

RESULTS OF THE INTER-AMERICAN INVESTIGATIONS OF MORTALITY RELATING TO REPRODUCTION¹

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What are the most desirable ages for mothers to have their babies? What should be considered satisfactory intervals between births? What is the most favorable range of birthweight for health and survival? Data from the Inter-American Investigations of Mortality suggest answers to these important questions.

The two large Inter-American Investigations of Mortality (1, 2)⁴ have given us information on reproduction-related problems that have clear implications for maternal and child health programs. Moreover, they have shown the need for additional research in fields that are involved in planning for the health and survival of infants. As the basis for maternal and child health programs in developing countries, much more knowledge is needed about human reproduction, and research should be an essential element of such programs.

Many questions need answers. What are the most desirable ages for mothers to have their babies? What should be considered satisfactory intervals between births? How much should a

mother gain in pregnancy in order to have a healthy baby? Does weight gain in pregnancy affect the infant's birthweight? What is the most favorable range of birthweight for health and survival? How does the distribution of birthweight vary in different societies and why? Does the nutritional state of the mother affect the health of her child?

Surprisingly, most of these questions have not been answered even in the developed countries. In the United States of America, for example, the Committee on Maternal Nutrition of the National Academy of Sciences (3) called attention in 1970 to the need for greater emphasis on studying the normal processes of human reproduction and made the following recommendation: "Support should be sought from foundations and governmental agencies for establishing and maintaining one or more multidisciplinary research and training centers for studying the biology of human reproduction. Definitive answers must be sought to questions about specific relationships between nutrition and the course and outcome of pregnancy." Community-centered research and training centers of the kind indicated should be given especially urgent priority in Latin America, for the problems of immaturity⁵ and

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⁵An *immature* infant is one weighing 5-1/2 pounds (2,500 g) or less at birth or one specified as immature by the attendant at the time of delivery. See discussion later in this paper.

of early nutritional deficiency are very much in need of clarification.

Maternal Mortality

One of the unexpected findings from the first Investigation (1), which studied deaths occurring in adults, was the excessive maternal mortality in the Latin American cities. Often the figure obtained in the Investigation was higher than the official rate. For example, in Bogotá the latter, calculated from the causes as stated on the death certificates, was 7.9 per 10,000 live births, whereas in the final assignment,⁶ based on all available clinical and pathological information, it was 12.6. In Mexico City the original and final rates were 11.2 and 15.6, respectively. In the 12 cities the final rates varied from a low of 1.1 in San Francisco to a figure 29 times higher in Santiago (31.6).

Abortion accounted for 34 per cent of the maternal deaths. Mortality from this cause was very high in three cities—16.6 deaths per 10,000 live births in Santiago, 8.0 in Cali (Colombia), and 7.5 in Guatemala City. In four others—Bogotá, Caracas, La Plata (Argentina), and Mexico City—it ranged from 3.1 to 4.6 per 10,000 live births, and it was lower than 3.1 in only three Latin American cities. Thus in some of these instances abortion may be regarded as a public health problem of major proportion. Fortunately, its seriousness as a cause of maternal mortality is now widely recognized. Many studies have been undertaken on the subject, and measures to prevent such needless loss of life are being introduced.

Infant Mortality

The Inter-American Investigation of Mortality in Childhood was designed to establish death rates for infancy and early life that would be as accurate and comparable as possible,

taking into account biological as well as nutritional, sociological, and environmental factors. The first Investigation had demonstrated the importance of studying mortality from the standpoint of its multiple causes, as well as the value, in understanding the epidemiology of diseases, of considering them not as isolated entities but rather as combinations of pathological states. In order to analyze both the underlying and associated causes of death and to examine the interrelationships among diseases and other conditions, it was decided to seek complete data on deaths in children under five years of age in accordance with standard definitions and procedures. To relate mortality to biological and other factors, considerable information was required regarding the mother, her age at delivery of the child who died, her reproductive history, her breast-feeding pattern, and the health care she had received.

As work progressed, many deficiencies in hospital records and procedures and in registration systems were uncovered. Also, the lack of standardization in the use of such terms as *abortion*, *stillbirth*, and *live birth* was found to be serious enough to invalidate many previous comparisons of neonatal and infant mortality.

