

A SURVEY OF INFANT MORTALITY IN PORTO RICO

By A. FERNÓS ISERN and J. RODRÍGUEZ PASTOR
From the Department of Health of Porto Rico

FOREWORD

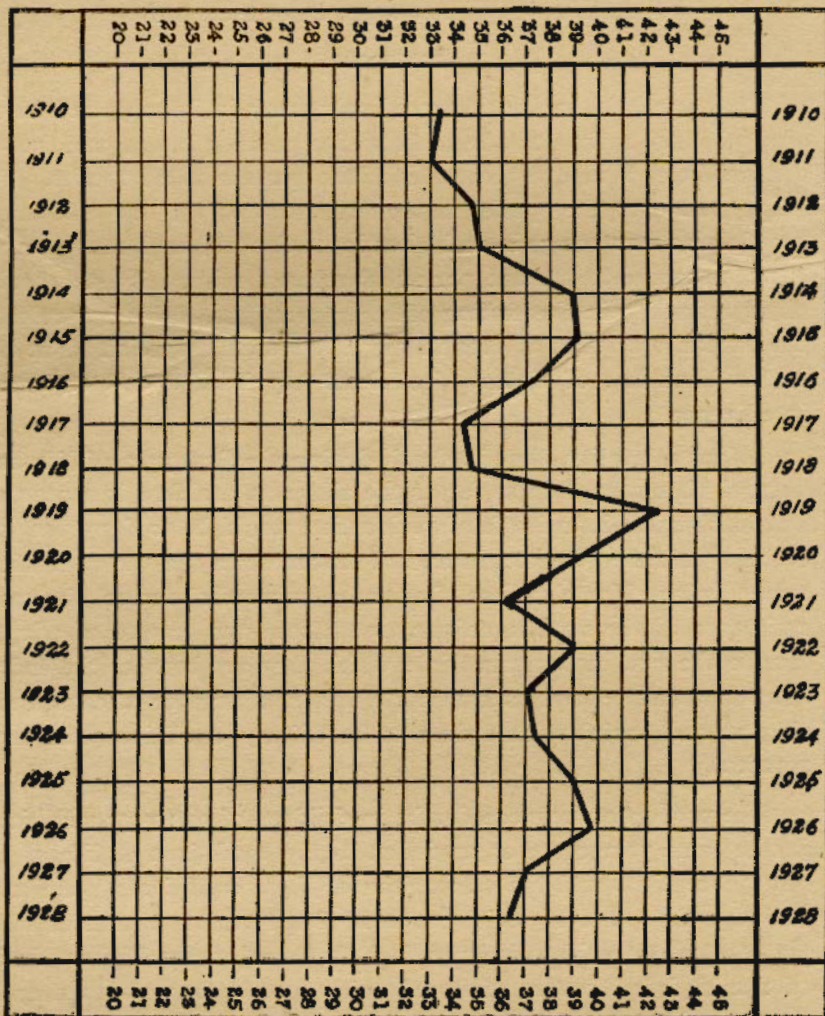
That our hold on life is exceedingly weak in infancy and in old age, when we make our advent from the great unknown and just as we are about to return thereto, is a law common to all species. The perpetuation of the species is the fulfilment of the law of Nature, multiplying new beings in such abundance that although many perish, enough survive to the age period of greatest robusticity, the period of reproduction in the linking of the generations. This law rules in the human species as it does in any other animal species. But this is the blind law of Nature, free from any intervention of human intelligence.

Infant mortality, that is, death during the first year of life, is a natural phenomenon in so far as the above natural law is concerned, but to abandon it to its fatal verification would be to deny the pre-eminent influence of thought and of sentiment in the life of civilized man. Infant Mortality has, then, as a primordial factor, the scant resistance of the new organisms to confront the process of adaptation to the new environment into which they are born at the end of intrauterine life; and as immediate factors a number of causes contingent and variable, according to hereditary conditions and environment.

The proportion between deaths in children of one year and births in the same year serve as an index to the conditions of life of the new generations and the comparison of these coefficients permits us to judge the grade of social progress of the various countries when we take into consideration the fact that one of the highest duties of mankind is the care of its offspring as a means of assuring its health and strength, which are essential to the future of progress and well-being.

Infant mortality as a social problem has motivated assiduous investigations above all within the last twenty years and in countries

CHART No. I
 BIRTH RATE IN PORTO RICO, PER 1,000 INHABITANTS DURING THE LAST NINETEEN YEARS: 1910-1928



of the temperate zone. In tropical countries these investigations have not prospered so much, although Porto Rico is, without doubt, one of the tropical countries which is giving most attention to this matter so important in itself and of such human and patriotic interest. Should the coefficient of infant mortality be the same in the temperate zone as in the tropical zone—or should it be higher or lower is not a question to be discussed unless we wish to indulge in reasoning without experimental foundation and without proof. Up to the present time, speaking in general terms, infant mortality is lower in the temperate zone; higher in the tropics.

Infant mortality is a social problem; it is a biological phenomenon; it is a public-health problem and a government problem; for its study or analysis the knowledge of medical science is indispensable.

It is not identical everywhere, although it has similar causes in many instances; it is affected by diverse conditions in different countries; within each country it presents regressions and aggravations according to the racial, social, economic, hygienic and climatologic conditions of each locality.

THE PROBLEM

Infant Mortality and the Problem of Population in Porto Rico

The birth rate in Porto Rico is high. This is indicated in Chart No. I. Our coefficient per 1,000 persons is not lower than thirty per year and it reached forty-two in 1919. (It is true that that year, due to special circumstances, there was a more exact registration than there had been hitherto.) The average number of persons that constitute a family in Porto Rico is 5.2 and the marriage age is as follows:

TABLE NO. I
DISTRIBUTION ACCORDING TO AGE
From 1925-6 to 1927-8

Age	Persons contracting matrimony (both sexes)	Percent as compared with total numbers
Under 20 years.....	12,520	20.22
Over 20 and under 30 years.....	41,607	67.08
Over 30 years.....	7,789	12.55
Total.....	61,896	100.00

TABLE NO. II
ACCORDING TO SEX AND AGE

Age and sex	Married persons in each group	Percent as compared with total numbers
Under 20 years		
Males.....	1,349	4.35
Females.....	11,171	38.09
Over 20 and under 30 years		
Males.....	23,943	77.36
Females.....	17,664	57.07
Over 30 years		
Males.....	5,656	18.27
Females.....	2,113	6.82
Total each sex.....	30,948	100.00

We have no data as to the marriage rate from the registration area of the United States and we understand that in very few states statistics as to this matter are compiled. We have for reference, however, a valuable work published by the Department of Health of New York State, in which the marriage statistics from 1916-1924 are recorded and from which we take the following data as to the years 1919-1924, in order to compare them with our data regarding the percentage of distribution by age and sex.

TABLE NO. III

Age	Percent as compared with total numbers	
	Males	Females
Under 20 years.....	2.5	25.5
Over 20 and under 30 years.....	67.5	55.3
Over 30 years.....	30.3	19.0
Total.....	100.00	100.00

Our reproductive rhythm is much more accelerated; our children are born early in the life of their parents and so, more children are born to each couple. Consequently, the care that each couple can give to their children is less because they begin their parental career before having accumulated a means of livelihood and this meagre experience and condition of resourcefulness must be divided among a large number of human beings. All this creates a problem of population; of population pressure, although the proportion of deaths occurring in those under fifteen years in Porto Rico compared with the United States is as follows:

TABLE No. IV
DEATH RATE UNDER 20 YEARS OF AGE
For the Year 1925

Age	U. S. Registration area deaths	Percentage	Deaths in Porto Rico	Percentage
Deaths under 15 years.....	259,255	21.3	17,829	56.8
Deaths under 1 year.....	161,961	13.3	8,109	25.8
Deaths from 1 to 14 years.....	97,294	8.0	9,720	31.0
Sum total of deaths.....	1,219,019	100.00	31,350	100.00

A high percentage of deaths occurring before the epoch of reproduction results in a tendency to stationary population; but with us, as the reproduction is carried on by the survivors at such an early age the number of births per year is little less or more than twice the deaths.

It is clear that a large number of these children are destined to die, due to the adverse conditions in which they have to live because of the poverty of their parents and the number of brothers and sisters with which they must share the scanty living provided them. So even if the cipher of reproduction is large the cipher of infant mortality is also large.

Infant Mortality in Porto Rico and Other Countries

Our cipher for infant mortality during the fiscal year of 1927-28 was 146 for each 1,000 births. In the last five years the average was 148. For each 1,000 children born here almost 150 succumbed before they were a year old. During the last 19 years, our infant mortality cipher has fluctuated, being very high from 1917-1927 and not so high in 1914, 1924 and 1928, but in general no tendency to a decrease in infant mortality is apparent.

In the United States, the rate of infant mortality in 1916 was 101. This year (1927), it was 64. In twelve years, the cipher of infant mortality has diminished 37 per cent in that country.

New Zealand has the lowest infant mortality rate in the world. It is below forty. Switzerland, England, United States, Norway and Canada have infant mortality rates not above eighty deaths per 1,000 births. Japan, Spain, Salvador and the Philippines are more or less on our level. Chile, India, China, Russia, Turkey and other countries have much higher ciphers of infant mortality.

CHART No. II

TABLE ON INFANT MORTALITY DURING THE LAST NINETEEN YEARS IN THE ISLAND OF PORTO RICO

(Deaths per 1,000 births—Stillbirths not included)

