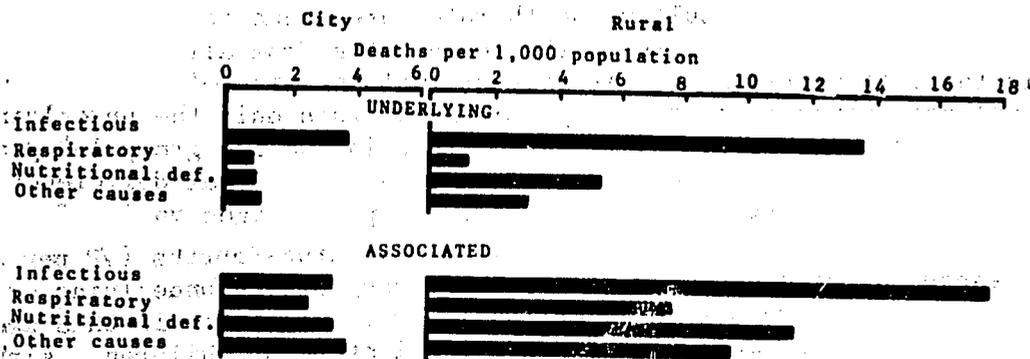


Figure 14b

UNDERLYING AND ASSOCIATED CAUSES OF DEATHS OF CHILDREN 1-4 YEARS BY BROAD GROUPS IN URBAN AND RURAL SAN SALVADOR; FIRST YEAR OF INVESTIGATION



In Recife and La Paz the infectious diseases were the underlying causes of nearly two-thirds of all deaths occurring in early childhood, with measles the largest single cause in Recife. While the role of diarrheal disease in the production of excessive mortality in this age group has been known, the seriousness of measles has not been recognized. In children 1-4 years of age, measles was the underlying cause of more deaths than diarrheal disease in three cities and one rural area; namely, Monterrey, Recife, São Paulo and the rural area of San Juan Province. During the second year of the Investigation, vaccination programs against measles were undertaken in Recife and La Paz, where mortality from this disease was unusually high, and it is hoped that the use of this vaccine on a sustained basis will be made in all countries of the Americas. As a result of early findings in the Investigation, a specific recommendation for such action was made at the Meeting of the Ministers of Health(7) in October 1968.

In the cities of Kingston and Santiago, with favorable death rates from all causes in early childhood, the pattern of underlying causes was distinctly different; in Santiago, for example, external causes became the leading cause of death in this group, with 27 deaths, while all infectious diseases produced only 23 deaths. The broad miscellaneous group of other causes which includes the neoplasms, congenital anomalies, diseases of the central nervous system and others acquires higher status in areas with low death rates. This illustrates the changes in mortality through prevention of infectious diseases.

As in the case of infant mortality, the study of multiple causes of death in early childhood permits measurement of the real size of morbid conditions which is otherwise masked by the use of single cause analyses. The data given in Table 6 and presented in Figure 14 show interesting interrelationships. Thus, the rates from the group of infectious diseases as underlying causes generally exceed those as associated causes, while the opposite is observed with the rates from diseases of the respiratory system, nutritional deficiency and other causes. In the rural communities near San Salvador, it was found that death rates were unusually high from all causes (Figure 14), and the infectious diseases and nutritional deficiency as underlying and associated causes are largely responsible for these excessive death rates.

In considering nutritional deficiency as a cause of death, it is evident that it is a major contributor to mortality in this age group. The deaths from nutritional deficiency as underlying or associated causes have been combined to reveal the true role of this condition in mortality (Table 5). The specific way in which nutritional deficiency operates as underlying or contributory cause or as a consequence of the underlying and other causes is given in the table. The resulting death rates are shown in the right hand side of Figures 12 and 13 to relate to the death rates from all causes which are shown in the left sections. It is evident that the size of the problem of nutritional deficiency in mortality is minimized when only the underlying cause is considered. In Recife and Ribeirão Preto in the age group 1-4 years, 70 per cent of the deaths occurred in children with nutritional deficiency. In Cali, Cartagena, Medellín and San Salvador, the percentages varied from 62 to 68. In rural communities of El Salvador, nearly three-fourths (72 per cent) of these deceased children had nutritional deficiency as the underlying or an associated cause. Thus, reduction of mortality from all causes in this age period necessitates improvement of the nutritional state of children. Although

important infectious diseases such as measles may be prevented through immunization, these children continue to be at great risk of death from other diseases and conditions because of their unfavorable nutritional state.

The section which follows gives additional information regarding nutritional deficiency, since it is responsible for excessive mortality in infancy and in early childhood.

### Nutritional Deficiency

Measurement of the direct and indirect role of nutritional deficiencies in mortality has been a constant preoccupation and objective of this Investigation. The nutritional state of the children who die has been assessed by the use of all information available, such as weight at birth and successive body weights, clinical history and autopsy data. The Gomez classification and scale (8, 9), based on the relationship of weights for age, applied to weight standards from Harvard<sup>(10)</sup> are being used for grading nutritional state. An effort has been made to determine whether nutritional deficiency is the underlying or an associated cause of death, following the rules of the International Classification of Diseases and rules developed in the Investigation. A group of experts in nutrition discussed in an internal meeting the nutritional aspects of the Investigation<sup>(11)</sup> and formulated recommendations regarding utilization of the results evolving from analysis of these data.

The role of nutritional deficiencies in mortality of infants and of children 1-4 years of age has been presented briefly in previous sections of this report. However, additional data are provided here regarding important aspects of their impact in specific age groups, the types of deficiencies found in deceased children, and their synergistic interrelationships with certain causes. The numbers of deceased children with nutritional deficiency as an underlying or associated cause in three age groups, under 1 year, 1 year, and 2-4 years, are given in Table 7. The death rates from nutritional defi-

Table 7. Nutritional Deficiency as Underlying or Associated Cause of Deaths for 3 Age Groups in Central Cities and Other Areas, First Year of Investigation

Central city and other area	Under 1 year		1 year		2-4 years	
	Number	Rate*	Number	Rate*	Number	Rate*
Cali	185	14.9	107	8.7	81	2.2
Cartagena	137	14.6	82	9.2	33	1.2
Kingston	104	5.6	37	2.1	19	0.4
La Paz	335	19.7	203	12.7	101	2.1
Medellin	155	15.5	89	9.3	67	2.3
Monterrey	571	17.3	134	4.3	111	1.5
Recife	608	37.1	217	15.5	159	4.1
Resistencia	146	29.2	29	6.4	16	1.3
Ribeirão Preto	71	15.8	12	2.9	16	1.3
San Juan	25	8.7	2	0.8	2	0.3
San Salvador	270	20.3	128	10.1	80	2.2
Santiago	230	14.6	31	2.0	15	0.3
São Paulo	559	20.1	77	3.0	58	0.7
Other area						
Chaco, rural	103	26.4	45	13.2	16	1.6
Francis	61	24.1	11	5.5	12	2.3
San Juan, suburban	90	23.7	12	3.5	3	0.3
San Juan, rural	139	30.3	24	6.0	17	1.4
San Salvador, rural	88	31.4	68	28.3	77	12.0

\*Excluding 4 other areas with insufficient deaths for analysis.

\*Under 1 year, rate per 1,000 live births; 1-4 years, rate per 1,000 population.

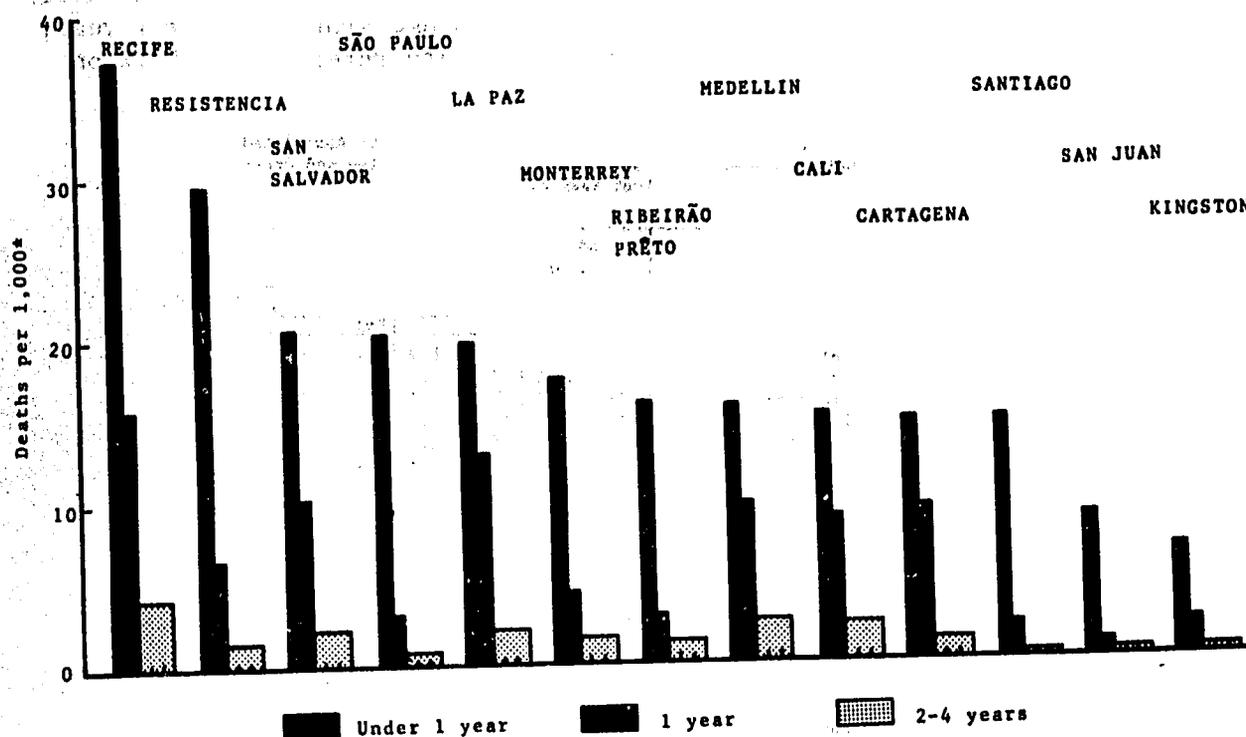
ciency by age and the variation of their magnitude for the cities and other areas within the projects are shown in Figures 15 and 16. In later analysis of data for the two years of the Investigation, further subdivision may be possible by single years of age.