Of the 27,602 deaths in the first year of life, 2,107, or 7.6 per cent, had not been registered. The problem was concentrated mainly in the neonatal period. In the first day of life alone the figure was 21.5 per cent for the 15 projects taken together,⁷ and it exceeded 10 per cent in 10 of them. At the beginning of the Investigation methods were introduced for evaluation of the completeness of registration. A standard of 10 deaths in the first day of life per 1,000 live births was adopted, this being the rate observed by Shapiro, Schlesinger, and Nesbitt (4) in the United States over the period 1950-1964. The nonregistered deaths were sought by consulting delivery books and clinical records in hospitals. All deaths in children under five years of age that were discovered in this manner were included in the Investigation.

⁶The procedure followed for arriving at the final assignment of cause of death is described in Chapter 15 of Puffer and Griffith (1), especially pp. 226-229 and 238.

⁷A full description of each of the projects and their population characteristics is given in Puffer and Serrano (2), pp. 8-26.

Table 1. Infant deaths per 1,000 live births, by age group, in 24 areas of 15 projects, Inter-American Investigation of Mortality in Childhood.

Project and area	Under 1 year (1)	Under 1 day (2)	Neonatal (under 28 days) (3)	Post-neonatal (3) from (1)
ARGENTINA				
Chaco Province				
Resistencia	76.2	11.9	33.4	42.8
Rural departments	85.0	8.8	30.9	54.1
San Juan Province				
San Juan (city)	50.7	8.9	29.6	21.1
Suburban departments	87.9	13.8	44.6	43.3
Rural departments	94.5	10.1	39.6	54.9
BOLIVIA				
La Paz	73.0	8.3	28.5	44.5
Viacha	123.5	14.1	49.4	74.1
BRAZIL				
Recife	91.2	11.7	35.3	55.9
Ribeirão Preto				
Ribeirão Preto (city)	43.0	10.2	24.0	19.0
Franca	71.5	13.4	36.9	34.6
Communities	50.8	12.0	27.1	23.7
São Paulo	65.1	10.7	33.7	31.4
CANADA				
Sherbrooke	18.3	8.6	13.5	4.8
CHILE				
Santiago	54.9	10.0	27.2	27.7
Comunas	57.9	6.5	19.4	38.5
COLOMBIA				
Cali	54.6	10.4	25.4	29.2
Cartagena	47.8	8.2	22.4	25.4
Medellín	47.6	7.0	19.7	27.9
EL SALVADOR				
El Salvador	81.7	9.3	28.2	53.5
Rural municipios	120.0	12.6	36.1	83.9
JAMAICA				
Kingston-St. Andrew	38.8	7.9	24.2	14.6
MEXICO				
Monterrey	60.7	10.6	26.0	34.7
UNITED STATES				
San Francisco	18.5	7.2	13.0	5.5
California, suburban	17.2	7.4	12.7	4.5

The infant death rates for the 24 areas of the 15 projects varied widely, from less than 20 per 1,000 live births in three to 120 or more in two of the rural ones, the highest being 7.2 times the lowest (Table 1). Close scrutiny of the deaths by age and by causes revealed a wide diversity in pattern. Each of the 24 areas appeared to have distinct differences from the others—although there were similarities as well. The various patterns can be viewed critically in terms of the possibilities of reducing mortality through preventive programs. The death rates for the first day of life, for the first 28 days, and for the postneonatal period are given in

Table 1. In the Latin American projects those after the first day of life showed a wide range, especially in the postneonatal period. While mortality after the first day of life has been reduced markedly in developed countries, the high rates in the first 24 hours continued to be a source of concern for obstetricians and pediatricians in all areas.

The inclusion of nonregistered deaths contributed to discovery of the serious problem of immaturity (category 777 of the International Classification of Diseases—5) in many areas of Latin America. The Sixth Revision of the International Classification (6) stipulates that

“an immature infant is a liveborn infant with a birthweight of 5½ pounds (2,500 g) or less, or specified as immature.” This definition was utilized in the Investigation. It was then necessary to determine the precise role of immaturity as either an underlying or associated cause of death. The rules for classification specified that immaturity was not to be considered the underlying cause “if any other cause of perinatal mortality is reported.”