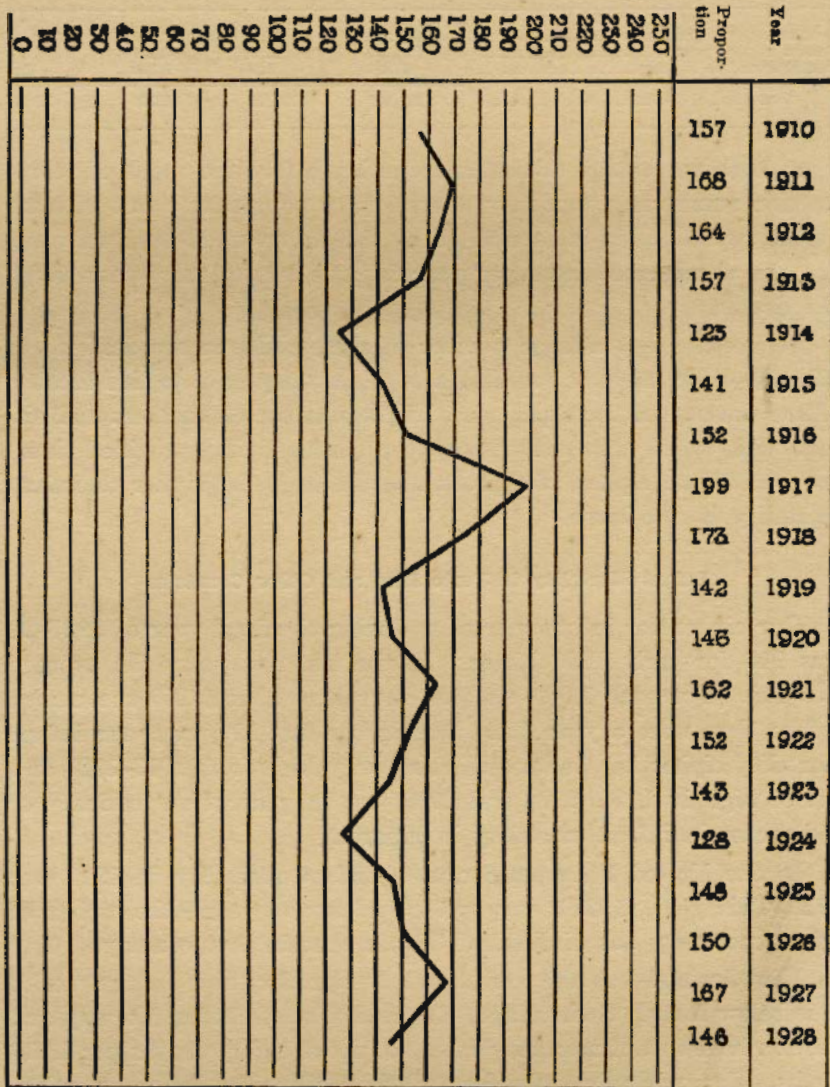


CHART No. III

INFANT MORTALITY IN THE UNITED STATES

Registration Area 1916-1927

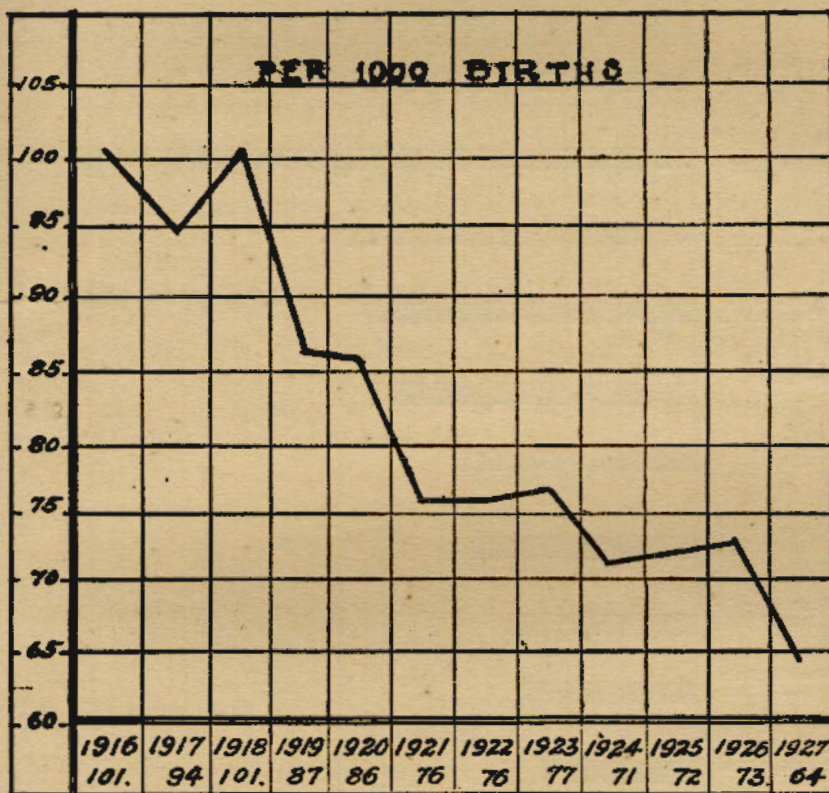
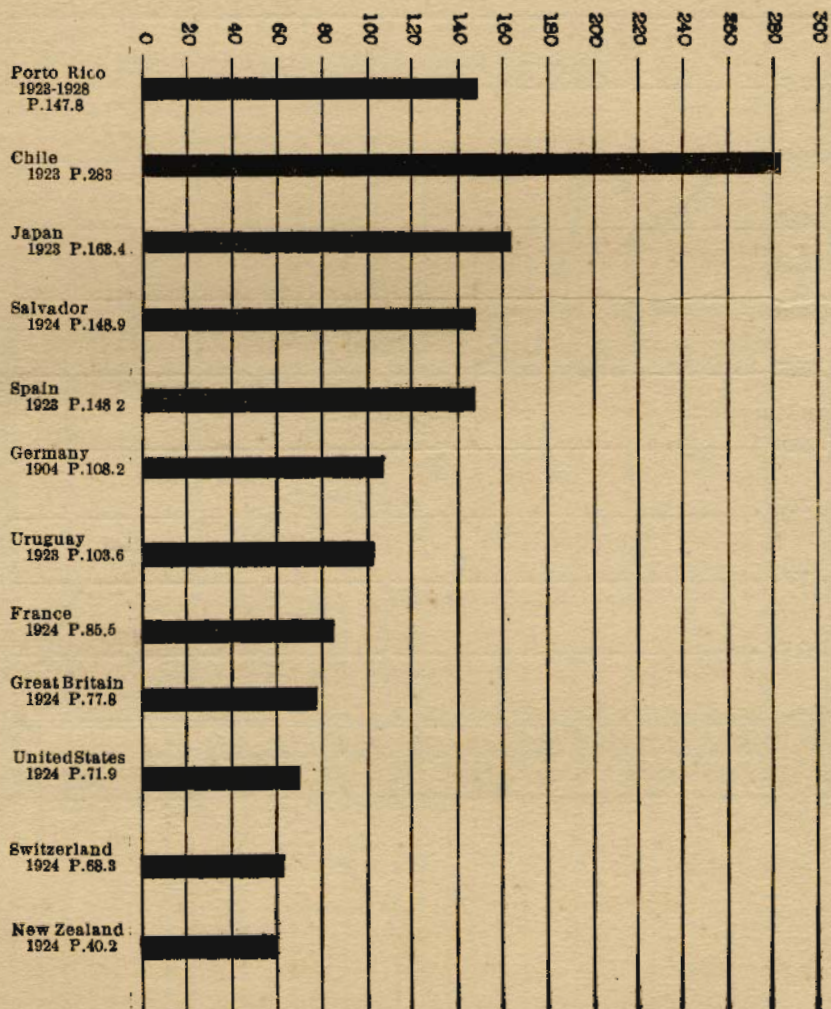


CHART No. IV

INFANT MORTALITY IN PORTO RICO AND OTHER COUNTRIES

(Per 1,000 births)



Analysis of Infant Mortality in Porto Rico**GEOGRAPHIC DISTRIBUTION**

In Porto Rico the highest rate of infant mortality is found in the coast towns, especially on the western coast and in the urban centers where the density of population is greater.

During the last five years, the percentage of infant mortality in the Western coast towns (Cabo Rojo, Hormigueros, Mayagüez, Añasco, Rincón, Aguada, and Aguadilla,) was 205; on the Southern coast the average was 164; on the Northern coast, 153 and on the Eastern coast 150. In the Central towns, the average was much lower: the cipher being 116.

INFANT MORTALITY IN THE URBAN AND RURAL ZONES

Infant mortality in Porto Rico occurs in direct proportion to the density of population, being much greater in the urban centers than in the rural. It would seem that the urban conditions existing in Porto Rico are extremely detrimental to the health of our children.

Chart No. V demonstrates the rate of infant mortality in its relation to density of population:

Regarding the density of population in town and country, it is necessary to consider the influence of congested conditions in the homes, more general and more serious, of course, in the towns than in the rural zones. In the last named, the house or shack is merely a place of refuge either for the night or when it rains. Aside from this, the open space is the place where the family meets, and forms an important part of the countryman's home. So the country family has more space than the family living in the suburban districts, where the agglomeration of houses is a serious problem and where entire families live in places consisting of one or two rooms; in tenement houses, etc.

It is sufficient to cite such districts as Puerta de Tierra; La Perla; the Cantera in Ponce; Santo Domingo in Arecibo; Vieques in Cayey.

The effect of this agglomeration has never been studied from a statistical basis in connection with infant mortality in Porto Rico.

There is a direct relationship between the overcrowding of families in reduced quarters and infant mortality. In the United States, investigation made by the Children's Bureau in different cities demonstrates this fact very clearly. For instance, in Akron, Ohio, the infant mortality rate among families where only one person used the same room was only 55.1. In cases where not more than two per-

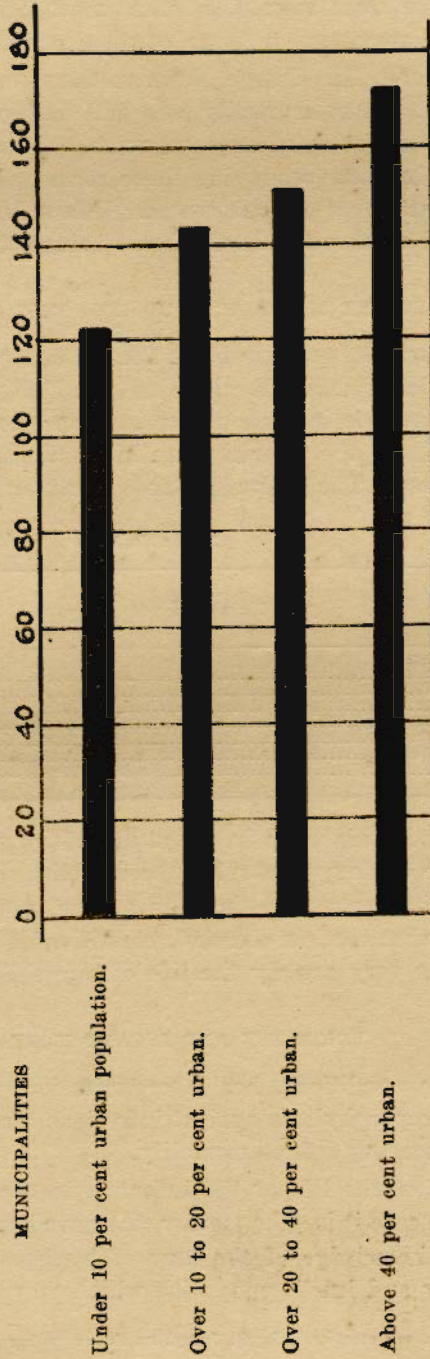
FIGURE I



CHART No. V

INFANT MORTALITY IN PORTO RICO—1927-28

Infant Mortality in Urban and Rural Districts Per 1,000 Births



sons used the same room, the infant mortality rate was 125.9; and where there were two or three persons in a room, it reached 170.2.

In England, Sir George Newman found in a group of families studied that infant mortality was 219 in those families occupying apartments consisting of only one room; 157 in those occupying two rooms, 141 in those occupying three rooms, and 99 in families that lived in apartments of four rooms. Infant Mortality became lower, as the number of rooms in the home became larger.