In both the urban and rural areas of all projects (with the exception of the rural communities of the San Salvador Area), mortality from this cause is much greater in the first year of life than in early childhood. The true impact of nutritional deficiency in early life is revealed only through the study of multiple causes as shown in Tables 1 and 6. The involvement of nutritional deficiency in infant mortality is apparent from the first months of life and indicates the need for measures leading toward prevention of deficiency states from their very origin. Some measures may have to be applied even in the prenatal period, in the form of insuring satisfactory nutritional state and medical attention to mothers during pregnancy.

In the second year of life, the death rates are also high in several cities; namely, Recife, La Paz, San Salvador and the three cities in Colombia. The problem of nutritional deficiency is much more serious in its contribution to mortality in children under 2 years of age than in older children.

Figure 15

NUTRITIONAL DEFICIENCY AS UNDERLYING OR ASSOCIATED CAUSE OF DEATH FOR THREE AGE GROUPS IN CENTRAL CITIES, FIRST YEAR OF INVESTIGATION

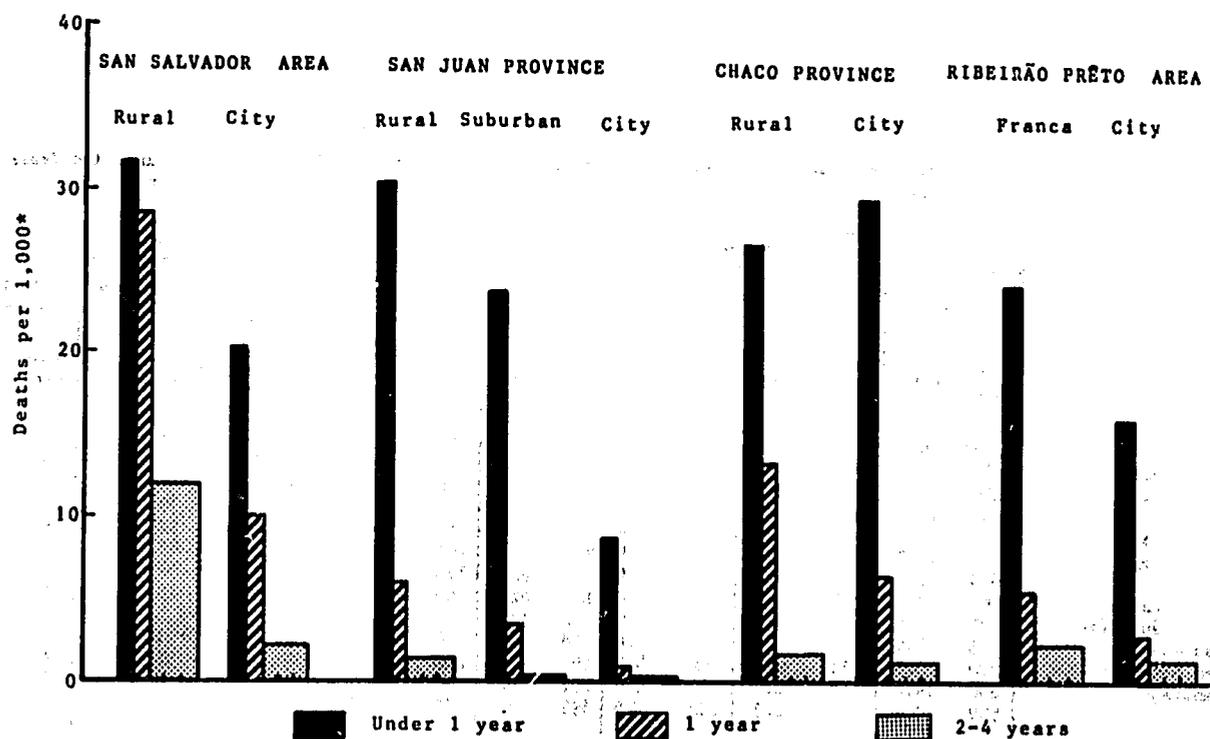


\*Under 1 year: deaths per 1,000 live births  
 1-4 years: deaths per 1,000 population

In four projects in which both urban and rural areas are included, and for which sufficient data are available, the death rates are shown in Figure 16. In the projects, with the exception of Chaco Province, the rates are much higher in the rural areas than in the cities. The problem is particularly serious in the rural communities near San Salvador; the death rate at one year of age is nearly as high as the rate in infancy. Also, the rate for the age group 2-4 years of 10 per 1,000 population is much higher than in the other areas. At this time, although the data for rural areas are limited, they indicate that the problem of nutritional deficiency is greater in suburban and rural areas than in the cities. There is sufficient evidence to begin planning preventive programs for cities and even for larger programs in suburban and rural areas.

Figure 16

NUTRITIONAL DEFICIENCY AS UNDERLYING OR ASSOCIATED CAUSE OF DEATH FOR THREE AGE GROUPS\*  
IN URBAN AND RURAL AREAS OF 4 PROJECTS, FIRST YEAR OF INVESTIGATION



\*Under 1 year: deaths per 1,000 live births  
1-4 years: deaths per 1,000 population

The International Classification provides separate categories for specific avitaminoses, 260-266; for protein malnutrition, 267; for nutritional marasmus, 268; and for other and unspecified types of nutritional deficiency, 269. This latter category includes nutritional states in which there is insufficient information for assignment to a more specific category. In this investigation, very few of the nutritional deficiency states which caused death, directly or indirectly, were specific avitaminoses. In fact, in only 15 deaths was an avitaminosis of the categories, 260-266, assigned, and in only one of these was the deficiency (vitamin C) assigned as the underlying cause of death. In all of the other deaths, one of the three categories, 267, 268 or 269, was assigned either as the underlying or an associated cause. Table 8 provides the numbers of deaths and death rates due to or associated with the following three categories of nutritional deficiency, protein malnutrition 267, nutritional marasmus 268 and other nutritional deficiency 269.

In infancy (under 1 year of age), relatively few deaths were attributed to protein malnutrition of the kwashiorkor type, while many more were from nutritional marasmus. In the cities from one-half to two-thirds of the deaths were assigned to the non-specific category, 269 (Figure 17), and were characterized by moderate or second degree malnutrition and by the unqualified forms of protein-calorie malnutrition.

**Table 8.** Nutritional Deficiency as Underlying or Associated Cause of Deaths of Infants and Children 1-4 Years by Type of Deficiency in Central Cities and Other Areas, First Year of Investigation