The death rates from immaturity as an underlying or associated cause⁸ for the 15 projects are shown by the dark sections in Figure 1. They were surprisingly high in several areas, exceeding 20 per 1,000 live births in five. In Santiago the figure was 19.7 per 1,000 live births, whereas if the nonregistered deaths had not been included, it would have been only 12.2. The rate in Cartagena was more than doubled by the discovery and inclusion of nonregistered deaths. In none of the Latin American projects was it under 10 per 1,000 live births. Such high death rates from immaturity have raised questions regarding the frequency of immature or low-birthweight babies, and this subject will be covered in a later section.

Nutritional deficiency was also a cause of excessive mortality in early infancy. In fact, for the 13 Latin American projects combined, the highest rates were observed in infants only two and three months of age. This finding of high death rates so early in life was unexpected and has raised questions regarding the condition of babies at birth.

Several areas that had high death rates with immaturity as a cause also had high rates for nutritional deficiency (Figure 1). It should be kept in mind that birthweights were not available for infants born at home and for some of those born in hospitals. Even so, and despite the marked variations in the material available from such widely separated areas, there appears to be some correlation between these two indicators of deficits in growth and development.

⁸The basic data for the figures presented here are from Puffer and Serrano (2) unless otherwise indicated.

In Recife for every 1,000 live births 60 of the infants who died had evidence of immaturity or nutritional deficiency, indicating serious problems. In the Latin American projects in general the death rate from these two causes together was higher in rural areas than in the neighboring cities. For example, in the rural communities of El Salvador it was 53 per 1,000 live births, whereas in the city of San Salvador it was 42. Likewise, the rate was much higher in the suburban and rural areas of San Juan Province (54) than in the city (28). These results suggest more serious problems in rural areas. Could it be that birthweights are lower there than in the cities?

The Investigation's findings on immaturity and nutritional deficiency in early life indicate a need to explore the factors in reproduction which are responsible for such excessive mortality. Why are these rates so high? Age of the mother, birth order, and birthweight are all probable determinants, and thus reference to the data available on these factors—though limited at present, especially on birthweight—is helpful for putting the matter into proper focus.

If we are to expand the study of these relationships in the future and lay solid bases for the planning of preventive action, a concerted effort will be needed to ensure the availability of data of good quality. Vital statistics systems, if modernized, can be used—as in the New York City study (7), which was based on official birth and death certificates.

Infant Mortality According to Age of the Mother

In addition to underlying and associated causes of infant mortality, other factors such as maternal age and birth order have a direct relationship to the health and survival of the infant. The calculation of death rates by maternal age group is dependent on obtaining for the same areas the distribution of live births by age of the mother, the denominator for infant death rates. Fortunately, this information was available for six of the Latin American projects.

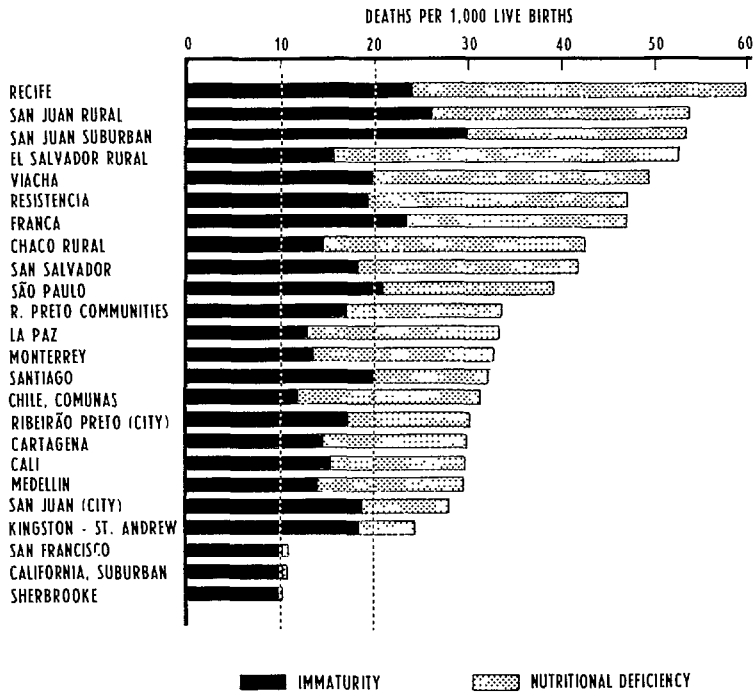


Fig. 1 Death rates from immaturity and nutritional deficiency as underlying or associated cause of infant death in 24 areas of 15 projects of the Inter-American Investigation of Mortality in Childhood.