INFANT MORTALITY AND ECONOMIC CONDITIONS

The United States Children's Bureau has proved through minute studies made in different cities of the United States, that infant mortality descends in these places in proportion to the salary of the father.* Where the salaries were high, the mortality rate was low and vice-versa. The following table demonstrates this fact:

TABLE No. V

Parent's Income	Infant Mortality Rate
Under \$450.....	116.9
From \$450 to \$549.....	125.6
From \$550 to \$649.....	116.6
From \$650 to \$849.....	107.5
From \$850 to \$1,049.....	82.8
From \$1,050 to \$1,249.....	64.0
Above \$1,250.....	59.1

We include this table in the study of infant mortality in Porto Rico for the analogy that might be established. No such study has been made in Porto Rico, but the general opinion, founded on experience, is that the low economic condition of our people is a factor which affects very acutely the life of our children.

IGNORANCE AND INFANT MORTALITY

Economic conditions, health organization, milk and water supplies, specific prophylaxis against infectious diseases are not the only factors influencing infant mortality.

The fate of the life of the infant is in the hands of the person under whose care it is—the mother, the grandmother, some relative,—and on the knowledge of the laws of hygiene and of dietetics and the assiduity and intelligence with which they apply this knowledge

* These data are mentioned by S. Josephine Baker in her book on "Child Hygiene."

to the daily life and care of the infant depends to a large degree its health and life.

Without further evidence we shall point out the ignorance of our masses as to infant hygiene, their fundamental basis of child care being tradition, superstition, and their notions on the matter, entirely foreign to the teachings of modern hygiene which are slowly being introduced by means of educational campaigns, of which we shall speak more at length later on. This we say is a very gradual work, the results of which will not be evident until some years have been spent in persevering labor.

We are referring to no special class. Ignorance on these matters may be found everywhere and among all classes, and sometimes goes with high culture along other lines of human knowledge and endeavor.

In a study of forty-three deaths, occurring in children under one year in certain districts of Santurce, we found that nine deaths from diarrhea and enteritis occurred in breastfed children. In order to ascertain the cause of the gastro-intestinal trouble, we visited the mothers of the dead children and found that in every case they had been fed with great irregularity. They had nursed them at any hour of the day or night, whenever they cried; the mother had not been careful to keep her breasts clean, and in almost every case, besides the breast feedings, the children had been given herb teas in dirty bottles, they had been given dirty pacifiers, which had been picked up off the floor and put in the child's mouth, and the infant had been cared for in such filth and abandon, that in spite of the fact that the mother nursed it the gastro-intestinal difficulties had been brought about through the lack of proper care as to cleanliness and systematic feeding. There was no tuberculosis, syphilis or other disease evident in the family; the cases were not sequelae or infectious diseases.

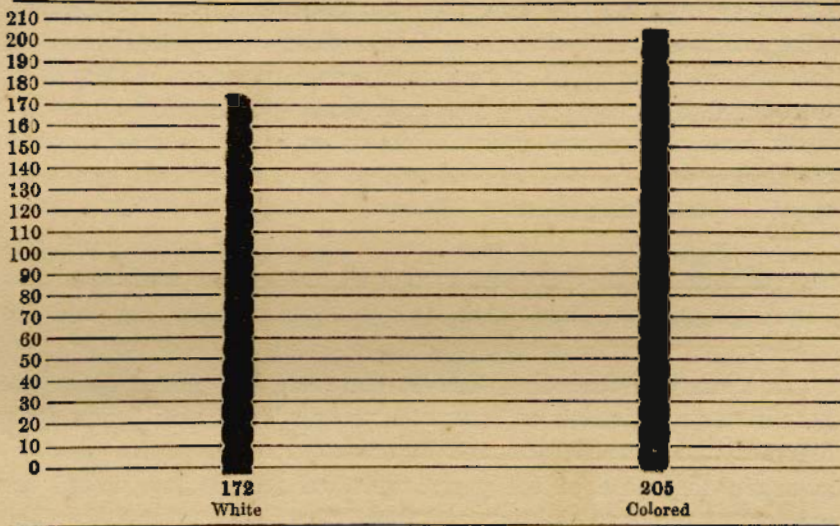
INFANT MORTALITY AND RACES

Infant mortality varies as to race, and it is higher in the negro race than the white. This is also true of the United States and other parts of the world. The high mortality rate in the colored race explains in part the fact already pointed out that more children under one year die in the coast towns than in the interior regions. We are acquainted with the fact that our colored population is much less numerous in the interior than on the coast.

CHART No. VI

INFANT MORTALITY IN PORTO RICO ACCORDING TO RACE--1928-1929

Mortality per 1,000 births



INFANT MORTALITY AND ILLEGITIMACY

Infant mortality varies also according to the social conditions of the child, a larger rate occurring among the illegitimate than the legitimate. In 1927-28 this rate was 122 per thousand among legitimate children and 246 among the illegitimate.

Chart No. VII demonstrates infant mortality among legitimate and illegitimate children.

In the United States, studies made by the Children's Bureau in such cities as Boston and Baltimore indicate that infant mortality is three or four times higher there in illegitimate children than in legitimate, as demonstrated in following table.

TABLE No. VI
INFANT MORTALITY, LEGITIMATE AND ILLEGITIMATE CHILDREN
IN BOSTON AND BALTIMORE

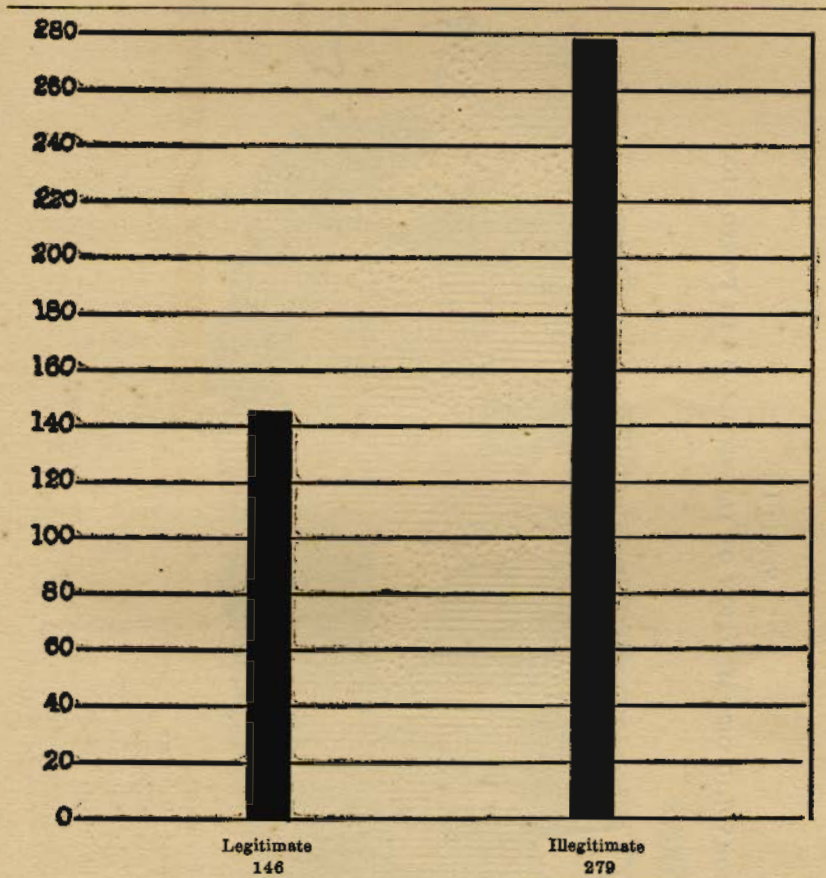
City	Legitimate	Illegitimate
Boston.....	95	281
Baltimore.....	95.9	315.5

In our country we may find certain types of illegitimate children born to parents not legally married, but who are practically a

CHART No. VII

INFANT MORTALITY IN PORTO RICO ACCORDING TO SOCIAL
CONDITION PER 1,000 BIRTHS

Average for the Three Fiscal Years—1925-1928



children by marriage; these are the children that first see the light of day in a mountain hut, born to a man and woman who have lived and are living together permanently, though their union be not blessed by the church nor sanctioned by the law.

This explains the fact that certain places having high rates of illegitimacy have low rates of infant mortality as happens in Villalba, with twenty seven per cent of illegitimate children; Aibonito, with twenty nine per cent; Comerío and Utuado, with a percentage of illegitimacy of twenty-five and twenty-eight.

FIGURE II
GEOGRAPHIC DISTRIBUTION OF ILLEGITIMACY IN PORTO RICO



On the other hand we shall point out that Santa Isabel, a municipality of very high percentage of illegitimacy, has had the highest infant mortality rate in the Island during the last five years.

Forty-eight per cent of the children born in Santa Isabel in 1926 and 1927 were illegitimate. The percentage of infant mortality in Santa Isabel during the last five years was 272.

Santa Isabel is on the southern coast, in the midst of the sugar cane area. We should also point out that Naranjito, Corozal and Morovis, the three municipalities with the lowest infant mortality in the Island, have illegitimacy rates of eleven, twelve and thirteen respectively, which are low in Porto Rico.

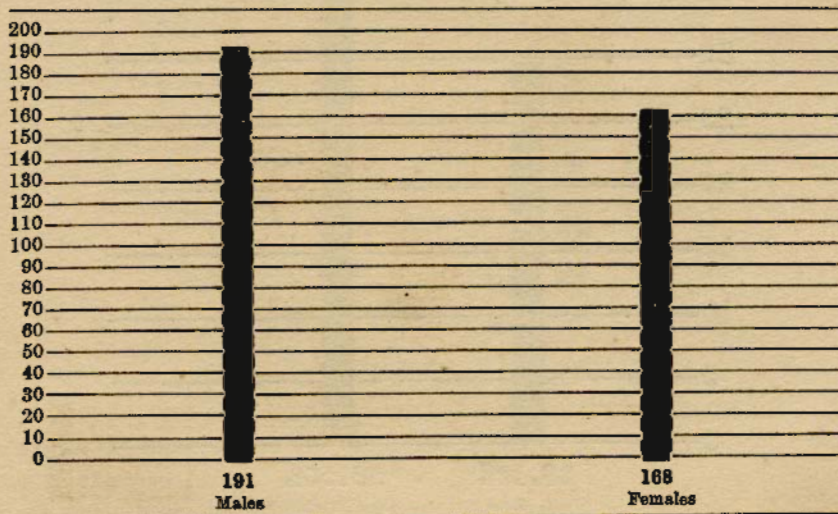
INFANT MORTALITY AS TO SEX

In Porto Rico, as in the United States and other countries, infant mortality is higher in boys than in girls. Although we have no statistical data of the infant mortality by sex before the year 1928, the data we have showing the rate of infant mortality during 1928-29 indicate a greater proportion of mortality in boys than in girls. During the year mentioned, our mortality rate in boys was 191, and in girls 168.