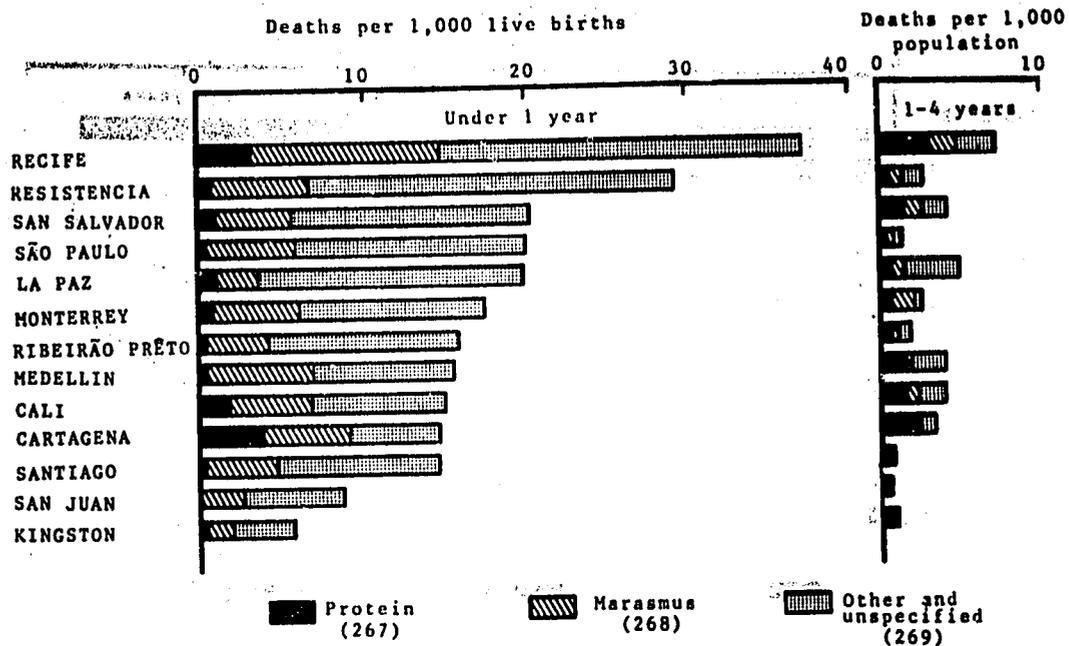
Central city and other area	Infant deaths								Children 1-4 years							
	Total		Protein malnutrition (267)		Marasmus (268)		Other (269)		Total		Protein malnutrition (267)		Marasmus (268)		Other (269)	
	Number	Rate	Number	Rate	Number	Rate	Number	Rate	Number	Rate	Number	Rate	Number	Rate	Number	Rate
Cali	185*	14.9	18	1.5	65	5.2	101	8.1	188	3.8	73	1.5	28	0.6	87	1.8
Cartagena	137	14.6	35	3.7	31	3.3	71	7.6	115	3.2	71	2.0	8	0.2	36	1.0
Kingston	104	5.6	4	0.2	29	1.6	71	3.8	56	0.9	13	0.2	13	0.2	29	0.4
La Paz	335	19.7	15	0.9	43	2.5	277	16.3	304	4.8	42	0.7	37	0.6	225	3.5
Medellín	155*	15.5	2	0.2	64	6.4	87	8.7	156*	4.0	53	1.4	12	0.3	90	2.3
Monterrey	571	17.3	17	0.5	111	3.4	443	13.4	245*	2.3	65	0.6	44	0.4	136	1.3
Recife	608	37.1	50	3.0	190	11.6	368	22.4	376	7.1	152	2.9	94	1.8	130	2.4
Resistencia	146	29.2	3	0.6	35	7.0	108	21.6	45	2.7	8	0.5	13	0.8	24	1.5
Ribeirão Preto	71	15.8	1	0.2	18	4.0	52	11.6	28	1.7	11	0.7	5	0.3	12	0.7
San Juan	25	8.7	-	-	7	2.4	18	6.3	4	0.4	-	-	1	0.1	3	0.3
San Salvador	270	20.3	11	0.8	62	4.7	197	14.8	208	4.2	70	1.4	51	1.0	87	1.7
Santiago	230**	14.6	2	0.2	69	4.4	157	9.9	46*	0.7	6	0.1	9	0.1	31	0.5
São Paulo	559*	20.1	8	0.3	152	5.5	399	14.4	135**	1.3	30	0.3	28	0.3	77	0.7
Other area																
Chaco, rural	103	26.4	3	0.8	7	1.8	93	23.8	61	4.5	7	0.5	7	0.5	47	3.5
Francia	61	24.1	1	0.4	17	6.7	43	17.0	27	3.2	3	0.4	2	0.3	18	2.5
San Juan, suburban	90	23.7	-	-	34	8.9	56	14.7	15	1.1	4	0.3	4	0.3	11	0.8
San Juan, rural	139	30.3	1	0.2	50	10.9	88	19.2	41	2.6	3	0.2	7	0.4	31	1.9
San Salvador, rural	88	31.4	9	3.2	11	3.9	68	24.3	145**	16.5	78	8.9	28	3.2	39	4.4

\* Includes one with category 260-266.

\*\* Excludes one associated cause with other nutritional deficiency.

Figure 17

MORTALITY IN INFANCY AND CHILDHOOD WITH NUTRITIONAL DEFICIENCY AS UNDERLYING OR ASSOCIATED CAUSE BY TYPE OF DEFICIENCY IN CENTRAL CITIES, FIRST YEAR OF INVESTIGATION



The pattern of death rates by type of nutritional deficiency was distinctly different in the 1-4 year age group. The clinical evidence was sufficient in over one-half of the deaths in 5 cities and 1 rural area for assignment to one of the specific categories. In Recife, of the deaths caused by or complicated by nutritional deficiency, the assignment was made to protein malnutrition in which edema was present in 152 or 40 per cent of the deaths and to nutritional marasmus in 94 or 25 per cent. Likewise, in San Salvador and in the rural communities near the city, protein malnutrition (267) accounted for high proportions of the deaths in this age group. In Cali, Medellín and Cartagena, Colombia, protein malnutrition was a serious cause of death in children in this age group with rates of 1.4-2.0 per 1,000 population. In Figure 18, the rates are shown for the urban and rural areas for these two age groups.

In order to clarify the relationship of nutritional deficiency as an associated cause of death to the underlying causes, deaths under 5 years, excluding neonatal deaths, have been combined in three broad groups of causes. Neonatal deaths have a distinct pattern, principally involving conditions present at birth and immaturity, and thus do not contribute to this analysis of nutritional deficiency by underlying causes. Data for postneonatal deaths and for deaths 1-4 years of age have been combined in Table 9 for the following three groups of underlying causes, infective and parasitic diseases (000-136),

Figure 18

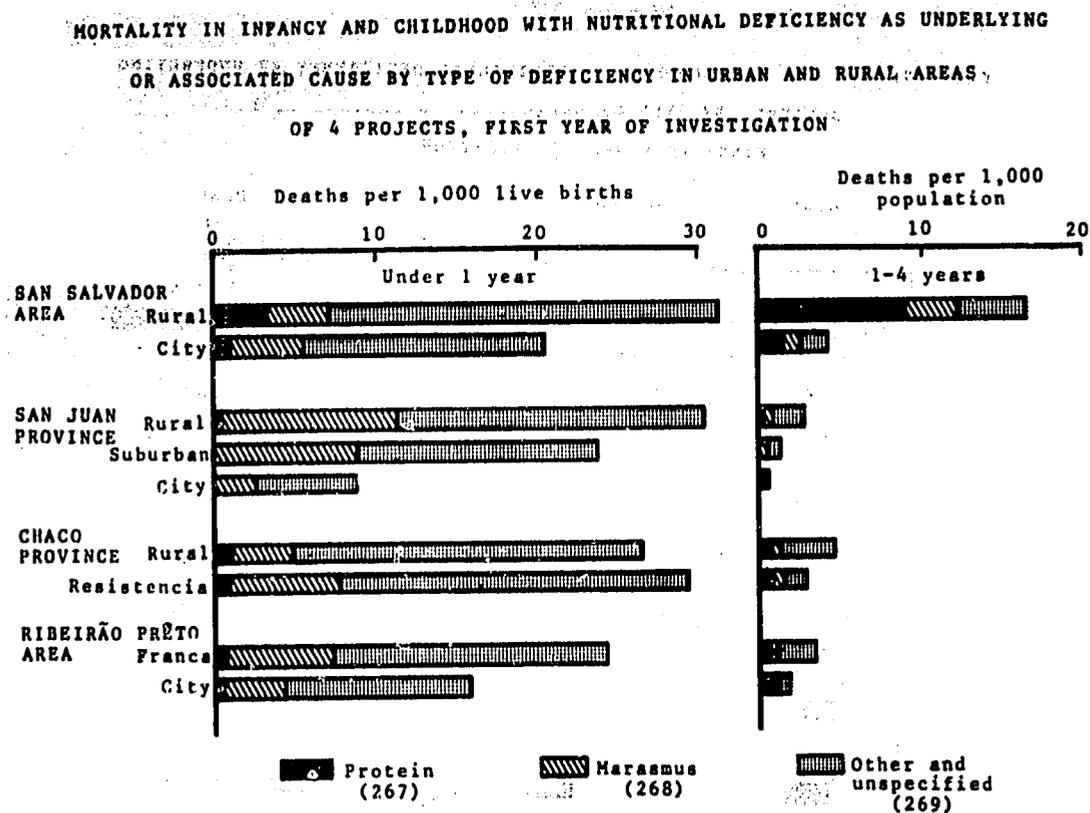


Figure 19

FREQUENCY OF NUTRITIONAL DEFICIENCY AS ASSOCIATED CAUSE FOR THREE-GROUPS OF UNDERLYING CAUSES OF DEATHS UNDER 5 YEARS, EXCLUDING NEONATAL DEATHS, IN CENTRAL CITIES, FIRST YEAR OF INVESTIGATION