Figure 2 shows the neonatal and infant death rates for these six projects according to five maternal age groups. In all instances the infant death rates were highest for mothers under 20 years of age. The lowest rates were for mothers from 25 to 29 years old, which would suggest that this maternal age span is the most favorable one in terms of survival of the child.

The excessive death rates among infants born to mothers under 20 point to problems in need of study in depth. These rates reached the levels of over 100 per 1,000 live births in the projects in Chaco Province, El Salvador, and São Paulo. At the same time, in five projects young mothers had more than 10 per cent of all the live births, the figure reaching a high of 18.3 per cent in the El Salvador project.

It is well known that low-weight births (2,500 g or less) occur frequently in young

mothers (8, 9, 10, 11). If suitable data are to be collected for analysis, all babies must be weighed at birth. Ideally, this information should be included on the birth certificate. In only one Latin American country, Cuba, is birthweight known to be included on the birth certificate at present. However, in many cities high proportions of the births occur in hospitals, where the birthweight is recorded. Data from hospital births in Latin America are already being collected which show excessive frequencies of low-birthweight babies for young mothers (12, 13).

In conclusion, young mothers appear to be at greater risk of losing their babies in the infant period than are the mothers in other age groups. The factors of parity, intervals between births, and birthweight should be considered in planning effective preventive programs.

Infant Mortality According to Birth Order

In the Investigation birth order was based on the total number of products born alive or dead, which is the desirable definition⁹ to be used in considering the effect of the number of pregnancies on the outcome of pregnancy and on the health of the child. Wide differences in the birth orders of the deceased infants were noted in the 15 projects. In Recife, which had the highest birth rate (41.6 per 1,000 population), half of the deceased infants were of fifth or higher birth order (50.7 per cent). In contrast, in the California project, where the birth rate was low (16.3), only 12.0 per cent were of fifth or higher birth order. In the 12 other Latin American projects the percentages of fifth or higher birth orders ranged from 25.3 (in the Bolivia project) to 47.5 (in Medellín).

In only three Latin American projects—Chile, Monterrey, and El Salvador—was it possible to calculate neonatal and infant death rates by birth order. In these projects the rates were lowest for first births and increased to high levels for those of the fifth or higher order.

For the El Salvador and Chile projects these rates were shown also in relation to maternal age. In the El Salvador project the infant death rate for the first-born of young mothers was already high—89.6 per 1,000 live births—and with the third product of mothers in this age group was in excess of 300. For first-born, mortality was lowest among babies of mothers 25-29 and 30-34 years of age. For all the maternal age groups the infant death rates in general were lower for the first births and increased with ascending birth order, being exceedingly high when the average birth intervals were short.

The same relationships were observed in a study of infant mortality conducted with the

⁹Demographers often consider only live births in determining birth order.