CHART No. VIII

INFANT MORTALITY IN PORTO RICO ACCORDING TO SEX—1928-1929

Mortality per 1,000 inhabitants



MORTALITY IN DIFFERENT PERIODS DURING THE FIRST YEAR OF AGE

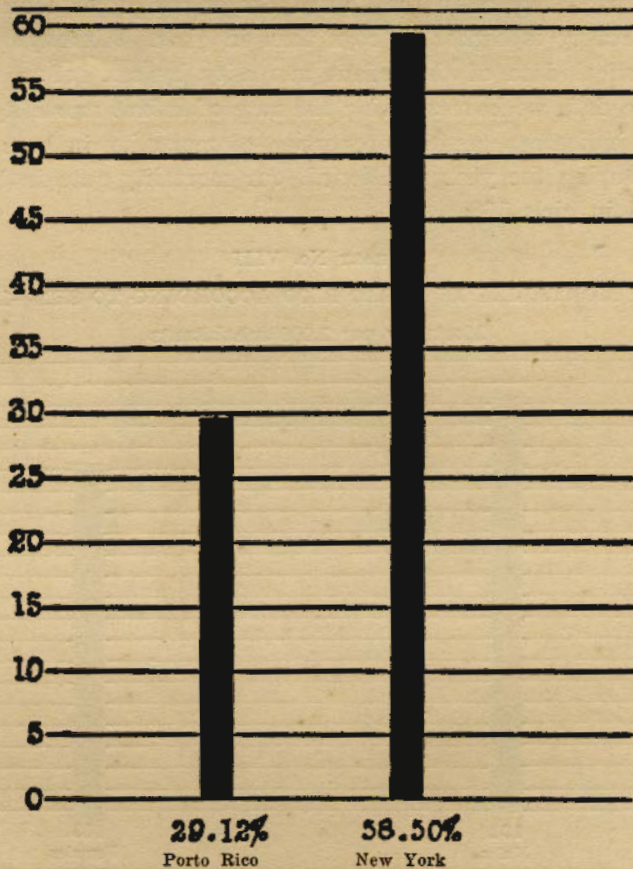
In the United States, infant mortality is greater in children under one month than at any other time of their first years. In Porto Rico the highest mortality within the first year of age occurs in children from one to six months old.

In 1924, the infant mortality rate of New York was 58 per cent in children under one month. In Porto Rico, the total percentage of infant mortality that year was 29 per cent, as may be seen in the following Chart:

CHART No. IX

INFANT MORTALITY IN PORTO RICO AND IN NEW YORK DURING THE FIRST MONTH OF LIFE—1924-1925

Per cent according to Total Mortality

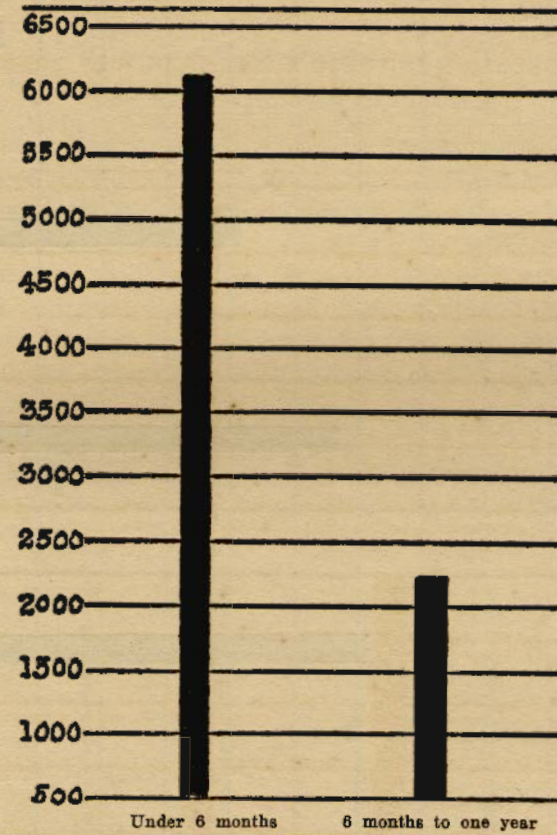


After the first month, the infant mortality curve rises in Porto Rico and in New York it descends. From the sixth month on, the infant mortality rate lowers noticeably both in New York and Porto Rico.

In the three years, from 1925 to 1928 inclusive, deaths in children under six months constituted 73 per cent of the total rate of infant mortality in Porto Rico.

CHART No. X

INFANT MORTALITY IN PORTO RICO ACCORDING TO AGE—1925-1928

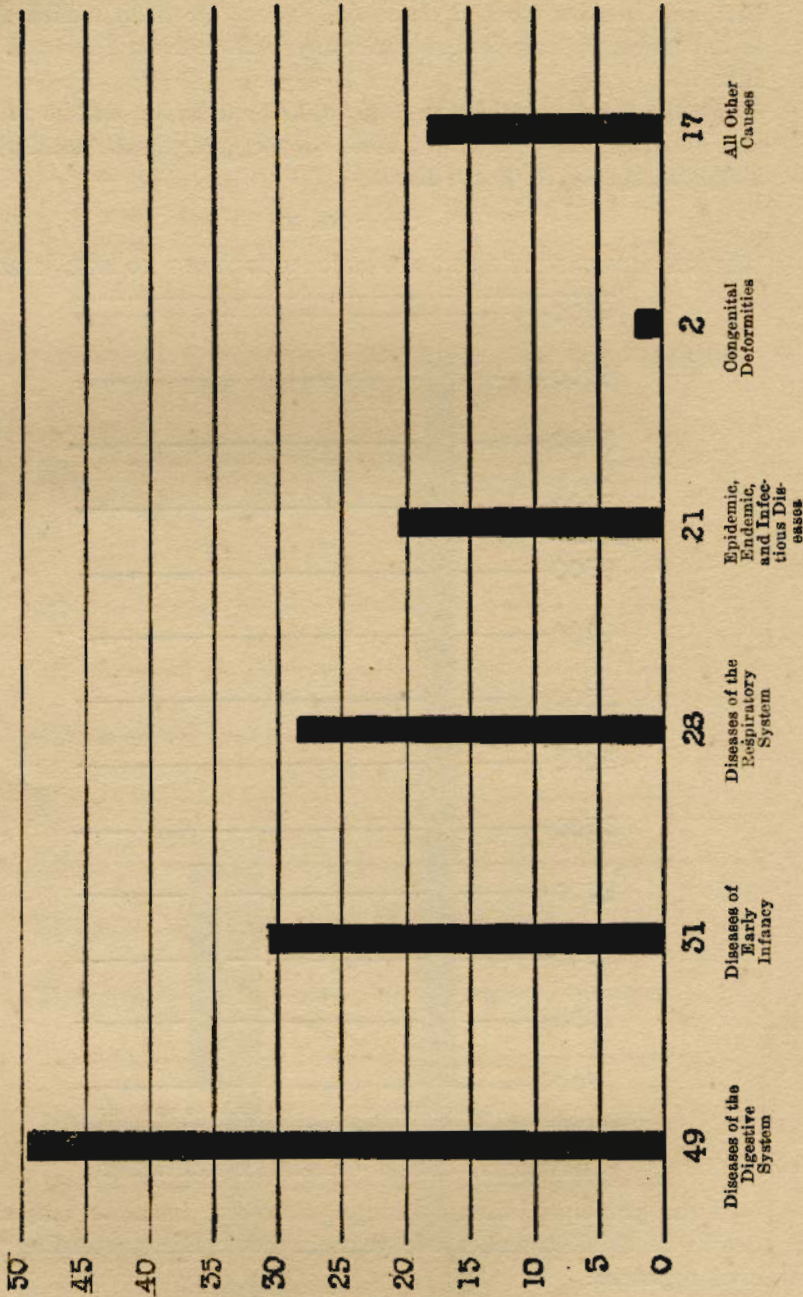


IMMEDIATE CAUSES OF INFANT MORTALITY

Four principal disease groups cause the immense majority of deaths in children under one year, in Porto Rico, according to our civil registers:

1. Diseases of the digestive system.

CHART No. XI
 INFANT MORTALITY IN PORTO RICO, 1923-28
 Infant Mortality Table According to Various Causes, per 1,000 Birth—Average for Five Years



2. Diseases of early infancy.
3. Diseases of the respiratory system.
4. Epidemic, endemic and infectious diseases.

The diseases of the digestive system caused 30 per cent of the infant mortality here in 1927-28; those of early infancy, 21 per cent; diseases of the respiratory system 19 per cent; and the epidemic, endemic and infectious diseases 16 per cent.

Let us consider each one of these groups and then analyze some of the pathologic entities of most importance in each group as well as the inter-relation between the different causes.

FIRST GROUP

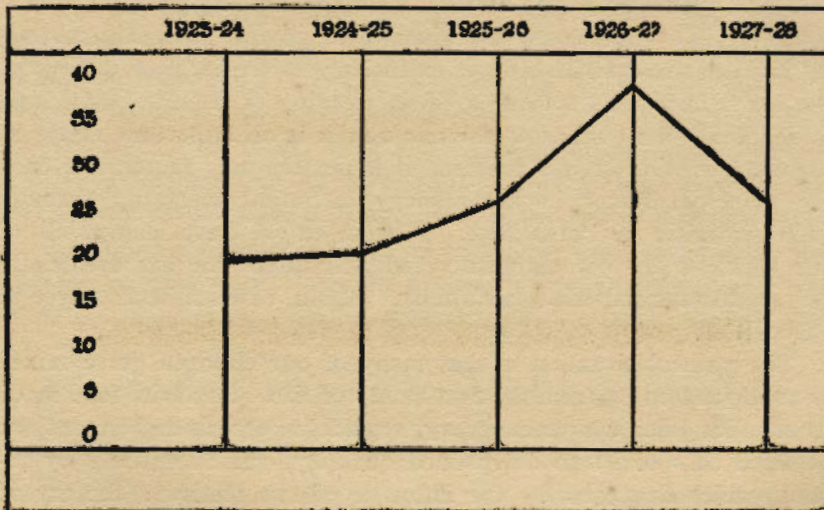
DISEASES OF THE DIGESTIVE SYSTEM

Among the diseases of the digestive system which cause death in children under one year in Porto Rico, gastro-enteritis occupies the first place. It is, generally speaking, the first cause of infant mortality and also the first cause of general mortality in the Island.

This disease caused the death of 2,645 infants in our Island last year, which constituted 94 per cent of the deaths from diseases of the digestive system in children under one year. The following chart demonstrates the importance of this disease as an independent cause of infant mortality.

CHART No. XII

INFANT MORTALITY RATE PER 1,000 BIRTHS DURING THE LAST FIVE YEARS, 1923-1928, FOR DIARRHEA AND ENTERITIS



The high mortality rate from diarrhea and enteritis in infants points to the food factor in the etiology of this disease. The importance of the maternal feeding as related to infant mortality is well demonstrated. In a study made in New York it was found that of 1,065 infants who died under one year of age, only 16.7 per cent had been breast-fed; on the other hand, out of 4,000 healthy children 79 per cent were breast-fed.