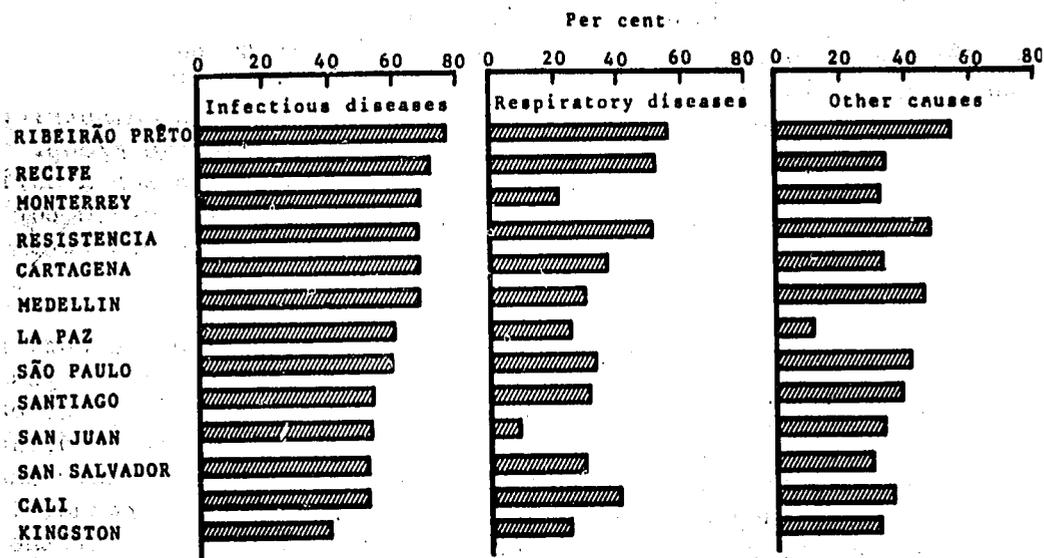


Table 9. Nutritional Deficiency as an Associated Cause of Death under 5 Years, Excluding Neonatal Deaths, by Underlying Cause Group in Central Cities and 5 Other Areas, First Year of Investigation

Underlying cause	Total deaths		With nutritional deficiency		Total deaths		With nutritional deficiency		Total deaths		With nutritional deficiency	
	Num-	Per cent	Num-	Per cent	Num-	Per cent	Num-	Per cent	Num-	Per cent	Num-	Per cent
	Call		Cartagena		Kingston		La Paz		Medellin			
All causes .....	667	266 39.9	403	176 43.7	413	131 31.7	1366	556 40.7	501	254 50.7	283	189 66.8
Infective and parasitic diseases ..	373	196 52.5	191	129 67.5	171	68 39.8	722	433 60.0	200	124 62.0	37	31 83.8
Diarrheal disease .....	275	141 51.3	125	87 64.0	143	58 40.6	395	266 67.3	46	34 73.9	54	-
Measles .....	49	32 65.3	17	16 94.1	3	1	236	119 50.4	55	16 29.1	109	49 45.0
Other .....	49	23 46.9	49	33 67.3	25	9 36.0	91	48 52.7	171	19 11.1	109	49 45.0
Nutritional deficiency .....	106	-	74	-	26	-	50	-	109	49 45.0	109	49 45.0
Diseases of respiratory system ....	83	33 39.8	61	22 36.1	63	15 23.8	423	104 24.6	109	49 45.0	109	49 45.0
Other causes .....	105	37 35.2	77	25 32.5	153	48 31.4	171	19 11.1	109	49 45.0	109	49 45.0
	Monterrey		Recife		Resistencia		Ribeirão Preto		San Juan			
All causes .....	1465	721 49.2	1471	880 59.8	298	170 57.0	143	96 67.1	65	24 36.9	30	16 53.3
Infective and parasitic diseases ..	854	578 67.7	993	704 70.9	185	125 67.6	91	69 75.8	19	13 68.4	6	2
Diarrheal disease .....	497	321 64.6	559	393 70.3	147	99 67.3	57	43 75.4	5	1	5	1
Measles .....	151	106 70.2	327	243 74.3	21	14 66.7	24	17 70.8	2	-	2	-
Other .....	206	151 73.3	107	68 63.6	17	12 70.6	10	9 90.0	12	1 8.3	21	7 33.3
Nutritional deficiency .....	64	-	84	-	20	-	3	-	21	7 33.3	21	7 33.3
Diseases of respiratory system ....	291	62 21.3	232	118 50.9	46	23 50.0	25	14 56.0	21	7 33.3	21	7 33.3
Other causes .....	256	81 31.6	172	58 33.7	47	22 46.8	24	13 54.2	21	7 33.3	21	7 33.3
	San Salvador		Santiago		São Paulo							
All causes .....	973	414 42.5	606	235 38.8	1235	558 45.2						
Infective and parasitic diseases ..	624	328 52.6	197	106 53.8	568	336 59.2						
Diarrheal disease .....	468	226 48.3	167	87 52.1	394	248 62.9						
Measles .....	91	63 69.2	7	7	81	42 51.9						
Other .....	65	39 60.0	23	12 52.2	93	46 49.5						
Nutritional deficiency .....	58	2 3.4	36	1 2.8	72	2 2.8						
Diseases of respiratory system ....	167	48 28.7	186	57 30.6	273	89 32.6						
Other causes .....	124	36 29.0	187	71 38.0	322	131 40.7						
	Chaco, rural		Franca		San Juan, suburban		San Juan, rural		San Salvador, rural			
All causes .....	318	153 48.1	141	69 48.9	207	80 38.6	357	140 39.2	392	173 44.4	257	147 57.6
Infective and parasitic diseases ..	183	115 62.8	78	51 65.4	89	46 52.8	170	84 49.4	196	107 54.6	37	28 78.4
Diarrheal disease .....	136	91 66.9	64	44 68.8	52	31 61.5	105	56 53.3	24	12 50.0	56	1 1.8
Measles .....	26	14 53.8	6	3	22	8 36.4	42	15 35.7	38	15 39.5	41	10 24.4
Other .....	21	10 47.6	8	4	15	7 46.7	23	13 56.5	41	10 24.4	41	10 24.4
Nutritional deficiency .....	9	-	12	-	19	-	29	-	41	10 24.4	41	10 24.4
Diseases of respiratory system ....	72	27 24.5	22	10 45.5	54	19 35.2	95	37 38.9	41	10 24.4	41	10 24.4
Other causes .....	54	11 20.4	29	8 27.6	45	15 33.3	63	19 30.2	41	10 24.4	41	10 24.4

\* Per cent not calculated for base less than 10.

diseases of the respiratory system (460-519) and all other causes, excluding nutritional deficiency. The percentages of these deaths with nutritional deficiency as an associated cause are shown in Figure 19 for 13 cities.

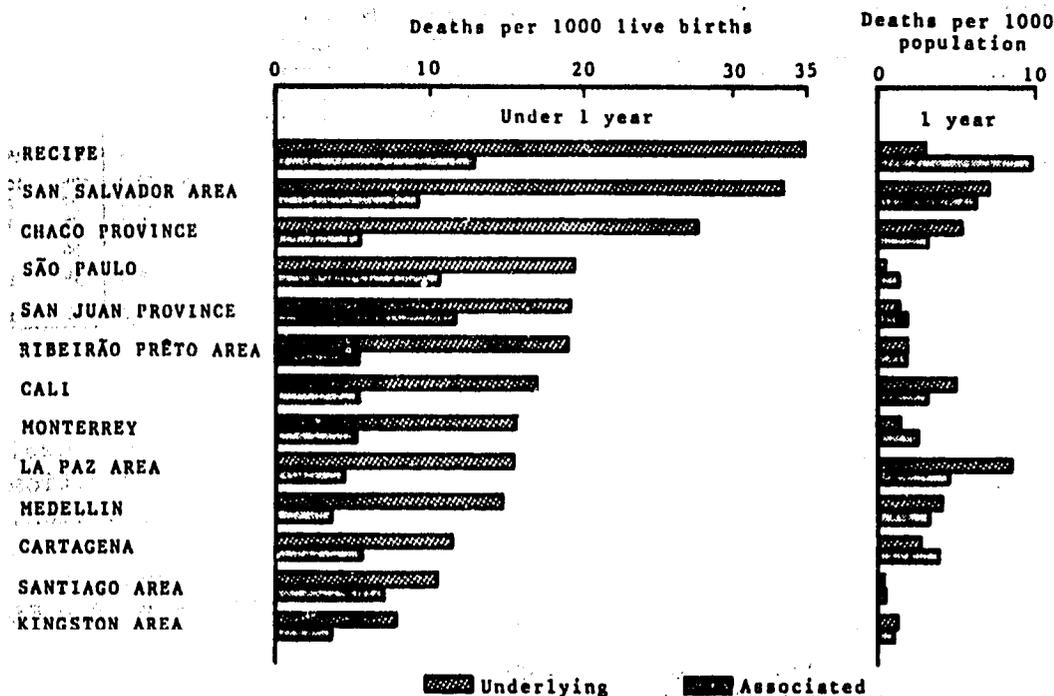
For deaths with infectious diseases as the underlying cause the percentage with an associated nutritional deficiency varied from 40 for Kingston to 71 for Recife and 76 for Ribeirão Preto. For the other two groups of underlying causes the corresponding percentage were lower. These findings are in accordance with previous research indicating the importance of the host as well as the infectious agent in the development of disease. In addition, they indicate the need for consideration of the interrelationships between diseases as a basis for community action.