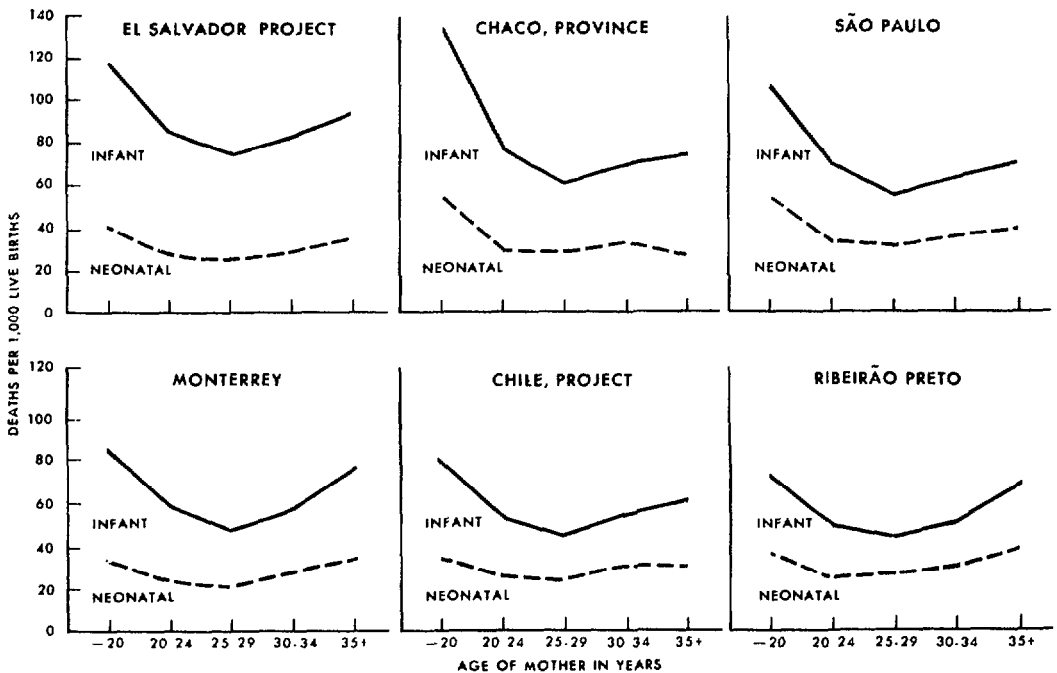


Fig. 2 Neonatal and infant mortality by maternal age group in six projects of the Inter-American Investigation of Mortality in Childhood.

cohort of 142,017 live births registered with the New York City Health Department in 1968 (7). Although the New York City infant death rate of 21.9 per 1,000 live births was very low in comparison with that of the El Salvador project of 88.4, the pattern of rates by maternal age group and birth order was similar. The infant death rate for the first-born of mothers 15-19 years of age in New York City was 24.1 per 1,000 live births and for the second product, 49.5. The rate for those fourth in order was 62.2. The lowest rate for first-born was 14.2, found among infants of mothers 25-29 years of age. Thus there is a similar pattern in New York City and the projects of the Investigation of increasing infant mortality according to rising birth order within the maternal age groups. This not only corroborates our data but also emphasizes the interrelationship between the two factors.

Knowledge of the length of birth intervals is useful for interpreting infant mortality by birth order and maternal age. In three projects of the Investigation (8) average birth intervals were derived by taking the difference between the mother's age in completed years at delivery of her first product of pregnancy and her age at the birth of the deceased infant and dividing it by the number of products in this period. In the El Salvador project the average interval for mothers under 20 decreased from 1.7 years for second-order births to 1.5 for those of the fourth order. In Recife and São Paulo the average intervals for young mothers were 1.3 for second-order births and 1.2 and 1.3, respectively, for those third in order. Marked reductions to short average intervals were noted in the other maternal age groups when the birth orders were high.

Until the Investigation revealed wide variations in the practice, breast-feeding was believed to be the usual method of providing nourishment for infants in early life in developing societies. In the Recife and São Paulo projects, where the average birth intervals were found to be relatively short, the proportion of breast-fed babies appears to be relatively low. Only 26.8 per cent of the deceased infants in

Recife (excluding those dying in the neonatal period) had been breast-fed for one month. In São Paulo the percentage was also low: 35.5. These low figures were unexpected and may be another factor contributing to the excessive mortality. As Jelliffe and Jelliffe (14) have pointed out, "breast-feeding is life-saving" in developing societies.

A recent editorial (15) stated that in the Philippines the average birth interval from the previous product was 29.4 months for mothers who nursed their babies and 23.9 for those who did not. Thus, the birth interval was extended by 5.5 months through breast-feeding. This prolongation of the interval is probably very important for the survival of the succeeding child. In Recife the experience of mothers with deceased infants gave an average interval of about 22 months. For young mothers under 20 years it was only 16 months. Further studies of breast-feeding and birth intervals would be worthwhile in Brazil. Santos (16) has described the problem of breast-feeding in Recife and reported on the introduction of a recorded tape at the time of delivery to encourage mothers to nurse their babies.