In Porto Rico, as everywhere, artificial feeding is in itself an etiological factor in gastro-enteritis and infant mortality. After the first month many infants are deprived of the mother's milk. Among the poor mothers the necessity of working in order to earn a living causes the mother to leave her child when only a few days old so as to make her daily wage at the shop, factory or plantation, where she will work from ten to twelve hours a day.

The proportion of children raised on natural feeding and on artificial feeding may be better understood by considering the following figures:

Of 2,583 children under one year, or a little over, registered in the Infant Hygiene Dispensaries of the Department of Health during the fiscal year 1927-28, 1,616 or 63 per cent were breast-fed and 967 or 37 per cent received artificial feeding exclusively.

Upon analyzing the food factor (natural and artificial regime) we observe first of all that many of our children (for diverse reasons) do not receive natural feeding or are not breast-fed; and if they are breast-fed it is at irregular times or corresponds to about the same extent as other foods. (Mixed feeding.)

There is a tendency to attribute the high rate of infant mortality from gastro-enteritis almost exclusively to the inferior quality of the cow's milk used for the artificial feeding of infants. Although undoubtedly the quality of the cow's milk is an important factor in the consideration of this problem, it is not the only factor, nor even the principal factor in the etiology of infant mortality through gastro-enteritis in Porto Rico. Because as we have shown, all of our children are not artificially fed and those who are artificially fed are always fed with cow's milk. Again, cow's milk is scarce in Porto Rico.

The painful situation is that many of our children get a mixed or artificial feeding from the first month of life. Artificial food made from solids (rice with bean gravy, vegetables, cereals and greens) at no fixed time or in no determined quantity, guided entirely by instinct which fluctuates by the influence of two motives: the cry of

the child and the urgent demand upon the mother to look after her home, industrial or agricultural affairs.

Cow's milk can only be considered, as we have already said, in cases of mixed or artificial feeding in which it is used and these are not in all cases, as may be understood from the following facts:

Out of one million four thousand inhabitants in Porto Rico, a million live in the country; four hundred thousand live in the urban districts. Those who live in the country obtain what milk they can get in their own *barrio*, from their own cow's or those of their neighbors, but with the exception of that taken immediately upon milking all of it is boiled in order to keep it sweet.

In this large group the problem is not the quality (as it is the same in every rural zone of the world) but the quantity. Where the regime of tenant farming still obtains, the land owner and the tenant can get milk for their homes, but, of course, where only one product is cultivated and the raising or keeping of cattle has disappeared, then the rural inhabitant is deprived of such facilities.

Among this sector of our people the harm done by the almost exclusive use of vegetables, cereals and greens in place of milk, and the way they are prepared, is much more serious than the poor quality of milk.

Of the 400,000 urban inhabitants 250,000 live in the ten or eleven cities of more than 10,000 inhabitants; 150,000 in the sixty-six or sixty-seven remaining towns.

The condition regarding the sale of milk is about the same in these smaller towns as in the rural districts, or at least in a large number of them. The industrialization of the sale of milk; the large dairy farm and the milkstand especially, are enterprises found in and about the large cities and so affect almost exclusively the 250,000 inhabitants of our largest cities. Even if we raise the percentage to 300,000 this could not cover 25 per cent of our population.

In the larger places the milk industry has increased notably during the last few years. The dairy farm is now a business on a large scale in which refrigeration and sterilization of the bottles by steam has become the custom.

The official standard is 500,000 non-pathogenic bacteria per one cubic centimeter as a maximum for the legal sale of milk. In the Biological Laboratory of the Department of Health counts have been made since August of last year until now with the following results:

From August to December, 1927----- 70 samples
 With a lower count of 26 or 37 per cent to the legal maximum.
 With a higher count of 44 or 63 per cent to the maximum.
 From January to November, 1928----- 51 samples
 With a lower count of 34 or 67 per cent to the maximum.
 With a higher count of 17 or 33 per cent to the maximum.

Regarding the chemical adulteration the following table demonstrates the progress made in the campaign against milk adulteration according to data gathered from our Chemical Laboratory.

TABLE No. VII
ADULTERATION OF MILK *

Years	Percentage of Adulteration
1901-02	25.0
1902-03	20.7
1903-04	23.8
1904-05	25.8
1905-06	28.7
1906-07	37.0
1907-08	25.0
1908-09	23.4
1909-10	21.3
1910-11	50.5
1911-12	26.6
1912-13	20.6
1913-14	11.9
1914-15	21.2
1915-16	19.9
1916-17	21.6
1917-18	22.5
1918-19	26.3
1919-20	26.68
1920-21	24.12
1921-22	19.4
1922-23	20.95
1923-24	14.22
1924-25	11.31
1925-26	10.5
1926-27	8.0
1927-28	5.57

The tendency to better the milk industry in Porto Rico is evident as shown by the above figures.

The effect of the poor quality of the milk in the rate of infant mortality should certainly not be a great factor; our highest infant

* On the basis of samples taken by Department of Health Officials.

mortality rate occurs in the first six months of life and according to the law of hygiene the child at that age should be breast-fed by all means as nature kindly has provided it with this means of nourishment.

The general custom of boiling the milk, although it deprives it of the anti-scorbutic vitamin, protects it from the contaminations that it may have encountered in its transit from dairy to home. The mistakes made in the handling of the milk may not be so many until after boiling while manipulated in the home, where it is kept without the protection of refrigeration.

By calculations made, based upon statistics from the Agricultural Department, the percentage of milk consumed in Porto Rico is one ounce per capita. According to the Department of Health the average consumption of milk in San Juan is seven to twelve ounces per capita; this we consider the highest average of the island.

We also believe that the factor of quantity and the prohibitive cost of milk are of greater importance than its quality, as far as it concerns the etiology of infant mortality in Porto Rico.

The regime and natural factor of foods is important, either because of scarcity (lack of mother's milk, scarcity of cow's milk) or because of the inadequate substances employed (premature feeding of solid food). As a consequence inanition, partial or absolute, supervenes with the reduction of digestive powers, intoxication and gastro-intestinal infection.

Costa has studied the bacteriology of diarrhea and enteritis in children but could find nothing specific.

Mortality from diarrhea and enteritis in children under a year in Porto Rico is not due to changes in climate, neither more or less rain, or humidity, nor does it vary with the seasons of the year. In children over two years, nevertheless, there is a certain relation between the mortality rate from diarrhea and enteritis and rain. This was demonstrated by Dávila and Phelps in an article which appeared in the *Porto Rico Review of Public Health and Tropical Medicine*, March 1928.

Although the variation of humidity and temperature do not affect greatly the infant mortality rate figures from diarrhea and enteritis in our country, the climate is a factor that cannot be underestimated when the figures showing the incidence of digestive disorders in small children of the tropics are compared with those of the same age in cold climates.

Everyone knows the disastrous effect of summer upon children

under a year, in the temperate zone. Infant mortality from diarrhea and enteritis rises there with the thermometer; and here, where the summer is eternal it is reasonable to think that in our small children the banal bacteria of the gastro-intestinal tube are reproduced the year round with great rapidity; reaching probably such enormous numbers that the intestinal lining or walls become irritated; or it may be that these bacteria become pathogenic in our climate.

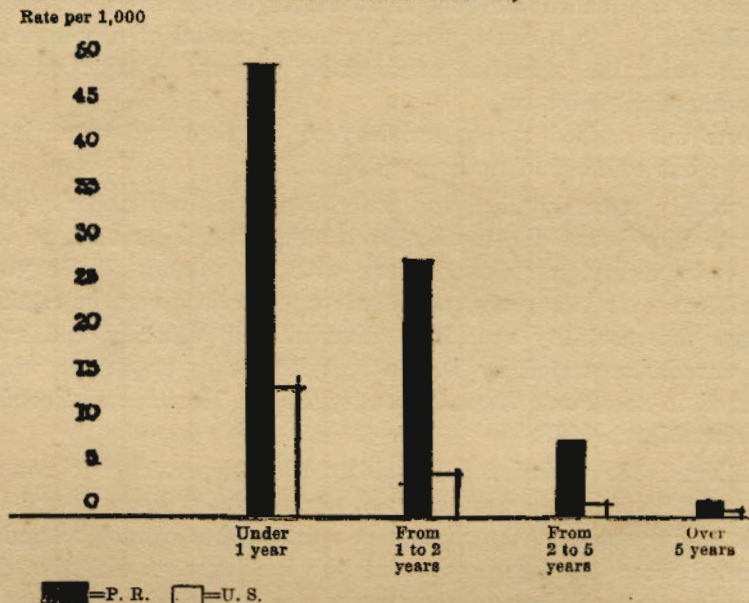
The cool climate which prevails in the plateau of our central mountain range may be the determining factor for the light infant mortality in the central region of the Island.

In this sense, climate is a continuous and permanent factor, a fundamental consideration with regard to infant mortality in Porto Rico.

Phelps concluded that "diarrhea and enteritis in the age groups above two years are of hydric origin," but he could not establish any etiologic relationship as to those under two years.

CHART No. XIII

DEATH RATE FROM DIARRHEA AND ENTERITIS FOR PORTO RICO
AND IN THE UNITED STATES. (THE UNITED STATES 1920.
PORTO RICO 1918-25.)



This might be interpreted to mean that, given our uniform temperature throughout the year and our very slight seasonal changes,

diarrhea and enteritis remain at as high a level throughout the year as they would in temperate zones during summer months.

In speaking of gastro-enteritis as a cause of death, we should add that not always the causal disease is pre-eminently a disease of the digestive tube. Further on we will make note of the coincidence of its curve with that of measles. In the same way diarrhea and enteritis without doubt doom many children although their illness began with diseases of a varied and distinct nature.

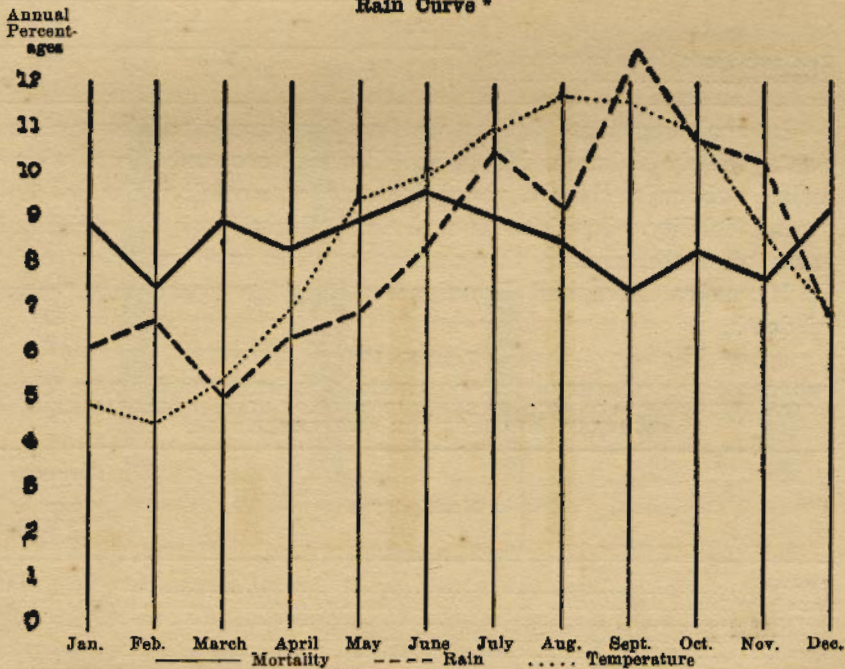
To summarize, we would say: That gastro-enteritis in infancy is due in Porto Rico:

1. To the regime and nature of the nourishment or feeding of the children.
2. To conditions caused by the invariable climate.
3. To other diseases that assume gastro-intestinal forms.
4. To economic and social factors which aggravate the former causes.