The two principal infectious diseases as underlying causes are diarrheal disease and measles. Table 9 also provides data regarding the number and percentages of such deaths in which nutritional deficiency was an associated cause. For diarrheal disease, the percentages of the deaths with nutritional deficiency also were over 70 per cent in Recife and Ribeirao Preto. In early infancy, nutritional deficiency is frequently a result (consequence) of repeated episodes of diarrheal disease. Later in infancy and in early childhood, the deficiency state acts more often as a contributory cause of deaths due to specific causes, such as measles.

Since diarrheal disease is a major underlying cause, the death rates are shown in Figure 20 for infants and in the second year of life. Mortality due to diarrheal disease as an underlying or associated cause is much more serious in the first year of life than in the children one year of age. In infants, the death rates from diarrhea as an underlying cause exceed by far the rates from the same disease as an associated cause. During the second year of life, however, not only mortality from diarrheal disease is much lower, but the difference between death rates of underlying and associated causes narrows and even becomes the reverse. During the second year of life, mortality due to diarrhea is higher in those projects in which nutritional deficiency is also high in this age period, such as in San Salvador Area and the three projects in Colombia and in the La Paz Area.

Figure 20

DIARRHEAL DISEASE AS UNDERLYING AND ASSOCIATED CAUSES OF DEATHS FOR TWO AGE GROUPS IN 13 PROJECTS, FIRST YEAR OF INVESTIGATION



During the first year of the Investigation, epidemics of measles occurred in several of the projects. Mortality due to this disease was particularly high in Recife and La Paz, with rates of 481 and 299 per 100,000 population respectively, as shown in Figure 21. Santiago, where a vaccination program against this disease has been underway for several years, experienced very low mortality. Very few deaths occurred in the Kingston Area. In fact, during the period 1965-1968 there were only 4 to 14 deaths from measles in Jamaica.<sup>(15)</sup>

Study of the distribution of deaths from measles by age groups reveals that nearly all of these deaths occurred in children under 3 years of age with a peak in the 9-11 month or 12-14 month interval. In most areas in which measles mortality was excessive, approximately one-third of all deaths from this disease occurred in the first year of life, and of those, approximately one-half occurred in infants below nine months of age. This indicates that prevention of measles by immunization is needed before nine months of age.

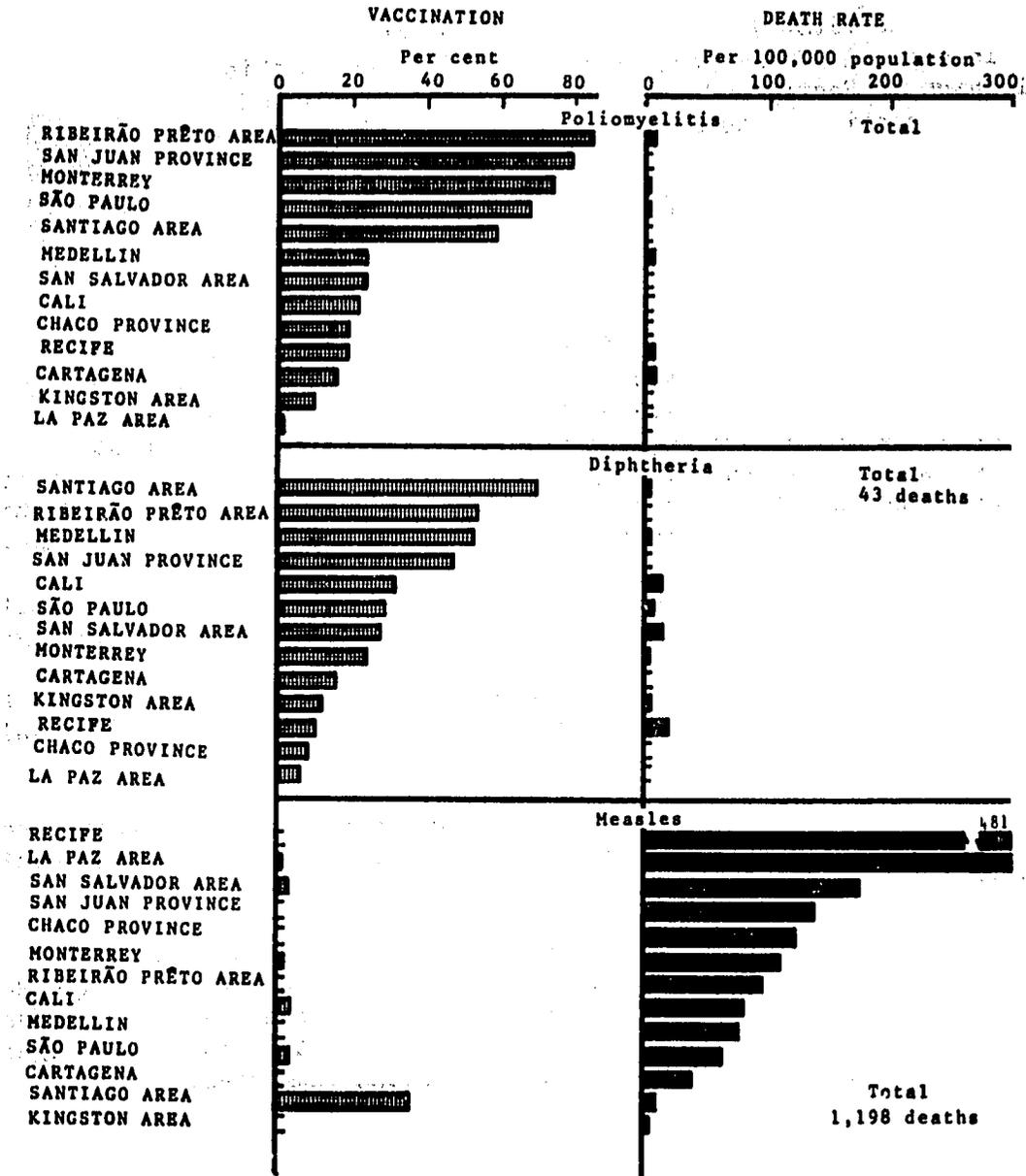
The percentage of children who had received vaccination against poliomyelitis, diphtheria, and measles are shown in Figure 21. Vaccination against measles was negligible in all projects except Santiago, where 37 per cent of the deceased children 1-4 years of age had been vaccinated. The death rates from measles were high in many areas, and the total number of deaths from measles was 1,198.

The impact of effective preventive programs against these communicable diseases is predictable and experience at national and international levels is abundant.

Judging from this experience, there is much to be done in several of the areas to reach an acceptable level of protection against these diseases. As discussed previously, an effective vaccination program against diseases such as measles in conjunction with prevention of malnutrition would significantly reduce childhood mortality in Latin American countries.

Figure 21

FREQUENCY OF VACCINATION AGAINST SPECIFIED DISEASES AND CORRESPONDING DEATH RATES OF CHILDREN 1-4 YEARS FOR 13 PROJECTS, FIRST YEAR OF INVESTIGATION



Breast Feeding and Other Factors

During the home interviews, information was obtained regarding the parents of the child, reproductive history of the mother, and information related to the deceased child such as breast feeding. In this section, breast feeding and three other factors are considered which have specific relationships.

Breast Feeding

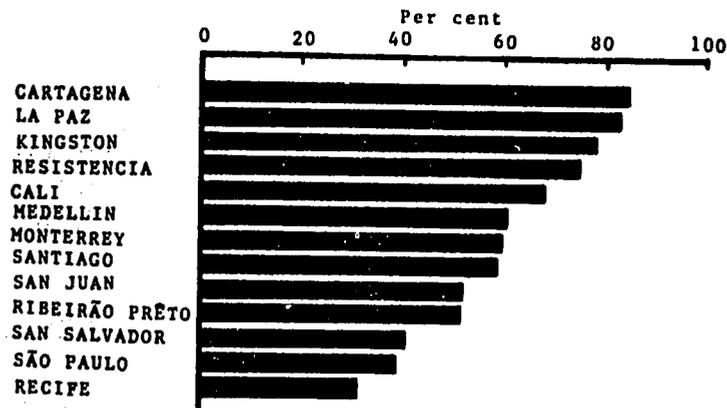
Because of its direct and indirect implications on nutritional state and on the incidence of diarrheal disease, breast feeding has been considered among the important factors related to mortality in childhood. Its duration as well as the introduction of complementary and supplementary foods of protein nature into the diet of deceased and living children has been investigated. The patterns of breast feeding in the areas of the Investigation will be known when the material of the probability sample of households for the two years is analyzed.

Data in this presentation relate to children under 5 years of age excluding the neonatal period. Premature infants dying in the hospitals who are not breast fed account for a major portion of neonatal deaths and is the reason that deaths in the neonatal period are excluded.