The foregoing analysis shows that birth order and maternal age must be considered together in evaluating their role in infant mortality. It also points up the need for further research to clarify these relationships in Latin American societies, and, likewise, in many other areas of the world.

Infant Mortality According to Birthweight

The high death rates from immaturity as an underlying or associated cause of death raised questions regarding the distribution of birthweight in these areas of Latin America. The first concrete evidence of a higher frequency of low-weight births came from the Ribeirão Preto project (17). Teruel and co-workers found that 8.7 per cent of the birthweights were 2,500 g or less, a percentage somewhat higher than the levels in the United States of America or European countries. Exploratory tabulations in Recife revealed that 14 per cent of the birth-

weights registered in one maternity service were low—nearly double the figure of 7.6 per cent for the California project. A form was introduced for obtaining minimum information on outcome of pregnancy in three maternity hospitals in Recife. This experience stimulated further exploration of birthweight distribution in the other Latin American areas.

Hospitals in Mexico City and San Salvador provided additional preliminary evidence of the high frequency of low birthweight. The percentages of 11.7 and 14.4 for hospitals in these two cities were considerably higher than the 8.7 for the Ribeirão Preto project (12).

Death rates in the first day of life and in the first 28 days (neonatal period) by birthweight group for the Ribeirão Preto and California projects are given in Figure 3. For purposes of comparison, data on the 1960 live-birth cohort of the United States are also shown. In these three experiences, as it was expected, the death rates were high for low-weight births (2,500 g or less) and declined with increasing weight. For the 2,501-3,000 g weight group the death rates were at least twice as high as those for the most favorable weight group (3,501-4,000 g). Thus weights of 2,501-3,000 g have been designated by Serrano and Puffer (12) as deficient. Kessner et al. (7) likewise observed the lowest infant death rate among babies weighing 3,501-4,000 g at birth. Their research also revealed rates over twice as high for babies born with deficient weight (2,501-3,000 g) as for those with the most favorable weight (3,501-4,000 g)—12.1 and 5.6 per 1,000 live births, respectively.

To return to the example of two projects and two hospitals, in addition to the greater frequencies of low-weight births in the hospitals and in the California and Ribeirão Preto projects, there were also higher frequencies of births in the category of *deficient* weight (2,501-3,000 g). The percentages were as follows:

California, four counties	19.1
Ribeirão Preto project	23.4
Mexico City hospital	33.9
San Salvador hospital	39.3

In the San Salvador hospital over half of the babies (709 out of 1,320, or 53.7 per cent) had low or deficient weights, while the comparable percentage in the four California counties was 26.7.

Differences in the relative size of these weight groups may depend on the extent to which certain biological and social factors are involved in the process of reproduction. For instance, chronic nutritional deficiency or relative depletion in the mother might be responsible for many of the low and deficient birthweights (2,001-3,000 g), while other social and biological factors and causes might be more especially involved in the very low birthweights (2,000 g or less). Studies of these relationships would contribute to our understanding of the pathogenesis of high reproductive risk.

The frequency of low and deficient birthweights varies with the age of the mother at the birth of her child. Mothers under 20 have a higher frequency of low-weight babies than do those in the other four age groups (Figure 4). In the experience of the Mexico City hospital, 53.1 per cent of the babies of young mothers had low or deficient birthweights. In the Ribeirão Preto project the figures were lower, and in the United States live-birth cohort lower still, declining by age group to 24.5 for mothers 35 years of age and older.

Data on birthweight according to both maternal age and birth order are desirable. The live-birth cohort study conducted in the United States in 1950 provided such information (10). For the mothers under 20 and from 20 to 24 the percentages of their low-weight births (2,500 g or less) by birth order were as follows:

<i>Birth order</i>	<i>Under 20 years</i>	<i>20-24 years</i>
1	8.6	6.9
2	9.6	6.9
3	12.0	8.0
4	14.0	9.1
5 and higher	18.3	10.5

As it can be seen, the percentages were higher for the younger mothers; in both age