CHART No. XIV

**INFANT MORTALITY FOR DIARRHEA AND ENTERITIS IN PORTO RICO
1911-1925**

Seasonal Variations and Correlations with Temperature Curve and Rain Curve *



* This is a quotation from Phelps and Dávila's "Porto Rico Review of Public Health and Tropical Medicine." No. 2. Vol. III.

SECOND GROUP

DISEASES OF EARLY INFANCY

The second cause of infant mortality in Porto Rico consists of the group known as "diseases of early infancy." This group of diseases caused 1,623 deaths last year (1927-28), or 21 per cent of the deaths of children under one year of age. In the United States the same group of diseases caused 48 per cent of the total infant mortality in 1925.

Among the diseases composing this group, congenital weakness holds the first place in Porto Rico. It caused 88 per cent of the total number of deaths among children under one year in 1926-27, and 86 per cent in 1927-28. This ratio is very much greater than that of the same group in the United States, where congenital weakness causes but 10 per cent of the deaths due to diseases of early infancy.

TABLE No. VIII
INFANT MORTALITY DUE TO DISEASES OF EARLY INFANCY

	Congenital Weakness		Other Diseases of Early Infancy	
	P. R.	U. S.	P. R.	U. S.
Total percentage of deaths due to infant diseases.....	86	10	14	90

In analyzing these figures we find that municipalities such as Santa Isabel, Yabucoa, Mayagüez, Hormigueros and Moca, where malaria abounds, show a very high rate of mortality due to congenital debility. In Yabucoa and Santa Isabel it is the principal cause of death, and in this respect prevails over gastro-enteritis. In Mayagüez, Moca and Hormigueros it is the second main cause of death.

TABLE No. IX
PROPORTION OF DEATHS DUE TO CONGENITAL DEBILITY IN THE FIVE MUNICIPALITIES OF PORTO RICO WHERE THE RATE OF INFANT MORTALITY IS HIGHEST. AVERAGE FOR FIVE YEARS, 1923-28

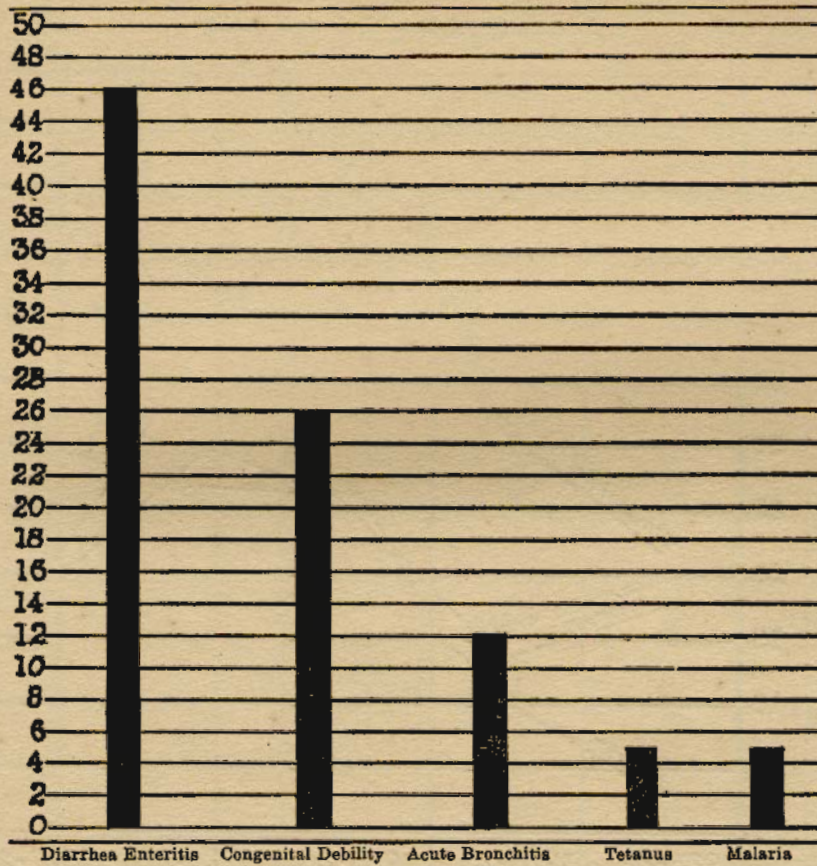
Municipality	Percentage of Deaths Caused by Congenital Debility
Yabucoa.....	33
Santa Isabel.....	32
Mayagüez.....	26
Hormigueros.....	25
Moca.....	18

The deaths of infants registered as due to congenital debility in

malarial districts are not due, of course, to the fact that little children suffer from malaria at such an early age; but rather to the fact that their mothers have the disease, accompanied by the cachexia ordinarily attendant thereto. Such is the cause of the births of children of low vitality.

CHART No. XV

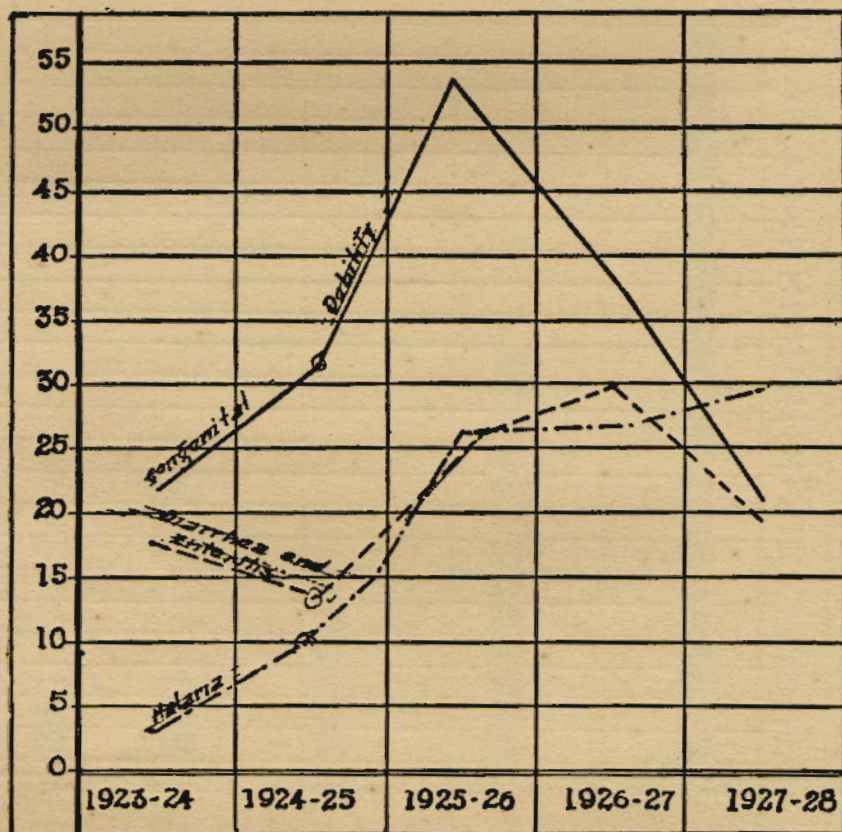
INFANT MORTALITY IN PORTO RICO DUE TO VARIOUS DISEASES
FIVE-YEAR AVERAGE—1923-1928



In Santa Isabel, where infant mortality in 1926-27 was 356 out of every thousand births, there was a decrease of 147 in the ratio of deaths of children under one year of age in 1927-28. Such decrease in infant mortality in Santa Isabel, upon analysis, shows that congenital debility decreased more than any other cause of death. This was the reason for a great proportion of the general decrease.

In 1927, the Malaria Bureau of the Department of Health began its battle against malaria in Santa Isabel by analyzing numerous blood specimens and administering quinine to over five hundred persons who were carriers of the malarial parasite.

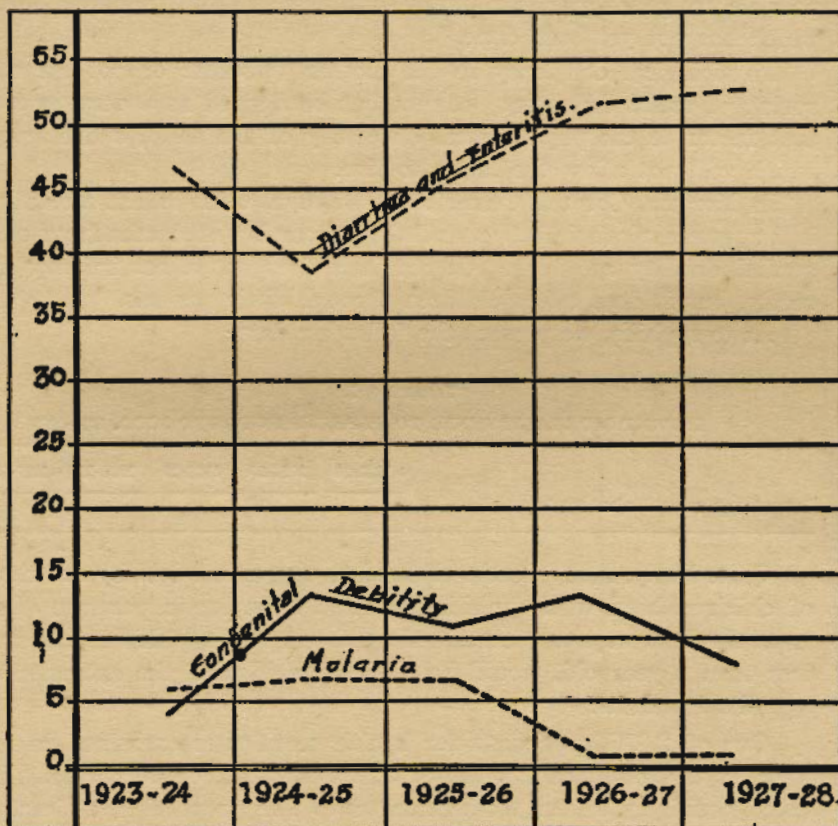
CHART No. XVI
INFANT MORTALITY DUE TO VARIOUS CAUSES—1923-1928
 Santa Isabel, P. R.
 Percentage of Total Infant Mortality



In Fajardo, where a campaign against malaria has been waged since 1926, the death rate on account of congenital weakness has decreased in greater proportion than all other causes of death of children less than one year old, malaria excepted.