Table 10 provides information on breast feeding of deceased children by age for cities and other areas of the 13 projects. The differences in the cities in provision of breast feeding are marked, as can be seen in this table and in Figure 22. In Recife and San Salvador, less than 40 per cent of all

Figure 22

PERCENTAGE OF DECEASED CHILDREN UNDER 5 YEARS\* BREAST FED ONE MONTH OR LONGER IN CENTRAL CITIES, FIRST YEAR OF INVESTIGATION



\*Excluding neonatal deaths

Table 10. Percentage of Deceased Children\* Breast Fed One Month or Longer by Age at Death in Central Cities and Other Areas, First Year of Investigation

Central city and other area	28 days-4 years			28 days-11 months			1-4 years		
	Total children	Breast fed 1 month or longer		Total children	Breast fed 1 month or longer		Total children	Breast fed 1 month or longer	
		Num-ber	Per-cent		Num-ber	Per-cent		Num-ber	Per-cent
Cali	435	293	67.4	239	144	60.3	196	149	76.0
Cartagena	309	259	83.8	180	143	79.4	129	116	89.9
Kingston	383	297	77.5	253	188	74.3	130	109	83.8
La Paz	783	641	82.0	423	316	74.7	360	325	90.3
Medellin	364	218	59.9	196	99	50.5	168	119	70.8
Monterrey	1217	723	59.4	869	457	52.6	348	266	76.4
Recife	1328	410	30.9	838	225	26.8	490	185	37.8
Resistencia	292	216	74.0	221	154	69.7	71	62	87.3
Ribeirão Preto	126	64	50.8	93	38	40.9	33	26	78.8
San Juan	62	32	51.6	51	24	47.1	11	8	72.7
San Salvador	932	371	39.8	634	200	31.5	298	171	57.4
Santiago	500	287	57.4	404	224	55.4	96	63	65.6
São Paulo	1032	398	38.6	797	260	32.6	235	138	58.7
Other area									
Chaco, rural	309	236	76.4	208	151	72.6	101	85	84.2
Franca	111	72	64.9	77	41	53.2	34	31	91.2
Ribeirão Preto, rural	57	29	50.9	39	13	33.3	18	16	88.9
San Juan, suburban	201	107	53.2	159	75	47.2	42	32	76.2
San Juan, rural	346	219	63.3	252	142	56.3	94	77	81.9
San Salvador, rural	375	229	61.1	185	79	42.7	190	150	78.9
Santiago, suburban	72	43	59.7	63	38	60.3	9	5	**
St. Andrew, rural	56	45	80.4	30	24	80.0	26	21	80.8
Viacha	34	32	94.1	17	16	94.1	17	16	94.1

\*Excluding neonatal deaths; in families with home interviews.

\*\*Percent not calculated for base less than 10.

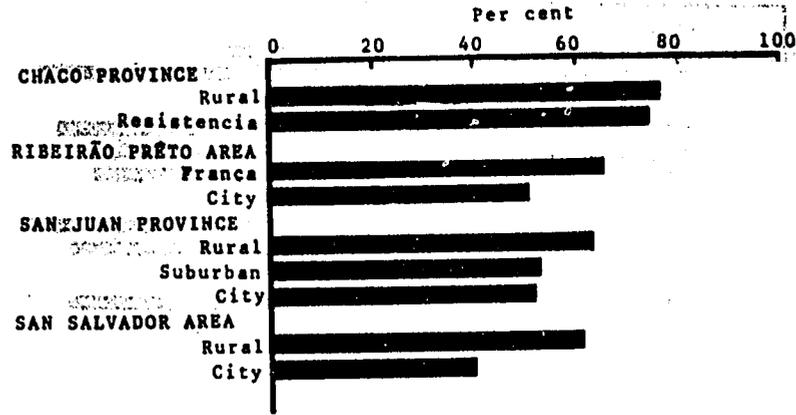
deceased children between 28 days-4 years of age had been breast fed for at least one month, while in Cartagena, La Paz, Kingston and Resistencia more than 70 per cent had been breast fed the same length of time. In general in the rural areas (Figure 23) proportions of deceased children breast fed for at least a month were slightly higher than in the corresponding cities and the variations in the rural areas were less than in the cities.

Another puzzling finding was that the proportions breast fed of the children who died at 1-4 years of age were higher than of children who died in the postneonatal period (Figures 24 and 25). A striking example of this is in São Paulo as shown below:

	Deaths	Breast fed	
		Number	Per cent
Postneonatal	797	260	32.6
1-4 years	235	138	58.7

Figure 23:

PERCENTAGE OF DECEASED CHILDREN UNDER 5 YEARS\* BREAST FED ONE MONTH OR LONGER IN URBAN AND RURAL AREAS OF 4 PROJECTS, FIRST YEAR OF INVESTIGATION.

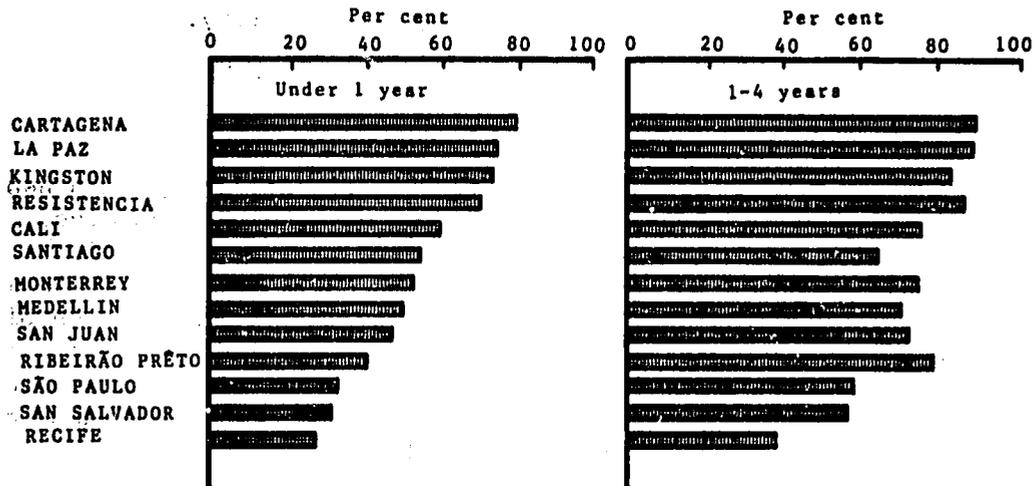


\*Excluding neonatal deaths

This difference of 26.1 between the percentages for breast feeding in the two age groups clearly indicates a need for further study of the two groups to understand the role of breast feeding on mortality as well as other factors involved. Study of the causes of death of children that were breast fed and those who were not breast fed is advisable. A similar and slightly smaller

Figure 24

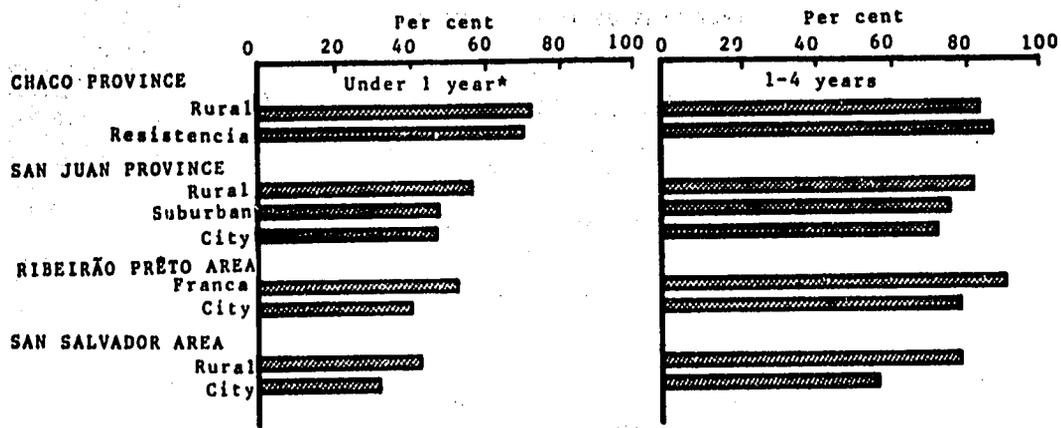
PERCENTAGE OF DECEASED CHILDREN\* BREAST FED ONE MONTH OR LONGER FOR 2 AGE GROUPS IN CENTRAL CITIES, FIRST YEAR OF INVESTIGATION



\*Excluding neonatal deaths

Figure 25

PERCENTAGE OF DECEASED CHILDREN\* BREAST FED ONE MONTH OR LONGER FOR 2 AGE GROUPS  
IN URBAN AND RURAL AREAS OF 4 PROJECTS, FIRST YEAR OF INVESTIGATION



\*Excluding neonatal deaths

difference of 23.8 was noted in Monterrey. At the two extremes, with high and with low proportions breast fed, the differences were small. In Recife, low percentages were noted for both age groups. In Cartagena and Kingston, the percentages were high in both age groups. However, in each city or other area the differences were in the same direction, with higher percentages breast fed for the children 1-4 years of age.