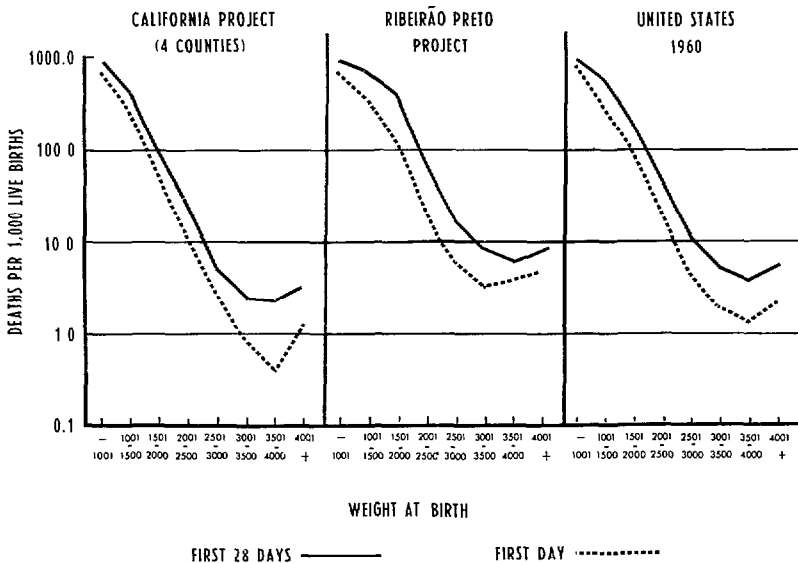


Fig. 3 Mortality in the first day and first 28 days of life, by birthweight, in projects in California and Ribeirão Preto, and in United States 1960.

groups they tended generally to increase as the birth order rose. Similar patterns were presented with the death rates with immaturity as an underlying or associated cause in the three projects of the Investigation (8). Mortality due to immaturity was especially high for young mothers, with increases occurring as the birth order rose. Thus the importance of the combination of these three factors should be recognized in maternal and child health programs. Not only are the risks greater for mothers having low-weight babies when they are young (under 20), but they increase even more with the second, third, and fourth products when the birth intervals become shorter.

Comments

Some of the questions raised at the beginning can now be answered. Neonatal and infant mortality are lowest for mothers 25-29 years of age and mortality is excessive in infants born to young mothers. The most satisfactory birthweight range appears to be 3,501-4,000 g. The limited data available indicate high fre-

quencies of low and deficient birthweight in certain areas in Latin America. Breast-feeding was limited in Recife and São Paulo and, likewise, the birth intervals were short, suggesting a relationship.

Although no data were available on weight gains in pregnancy, a study of weight gain in relation to the birthweight of the product has been initiated in Recife. There are differences in the desirable weight gains for pregnant women recommended by British and United States obstetricians. The opinion of the Committee on Maternal Nutrition of the U.S. National Academy of Sciences (3) is for a gain of 24 pounds (10,900 g) within a range of 20 to 25 pounds (9,100-11,300 g). The British figure (3) is 27 pounds (12,000 g). Rush and co-workers (18) are studying prepregnancy and pregnancy weight gains in relation to the outcome in New York City. The purpose of their work is to establish the frequency of low birthweight and then to plan strategies to prevent the occurrence of this problem and its sequelae. Desirable weight gains should be established in Latin America as well, and

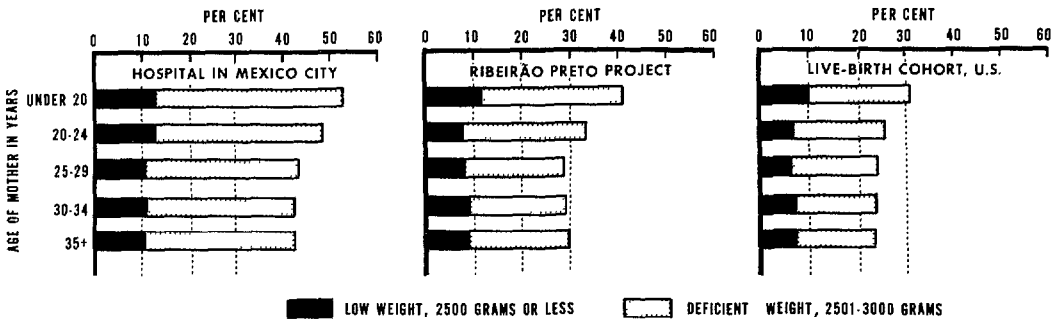


Fig. 4 Percentage of live births with low and deficient birthweights for mothers in five age groups in a Mexico City hospital, Ribeirão Preto project, and in the United States live-birth cohort of 1960.

pregnant women should be educated to understand the importance of satisfactory gains for the health of their babies.