That the organization of the aforesaid campaign coincided with a notable decrease of infant mortality is a suggestive fact, particularly as regards deaths from congenital debility in Santa Isabel. Without seeking to establish a final relation of cause and effect be-

CHART No. XVII
INFANT MORTALITY DUE TO VARIOUS CAUSES—1923-1928
 Fajardo, P. R.
 Percentage of Total Infant Mortality



tween these two coinciding facts, we make note of our observations because they seem to us worthy of further future study. If, as it seems, the campaign against malaria proves to be an important factor in the decrease of infant mortality from congenital debility in Santa Isabel, we have reason for optimism as regards the reduction of in-

fant mortality in Porto Rico (in the extension of such campaigns to other sections of the Island) not only from congenital debility but also directly from malaria, in so far as it affects infants.

Throughout the island, generally, mortality from congenital debility has decreased 34 per cent this year. This is one of the causes most notably contributing towards a reduction of 13 per cent in infant mortality in the Island from 1926-27 to 1927-28.

Aside from malaria and its apparent connection with congenital debility, we must think of the uncinariasis of our peasants and of the tuberculosis of our city dwellers. Also of syphilis. It is impossible to go deeper into these questions without research work which has not yet been done.

Physiological deficiency in the mother (whether or not the offspring of social deficiency) cannot but be figured as a very important factor to the physiological deficiency of the child, a deficiency which will not allow the latter to live.

In Morovis, Corozal, Comerío and Jayuya, while infant mortality is low, uncinariasis infection and the proportion of deaths from congenital debility are high. Uncinariasis does not affect infancy directly, but it does affect children through their parents.

As to syphilis, we present the following data:

TABLE NO. X
INFANT MORTALITY DUE TO SYPHILIS IN PORTO RICO, 1923-1928

	1923-24	1924-25	1925-26	1926-27	1927-28
Percentage of general infant mortality.....	1	0.9	1	2	3

Quite likely, many deaths charged to congenital debility are those of children born with syphilis inherited from luetic parents. Perhaps the best way to ascertain the existence of syphilis in children less than a year old, would be to gain an idea of the extension of syphilis in adults.

Out of 2,395 applicants for health certificates examined in one year by the local health office of San Juan, 242, or 10 per cent, reacted positively to the Wasserman test. The proportion, at least in San Juan, is sufficiently high to lead us to think that probably the death rate from congenital syphilis is greater than our statistics indicate.

G. F. Still, Professor of Pediatrics at King's College, London, referring to syphilis as a cause of congenital debility, says: "Congenital debility is one of the causes of marasmus most frequently

mistaken. The prognosis of the marasmus of congenital syphilis is always serious."

Out of 4,011 children admitted to the Infant Hygiene Clinics of the Department of Health during the year 1927-28, one hundred and ten, or 2.7 per cent were syphilitic.

THIRD GROUP

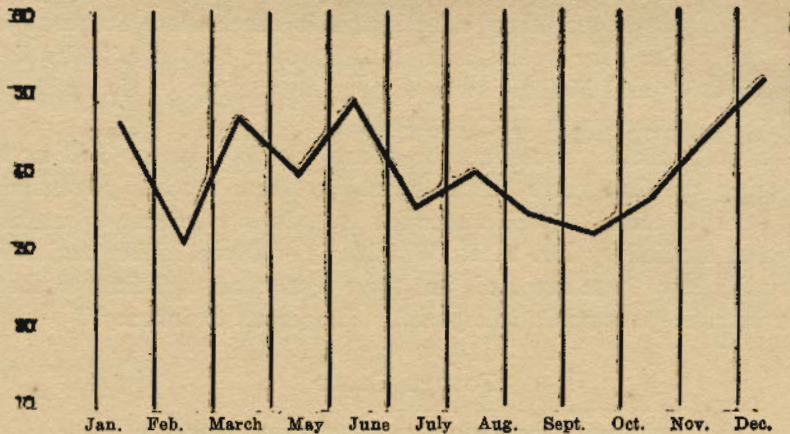
AFFECTIONS OF THE RESPIRATORY SYSTEM

Affections of the respiratory system are the third cause of death in children under one year of age in Porto Rico. In 1927-28, fourteen hundred and twenty-eight infants died as a result of such diseases. This was 19 per cent of the total number of deaths of children of the aforesaid age, the proportion being twenty-eight deaths for every thousand births. The number of deaths due to affections of the respiratory system was greater in the months of November, December, January, March and May. It might be thought that changes of temperature, gradual and moderate as they are in this country, exercise some influence on mortality from the diseases in question among children of the age above mentioned.

CHART No. XVIII

INFANT MORTALITY FROM DISEASES OF THE RESPIRATORY SYSTEM, BY MONTHS—1927

No. of Deaths
per 1,000 births



Probably the most important factor in the etiology of respiratory affections in children under one year of age, is direct contagion from older persons suffering from bronchitis and influenza, who, be-

cause of ignorance or carelessness, fail to take the precautions necessary to protect little children against infection. This becomes very serious on account of the low resistance offered against these infections by our undernourished children.

Jackson, in his "Effects of Inanition and Malnutrition Upon Growth and Structure," says: "Whether it be a direct effect caused by toxins in circulation, a lowered resistance to infection is a well-known result of various types of inanition, both total and partial. Thus the immediate cause of death following inanition is frequently an infectious complication, such as terminal broncho-pneumonia in the human species."

Acute infections in childhood, particularly measles, are another etiological factor of importance. This will be dealt with later on.

Among the diseases of the respiratory organs, acute bronchitis causes more deaths than any other. In 1927-28, deaths certified as from acute bronchitis constituted 40 per cent of all deaths from broncho-pulmonary affections in children under one year of age.

G. F. Still, says in connection with the frequency of broncho-pneumonia in little children:

"Statistics that I have studied in cases of children up to ten years of age, show that 84 per cent of the cases of primary broncho-pneumonia occurred in infancy, that is, during the first two years of life." And he adds: "Broncho-pneumonia, as a primary affection, is much more frequent in infancy than at any other stage of childhood. As a secondary affection, it is much more frequent in children under four years than in those over that age." In this respect Osler and McCrae state that up to the age of six susceptibility to pneumonia is very marked.

As to mortality from broncho-pneumonia in infancy, Still says: "During the first years of life, mortality from broncho-pneumonia was 64.4 per cent." (This statement is made in reference to a series of cases studied by Dr. T. R. Whipham.) "Even higher ratios of mortality have been reported, but these figures are sufficient to show that broncho-pneumonia is especially dangerous to infancy."

FOURTH GROUP

EPIDEMIC, ENDEMIC AND INFECTIOUS DISEASES

Epidemic, endemic and infectious diseases caused 16 per cent of the deaths of children under one year in Porto Rico during the fiscal year 1927-28. Twelve hundred and twenty children under the

stated age died in the fiscal year 1927-28, and twelve hundred and seventeen in 1926-27, from this group of diseases.

Of the epidemic, endemic and infectious diseases, malaria and tetanus are the chief causes of death in Porto Rico. In the fiscal year 1927-28, these two diseases caused 63 per cent of the total number of deaths charged to the group to which they belong.

Malaria is much more common in the coast towns than in towns of the interior of the island. Although extensive surveys have not been made of malaria in the inland towns, Dr. Walter C. Earle, Chief of the Malaria Bureau of the Department of Health, estimates that not more than 6 per cent of the population is infected with the malaria parasite in such towns, while on the coast, according to conscientious studies made in different sections, the percentage of persons infected with malaria varies from 15 per cent to 50 per cent, the average being between 25 per cent and 35 per cent. This condition, of course, covers infants not a year old, and this explains why malaria holds first place in this group of the causes of death in the first year of life.

Tetanus as a cause of infant mortality is irregularly distributed geographically. In 1927-28, the towns showing the highest percentage of infant mortality from tetanus, were: Aguada, 30 per cent; Rincón, 28 per cent; San Germán, 24 per cent; Juncos, 19 per cent; Morovis, 15 per cent; Vega Baja and Yabucoa, 14 per cent; Vega Alta, 13 per cent; Maricao and Aguadilla, 12 per cent; Manatí and Hatillo, 10 per cent; and Humacao, 9 per cent. On the other hand, San Juan showed but 1.59 per cent. However, there seems to be a zone of greater occurrence in the west and another of lesser occurrence in the north, towards the middle of the island. And it is observed that such occurrence is in municipalities where a rural population predominates, except in the case of Aguadilla.

As regards acute infectious diseases of children, one of us, Fernós, in his work on measles in Porto Rico, published in No. 165 of the *Bulletin of the Medical Association of Porto Rico* for September, 1928, said:

"In the group of acute infectious diseases generally considered as common to children, such as diphtheria, scarlet fever, whooping cough and measles, none is so important in Porto Rico as the last named, judging from the deaths recorded from this disease in our civil registers.

"We are practically free from scarlet fever, a disease which is considered serious in the United States and which caused a mortality rate of 11 per 100,000 children under fifteen years in the Death Registration Area from 1921 to 1925.

"The mortality rate from diphtheria in Porto Rico was only 12 per 100,000 while this disease produced in the United States thirty-nine deaths per 100,000 under fifteen years of age in the same area and period.

"The mortality rate from whooping cough seems as high—or a little higher—in Porto Rico as in the United States. This disease caused twenty-five deaths per 100,000 in children under fifteen years in the United States while 35 per 100,000 were registered from the same disease in Porto Rico. (1921-25.)

"But from measles while 19 per 100,000 children under 15 years died in the United States, 57 deaths per 100,000 were registered from this disease in Porto Rico."

Granting that the compilation of data may fall short in some respects the fact remains that measles is a cause of death of importance in Porto Rico. The ciphers show clearly that mortality from this disease is much higher in Porto Rico than in the United States, and that it is the disease of greatest importance in the group of which it forms a part, when considered from the collective viewpoint. (We are not referring to case mortality.) Hence, we are justified in studying the incidence of the disease in our midst. Fernós further states:

"Measles is an epidemic disease; that is, it appears in periodic waves disappearing and re-appearing from time to time. The periodicity of these waves has been observed at different times by various investigators in other countries. Let us see if we can point out like phenomena in Porto Rico.

"The year 1909 began without any death record from measles. The first death occurred in April; then more occurred and by the end of the year (month of December) the cipher rose to 28 deaths from this cause. Beginning with the year 1910 the wave continued *in crescendo* until the month of April when the high-water mark of the epidemic was reached, the cipher for the month of April 1910 being 67 deaths from this cause. (Exactly one year since the start.)

"Then a gradual decrease is noticeable. By the end of the year

only seven deaths from this cause were registered. In 1911 some cases still appeared and by April of that year the epidemic had ceased almost entirely. After two years' time the epidemic was extinguished.