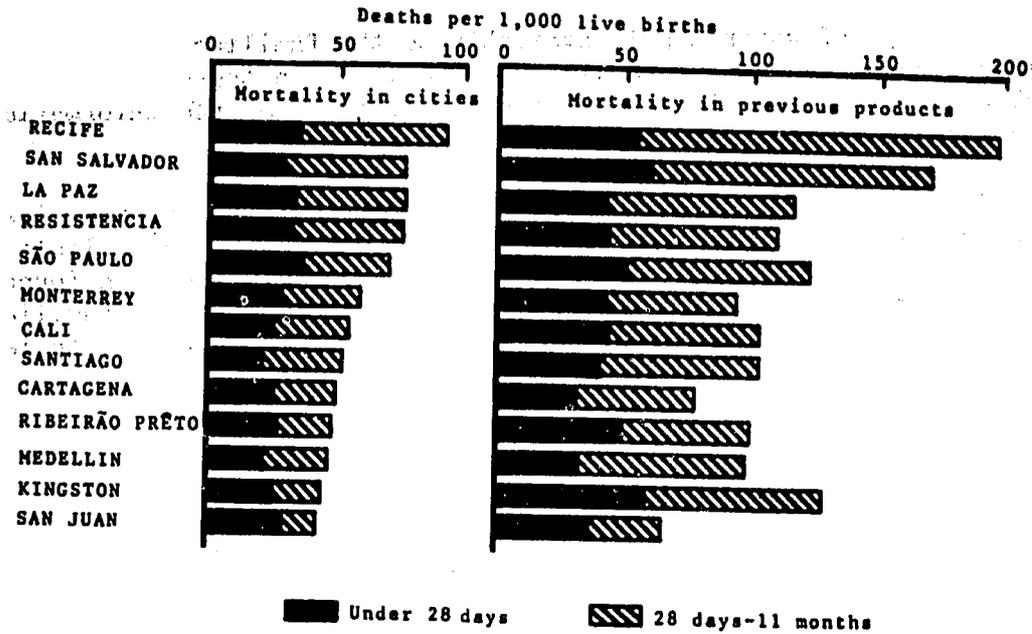
The cities with the very high death rates, Recife and San Salvador, have small proportions of children breast fed. Also, these same cities have other unfavorable conditions such as limited prenatal care and piped water supplies available to only a small portion of homes. Thus, limited breast feeding and several other negative factors in combined action contribute greatly to excessive death rates in these areas. Further analyses are indicated for greater understanding of the effect of breast feeding on mortality.

Infant Mortality in Products of Previous Pregnancies

From data regarding age at death and live births, infant and neonatal death rates in products of previous pregnancies have been calculated. In all of these projects, infant mortality of the previous live births was greater than that found in the Investigation, as shown for the cities in Figure 26. The high infant mortality among the previous live born children of the mothers in this Investigation may be indicative of a specific group with high risk of pregnancy loss. Part of the difference in the rates is due to the time factor since infant mortality has been declining and the infants of older mothers would have experienced conditions of 10 years ago.

Figure 26

INFANT MORTALITY IN CENTRAL CITIES AND IN PRODUCTS OF PREVIOUS PREGNANCIES OF MOTHERS OF DECEASED CHILDREN, FIRST YEAR OF INVESTIGATION

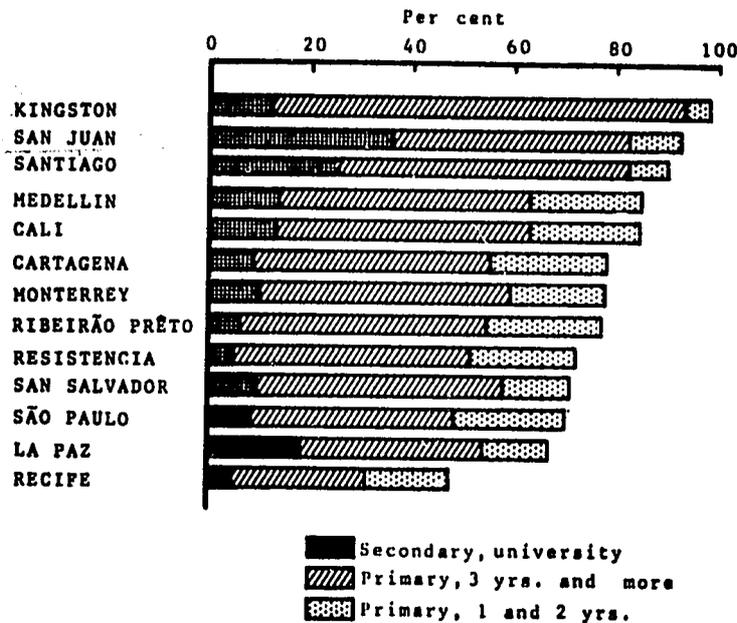


Education of the Mother

The years and level of education of the mothers of deceased children were obtained in the home interview and are presented in three divisions (Figure 27). Here again, as in many of the factors considered, there is a wide variation. Small proportions of mothers of the deceased children had secondary, technical, or university education. Such education was more frequent in the cities of San Juan and Santiago than in the other cities (35.9 and 25.3 per cent respectively).

Figure 27

EDUCATIONAL LEVEL OF MOTHERS OF DECEASED CHILDREN IN CENTRAL CITIES, FIRST YEAR OF INVESTIGATION



## Water Supply

The type of water supply available to the families of deceased children was investigated during the family interview. As in the case of other environmental and socio-cultural factors, the completeness of the information depends on the success in locating the homes.

The information on water supply was limited to piped water inside or outside the house or other sources of supply. As presented in Table 11 and Figure 28, piped water, either inside or outside the house, was found to be provided to more than 80 per cent of the homes of interviewed families in six cities: Cali, Cartagena, Kingston, Medellín, San Juan and Santiago. In

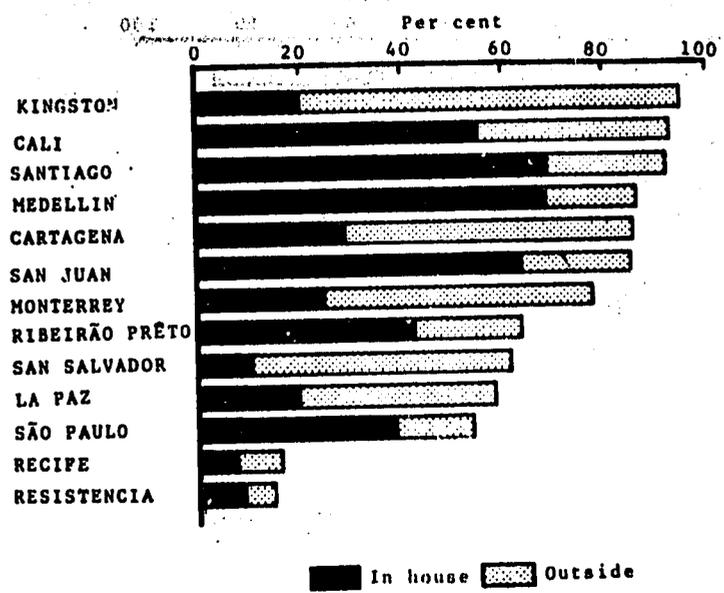
Table 11. Water Supply in Homes of Deceased Children under 5 Years in Central Cities and Other Areas, First Year of Investigation

Central city and other area	Total homes*	Piped water				Other or unknown	
		In house		Outside		Number	Per cent
		Number	Per cent	Number	Per cent		
Cali	667	365	54.7	251	37.6	51	7.6
Cartagena	410	117	28.5	229	55.9	64	15.6
Kingston	841	164	19.5	631	75.0	46	5.5
La Paz	1,078	194	18.0	422	39.1	462	42.9
Medellín	497	335	67.4	90	18.1	72	14.5
Monterrey	1,809	437	24.2	956	52.8	416	23.0
Recife	1,817	108	5.9	165	9.1	1544	85.0
Resistencia	428	33	7.7	25	5.8	370	86.4
Ribeirão Preto	226	94	41.6	48	21.2	84	37.2
San Juan	128	81	63.3	27	21.1	20	15.6
San Salvador	1,273	117	9.2	653	51.3	503	39.5
Santiago	743	507	68.2	175	23.6	61	8.2
São Paulo	1,867	702	37.6	286	15.3	879	47.1
Other area							
Chaco, rural	470	6	1.4	11	2.6	403	96.0
France	210	45	21.4	26	12.4	139	66.2
Ribeirão Preto, rural	97	44	45.1	46	47.4	17	17.5
San Juan, suburban	343	56	16.3	57	15.2	235	68.5
San Juan, rural	524	23	4.4	21	4.0	480	91.6
San Salvador, rural	464	2	0.4	63	13.6	399	86.0
Santiago, suburban	98	16	16.3	47	48.0	35	35.7
St. Andrew, rural	83	4	4.8	38	45.8	41	49.4
Vincha	53	20	37.7	21	39.6	12	22.6

\*With family interviews.