Even from the limited data available for Latin America, it is clear that maternal and child health programs should be aimed at preventing low and deficient birthweight. On the basis of their work in New York City, Kessner et al. (7) state that infant mortality is related more closely to birthweight than to any other maternal or infant characteristic, and that more detailed studies are needed to refine risk categories and to direct the woman to appropriate services so as to decrease her chances of producing a low-birthweight or nonviable infant.

As a result of the Investigation, specific recommendations (12) have been made for future studies in greater depth taking into account these multiple factors in Latin America. Until such time as birthweight is reported on all birth certificates, the utilization of hospital records is recommended. They can supply information on the outcome of pregnancy by maternal age and birth order, as well as on mortality in the first day of life.

In Recife, Nunes (13) has just completed an analysis of the outcome of 24,598 pregnancies observed in three large maternity hospitals during 1974. The frequency of low and deficient birthweight was high, especially so for young mothers (those under 20 representing 20 per cent of all mothers). The death rate in the

first day of life was excessive, and for infants of young mothers it was so high that it is obvious many were born in conditions unfavorable for survival.

Evidence has been accumulated by Lechtig et al. (19, 20) and Birch (21) pointing to the relationship of birthweight to the mother's general health and nutritional status. Supplementary feeding of 35,000 calories during pregnancy (about 149 extra calories per day) resulted in a reduced frequency of low-birthweight babies (20).

Programs for preventive action are already being established in Recife and in São Paulo State, according to reports submitted to the PAHO/WHO Planning Meeting of the Maternal and Child Health Development Program held in Rio de Janeiro in October 1975 (22). Food supplementation for pregnant women, nursing mothers, and their babies is to be initiated in both areas. Operational research will be conducted to evaluate the health changes effected in mothers and their babies as a result of these programs.

To attack the health problems of infancy and childhood requires primarily preventive programs conducted on a community basis, in contrast to care and treatment of premature infants and the rehabilitation of those with nutritional deficiency. While clinical research has become an important part of medical education in developed countries, in medical schools in Latin America community-centered

research with major emphasis on prevention will be the most effective method for achieving results. Food supplementation programs which are being introduced in Brazil may prove to be far less costly than treatment and make a major contribution to the health of infants and young children and thus to the population at large.

The entire approach in health programs

could be reoriented to the community. Changes would then be brought about enlisting the entire educational system—schools of medicine, public health, and nursing and midwifery, as well as primary and secondary schools and universities—so that all would be concerned with their role in attaining the health and well-being of their societies.

SUMMARY

Maternal age and parity, according to the findings of the Inter-American Investigation of Mortality in Childhood, have a direct relationship to the health and survival of the infant. Among the results of this broad undertaking are data suggesting that babies born close in succession, especially within large families and as birth order ascends, are at greater risk of dying. Also, the offspring's future is increasingly threatened as the mother's age tends toward the extremes of the childbearing years. Compromise of the mother's health, in turn, was indicated in the earlier Investigation, a study of deaths in adults, which revealed unexpectedly high maternal mortality in the Latin American cities that it covered.

Immaturity, or low birthweight, and malnutrition emerged as the two major underlying or

associated causes of death in the Latin American projects of the Inter-American Investigation of Mortality in Childhood. Despite the marked variations in the data available from the different areas, there appeared to be some correlation between these two indicators of deficits in growth and development.

Mortality due to immaturity was especially high for babies of young mothers, with increases occurring as the birth order rose. Not only are the risks greater for mothers having low-weight babies when they are young (under 20), but they increase even more with the second, third, and fourth products when the birth intervals become shorter.

Maternal age, birth order, and birthweight are factors that must be considered in combination in the programming of protective health measures.

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