"During an interval of five years scarcely any deaths from measles was registered. It seems that an infant population of one to five years accumulated without becoming immune to the disease up until the year 1917. In January of that year twelve deaths from measles were registered. The mortality rate rose and by July 1917, 232 deaths were registered. In December the figures had decreased and in 1918 the epidemic died out. This outbreak was much more sudden, more of an outburst than the former one. It produced 1,800 deaths, (the former produced 500) and lasted about the same period of two years.

"Then an almost perfect periodicity is established, with free intervals of two years and epidemics of two years, up to the present time. Hence, during 1919 and 1920 there were almost no deaths from measles. During 1921 and 1922 an epidemic occurred. The years 1923 and 1924 were free from the disease; 1925 and 1926 recorded another epidemic and 1927 and 1928 are again free.

"It would seem reasonable to predict that in view of the facts already set forth another epidemic will begin by the end of this year and continue through the year 1929 possibly up to 1930. The bi-annual periodicity of measles in Porto Rico has really been noteworthy during the last ten years.

"Measles does not appear only as such in the death registers. Broncho-pneumonia being one of the most frequent fatal complications, many deaths are registered under this list when the primary cause of death was really measles. We have already seen how the years 1909 and 1910 marked a measles epidemic, how the five ensuing years were free from epidemics of the disease and how the ten years following have had a bi-annual epidemic rhythm. Broncho-pneumonia shows a general tendency to a gradual rise in the total deaths from 1909 to 1928 and in 1917 a rhythm begins which corresponds exactly with that of measles. There is a rise in the mortality curve in 1917 and 1918; a drop in 1919 and 1920, a rise again in 1921 and 1922, a drop in 1923 and 1924, and another rise again in 1925 and 1926. In 1927 there is not a pronounced drop.

"The casuality of broncho-pneumonia is not measles alone, of

course. Other causes may determine variations in the mortality curve, singularly, for instance, influenza in 1918. Yet, this bi-annual rhythm synchronous to that of measles for a period of ten years is indeed very suggestive.

“Another frequent complication in Porto Rico as a result of measles is diarrhea and gastro-enteritis. Although the diversity of factors in its etiology makes a correlation as to incidence more difficult, it is certain that its rhythm and that of measles correspond.

“In the period from 1910 to 1925 the maximum cipher of gastro-enteritis in children under two years corresponds exactly with the maximum cipher for measles (1917). And in the years recorded as free from measles there is a proportional drop in the occurrence of gastro-enteritis in accordance with its own incidence during the years in which measles was recorded.”

It is observed, then how infecto-contagious diseases are either mediate or immediate causes of infant mortality almost before the first three months of life have elapsed, hardly has the immunity inherited from the mother disappeared. And see, also, how the relative importance thereof varies in Porto Rico as compared with other countries.

There is another disease in this group which we must again mention—tuberculosis.

“We already know,” says Saner in Abstracts of Pediatrics, “that:

1. Infants are very prone to tuberculosis,
2. A precocious diagnosis is difficult,
3. The sources of infection are multiple.”

On the other hand Calmette insists on the transplacental tuberculous infection, no matter how infrequent it may be. The source of infection is the active tuberculous patient with open lesions.

With 3,604 deaths from pulmonary tuberculosis in 1927-1928, would it be illogical to presume that a great number of children from among those contaminated, succumb to acute generalized tuberculosis which escapes diagnosis? But we lack data to prove our presumption. Our civil registers show the following, from 1923 to 1928:

Disease	Average No. of Deaths
Miliary tuberculosis.....	4.4
Tuberculous meningitis.....	12.4

Though our statistics show but little on this subject, we believe

it advisable to state that in our opinion tuberculosis, in forms easily escaping diagnosis, increases the figures of infant mortality, especially in the group of gastro-intestinal diseases and in diseases of the respiratory organs.

Epidemic dysentery is an open question to us in view of the gastro-enteric outbreaks recently appearing in several sections of the Island. There are not enough data, however, allowing us to include or exclude it as a permanent cause of infant mortality.

Uncinariasis does not clearly appear as a factor of infant mortality. If we consider the low vitality of parents and children; the lowering of their economic level; the premature ceasing of the period of lactation exhaustion, and the impoverishment of mothers' milk, making artificial nourishment necessary in both cases, it might seem to be such a factor, though only indirectly.

AVITAMINOSIS AND OTHER DIRECT CAUSES OF INFANT MORTALITY

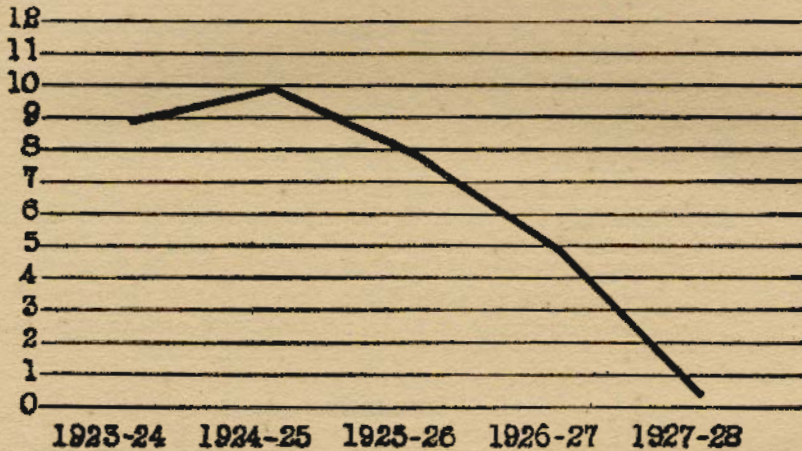
In speaking of the etiological factors of infant mortality in Porto Rico it would not be improper to mention avitaminosis, an important cause of death in other tropical countries where the diet of the poor is deficient, just as it is in Porto Rico. The deficient artificial nourishment of a large proportion of infants being known, as well as the deficient nourishment of the mothers of sucking babies, is it not reasonable to suppose that some of the inanition, some of the marasmus observed in our country in children not a year old, is due basically to deficiency in one or another of the vitamins determining the nutritive balance of our organism?

All other diseases considered together are unimportant as causes of death when we compare them with those we have just surveyed. Rickets, which erroneously figured as a great cause of death prior to 1924, now hardly appears in our civil registers, the same having been substituted by other more exact denominations. One of our number, Fernós, first dealt with this matter at the Convention of the Medical Association held in 1924, when he read his first paper on infant mortality. Later on a survey was made by the technical committee from the Children's Bureau of Washington which confirmed his statements. The decrease of rickets as a declared cause of death may be observed in the following chart:

CHART No. XIX

INFANT MORTALITY IN PORTO RICO DUE TO RICKETS DURING THE
FIVE YEARS—1923-1928

Per 1,000 births



The Fight Against Infant Mortality

The struggle against infant mortality, is hygienic and social. It is based on general and special measures, both of which must vary according to conditions and the problems of each locality.

The general measures consist of sanitation, suppression of epidemic and contagious diseases, elevation of the social and economic level of the people, diffusion of knowledge, and of all such things as tend to form a better world, a better society in which to receive the newly arrived.

The special measures would be such as—

1. Prenatal clinics for pregnant women. (A certain number already exist in Porto Rico.)
2. Maternity Hospitals.
3. Infant hygiene clinics for the teaching of infant feeding and care to mothers and for the application of specific prophylactic measures such as vaccination, etc. (They exist among us.)
4. Cradle-rooms annexed to factories where working mothers may nurse their children.
5. Day nurseries (creches) where children may be kept during the day, in default of cradle-rooms.
6. *Gouttes de lait* annexed to infant hygiene clinics, for the distribution of milk at low prices for artificially fed children. They should also be centers of instruction as

- to infant feeding in connection with the preparation of said food.
7. Hospitals for children.
 8. Organization of "Little Mothers' leagues"; mothers' conferences, and other forms of spreading knowledge of maternal and infant hygiene. (Schools, newspapers, articles, pamphlets.)
 9. Education of the public as to the services of midwives. Supervision of their work.
 10. Distribution of prophylactic material for umbilical cures.
 11. Services of visiting nurses and social workers to care for infants in their homes.
 12. Educating the public to the supreme importance of keeping expectant mothers and later, mother and child under the care of competent professionals to watch the course of pregnancy and child-birth, and to direct the care of the child, especially as to its nourishment, and prompt attention in such cases of diseases as may arise.

SUMMARY

Infant mortality in Porto Rico is high, families are large, the marriage age early, and the density of population great. Infant mortality is influenced by this problem. It is greater in the towns along the coast, and higher on the western coast than elsewhere in the island. It is lower in the inland municipalities, and increases in direct proportion with the conglomeration of inhabitants, it being much higher in the urban centers than in the rural districts. It is more noticeable in the black than in the white race, and among boys than girls. It is much higher among illegitimate than among legitimate children, and is especially noticeable among children from one to six months of age. Its principal direct causes are diseases of the gastro-intestinal system, especially the pathological entity or entities figuring in the death registers under the names of diarrhea and enteritis. Diarrhea and enteritis cause thirty-one per cent of the deaths of children under a year old in Porto Rico.

As causes of the diseases of the digestive system in children under a year of age we have indicated three principal factors:

1. An inadequate régime and the deficient nature of the food given the children.
2. Social conditions such as the ignorance of parents in matters of infant hygiene, deficiency, illegitimacy and overcrowding.
3. Infectious diseases such as measles, whooping-cough and congenital syphilis, which frequently bring on gastro-intestinal troubles as a consequence.

4. Inalterable factors of climate: the high temperatures of our eternal tropical summer which favors the multiplication of bacteria in the gastro-intestinal tube and creates a predisposition, through other means, to all sorts of digestive troubles.

The second cause of death in children less than a year old in Porto Rico, is constituted by the diseases comprised in the group known as "diseases of early infancy". Among these, congenital debility holds the first place. It is caused by multiple factors, and a certain relation may be observed between this disease and malaria, uncinariasis, syphilis and tuberculosis as they occur in adults.

Diseases of the respiratory system constitute the third group of direct causes of death among infants under a year old in Porto Rico, acute bronchitis holding the first place among these diseases as a cause of death.

The most important etiological factor of respiratory diseases seems to be direct contagion of undernourished infants. The inanition resulting from a poor system of nourishment is a predisposing factor in the causes of broncho-pneumonia. Acute infectious diseases are also important etiological factors.

Broncho-pneumonia probably causes more deaths, and acute bronchitis fewer, than our civil registers show.

The fourth group of diseases causing infant mortality in Porto Rico is constituted by endemic, epidemic and infectious affections. Among these, malaria and tetanus are the most important. Malaria prevails along the coast. Tetanus is irregularly distributed. Next come, among acute infectious diseases, measles and whooping-cough, which are problems of consideration among us.

The means we deem most efficacious to combat infant mortality are the following: Maternity and child hygiene clinics; maternity and children's hospitals; cradle-rooms and day nurseries for working mothers; the *goutte de lait*; educational campaigns among mothers and school girls on infant hygiene; greater supervision of midwives, and distribution of prophylactic material for umbilical cures.