Figure 28

PERCENTAGE OF HOMES OF DECEASED CHILDREN WITH PIPED WATER  
IN CENTRAL CITIES, FIRST YEAR OF INVESTIGATION



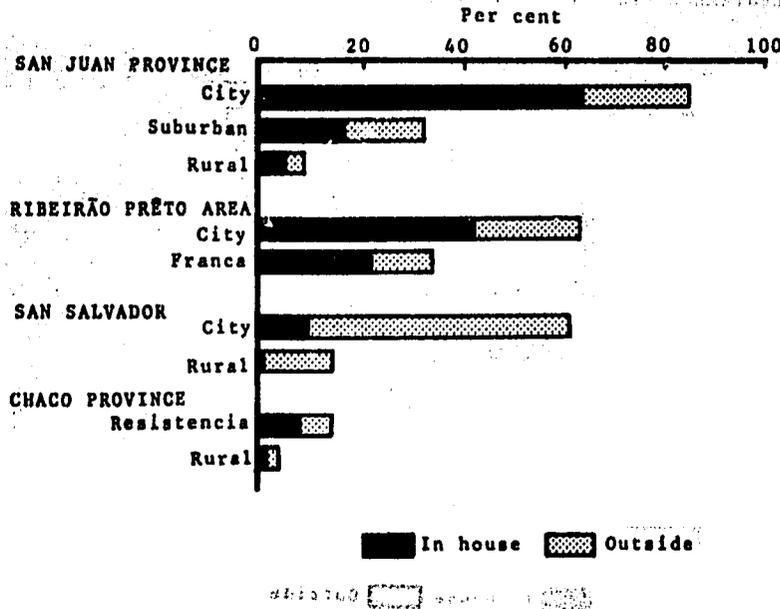
the Colombian projects of Cali and Cartagena, location of homes was unsuccessful for over 30 per cent of the deceased children and thus environmental conditions are not known in that high proportion. However, the principal collaborators of these projects report that piped water is available to nearly all the population.

In Resistencia and Recife and several rural areas, a very small proportion of homes had piped water. In the projects that include also suburban and rural areas, the differences in the provision of piped water are striking as given in Table II and shown in Figure 29.

The central cities and other areas with limited water supplies, especially Recife, Resistencia and San Salvador, are the ones with excessive mortality of children under 5 years of age. In contrast, Kingston and Santiago with water supplies available to high proportions of homes have low death rates. Cali and the other cities in Colombia, however, with water provided to a high proportion of homes have intermediate positions in mortality. Thus, the provision of water does not appear to have the same inverse correlation for these areas as presented in the Progress Report, June 1970. Within Brazil, the inverse relationship is noted and likewise, when urban and rural areas in projects are studied. In Figure 30 the relationship between availability of piped water and death rates is presented for the rural areas and corresponding cities of four projects. In these an inverse relationship can be observed

Figure 29

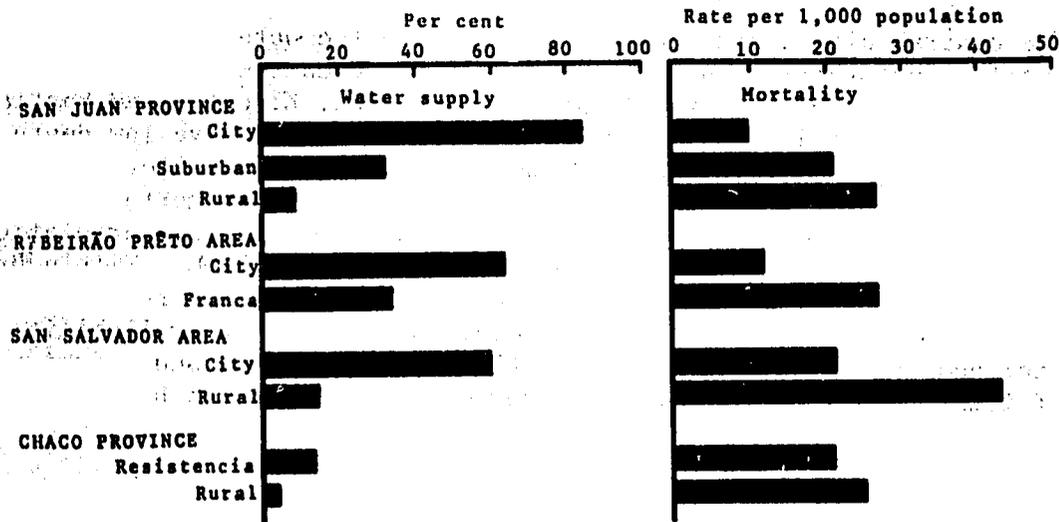
PERCENTAGE OF HOMES OF DECEASED CHILDREN WITH PIPED WATER IN URBAN AND RURAL AREAS OF 4 PROJECTS, FIRST YEAR OF INVESTIGATION



between mortality and availability of piped water. Thus, it seems evident that intensive efforts should be made to provide urban and rural populations with adequate service of water supplies. Lack of this essential sanitary facility can be an important contributing factor to high mortality in infancy and childhood particularly in areas in which breast feeding and other sources of high quality nutrients are insufficient.

Figure 30

PERCENTAGE OF HOMES OF DECEASED CHILDREN WITH PIPED WATER AND MORTALITY UNDER 5 YEARS IN URBAN AND RURAL AREAS OF 4 PROJECTS, FIRST YEAR OF INVESTIGATION



In summary, wide differences are noted in social and biological factors affecting mortality in these families of deceased children. The reproductive histories reveal serious pregnancy losses in several areas and high infant mortality of previous products of these mothers. The relation of breast feeding to infant mortality requires further exploration. In general, the data indicate

sufficiently different patterns of these social, cultural and biological characteristics to recommend collection of complete and accurate data on live births and infant deaths for analyses for greater understanding of natality and mortality in each country.

### Utilization of Results

An important objective of the Investigation is full utilization of the findings for local, national and international actions. Although the projects were conducted in specific areas, certain results serve also for indication of problems in other areas of the countries and for neighboring regions. Serious problems revealed, such as nutritional deficiency, deserve additional studies for measurement and actions at the local level. There are several important fields for action which include among others maternal and child health and research and teaching.

Integrated Maternal and Child Health Programs. The comprehensive study of mortality in childhood, taking into account the multiple causes of death and the determination of contributing factors, provides measurement of the major problems in child health. This knowledge should be utilized in planning activities for improvement of the health of mother and child.

Throughout this report, the interrelationships of diseases and conditions such as immaturity, nutritional deficiency and infectious diseases have been analyzed. The availability and use of adequate food supplies by mothers and their children is probably the most important factor to be stressed for the prevention of mortality. Several factors have been analyzed such as breast feeding, prenatal care, vaccinations and provision of water supplies which indicate the need for actions in these specific fields.

From the preliminary analysis of the information obtained during the first year of data collection, it seems evident that in several areas and possibly in several countries the health problems are serious. Indeed there seems to exist an unavailability and/or subutilization of basic health services, such as prenatal care, hospital services for delivery, and prophylactic health services against childhood diseases and nutritional deficiency.

The magnitude of these deficiencies is increased by the reciprocal actions of unfavorable factors prevalent in these areas. Such is the case in the low level of education in general, the inadequate environmental sanitation, especially in relation to water supplies and housing conditions. All these and other adverse factors result in excessive biological wastage.

The solution to the complex health problems of mother and child requires comprehensive and coordinated actions within a multisectorial and multidisciplinary approach. For example, immunization programs against an infectious disease as measles will succeed in the prevention of measles, but without improvement of the nutritional state, the susceptible child will probably continue to be at risk of death from another infectious disease. Without provision of water for the family, the risk of spread of diarrheal diseases continues. Thus, an attack on these problems simultaneously is strongly recommended.

Research and Teaching. Community centered research in health problems is an ideal method for faculties of medicine and public health to obtain knowledge of local conditions and to teach from their findings and experience locally. The patterns of mortality in infancy and childhood vary widely and only through knowledge of the specific problems can actions be taken. Problems have been revealed in the Investigation that can be solved by the leadership of health authorities and faculties of such schools. This program is only a beginning, involving 14 schools of medicine or public health. Greater participation in research by such faculties in the Americas will have immeasurable benefits.

In the area of education, the material collected locally should be used for teaching in schools of medicine and public health and in the schools of other health sciences. Seminars, analyses and discussions of specific phases of the Investigation as well as studies of local problems with field work by students would contribute to understanding the role of community centered research and the actions required for solution of problems. The analyses could serve in the orientation, in the methodology of teaching and in the content of curricula, principally in the fields of maternal and child health, epidemiology, social medicine and statistics. The development of important disciplines, such as pathology in general and pediatric pathology in particular, is highly recommended in order that the standard of teaching and practice in the disciplines related to maternal and child health be elevated.

Operational research in the delivery of health services is urgently needed. Once the serious health problems are measured and the related factors described, practical solutions within the context of the resources available should be found and applied.

The improvement of nutritional status and prevention of infectious diseases deserve the highest priority for operation research leading to development of practical procedures adaptable to local needs and characteristics of areas.

Epidemiological studies of the longitudinal type in human reproduction taking into account biological, social and environmental factors are highly recommended in order to understand the differences in patterns of vital wastage. This knowledge is essential for sound programs oriented to attaining optimal reproduction and health of the product of conception.

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