Infant Mortality and Infant Feeding in Puerto Rico[1]

Preliminary Note

By MYRON E. WEGMAN, R. FERNÁNDEZ MARCHANTE, *and* MORTON KRAMER

From the Department of Public Health, School of Tropical Medicine, and the Bureaus of Infant Hygiene and Vital Statistics of the Insular Department of Health

THE INFANT mortality rate is one of the most important indices of the health of any community. Puerto Rico, which has serious problems in almost every field of public health, is faced with a particularly bad situation with regard to infant mortality. The average rate for the five-year period 1935–39 was 122.7 deaths under one year of age per 1,000 live births; in other words, out of every eight children born, one was dead before the end of the first year of life. The magnitude of this mortality makes it very desirable that the work of the Bureau of Maternal and Child Hygiene of the Insular Department of Health be supplemented by investigations into the various factors concerned with this mortality.

TABLE 1

Infant Mortality Rates (Deaths under 1 year per 1,000 Live Births) by Age, Puerto Rico and Continental U.S.A., 1932-40

Year	Puerto Rico[a]			U.S.A.[b]		
	Total Under 1 Year	Under 1 Month	1-11 Months	Total Under 1 Year	Under 1 Month	1-11 Months
1932	132.4	54.2	78.2	57.6	33.5	24.1
1933	139.4	56.9	82.5	58.1	34.0	24.1
1934	113.5	39.9	73.6	60.1	34.1	26.0
1935	114.7	35.6	79.1	55.7	32.4	23.3
1936	127.3	35.5	91.8	57.1	32.6	24.6
1937	138.4	39.9	98.5	54.4	31.3	23.1
1938	121.2	36.2	84.9	51.0	29.6	21.4
1939	112.4	33.7	78.8	48.0	29.3	18.7
1940	113.4	35.2	78.2	47.0	28.8	18.3

[a]Source: Reports of the Division of Vital Statistics of the Insular Department of Health.
[b]Source: U. S. Bureau of the Census.

1. Presented at the first meeting of the Puerto Rico Public Health Association, San Juan, Puerto Rico, September 23, 1941; received for publication October 19, 1941.

Since the factors affecting infant mortality differ with the age of the child, it is of interest to examine the trend of the mortality over several years by certain subdivisions of the first year of life. Table 1 and Figure 1 show such an analysis for Puerto Rico for the years 1932–40. In addition, Table 1 includes figures for continental United States for comparison. The data are limited to this period since earlier records are not available for Puerto Rico.

In Puerto Rico the mortality rate for the entire first year has

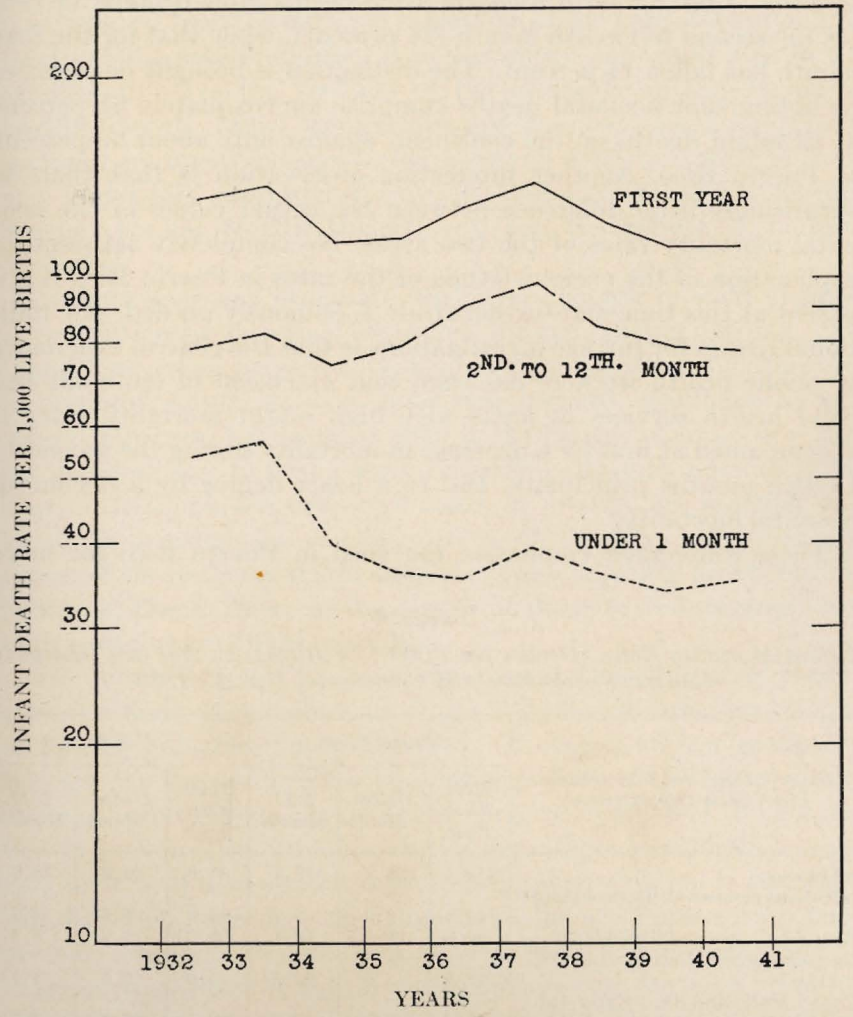

FIGURE 1

TREND OF INFANT MORTALITY, BY CERTAIN PERIODS OF THE FIRST YEAR OF LIFE, PUERTO RICO, 1932–40

decreased slightly, if at all. The rate for the second to twelfth month has shown no definite trend, while that for the first month appears to have fallen rapidly, having decreased 35 percent. It should be pointed out, however, that almost all this decrease occurred between 1933 and 1934, and that since the latter year the drop has been only 12 percent.

The figures for continental United States for the same period are markedly different. The total infant mortality rate has been falling steadily. Unlike Puerto Rico, there has been a rapid drop in the rate for the second to twelfth month (24 percent), while that for the first month has fallen 14 percent. The distinction is brought out further by noting that neonatal deaths comprise approximately 61 percent of all infant deaths on the continent, against only about 30 percent in Puerto Rico. Another interesting observation is that there is surprisingly little difference between the actual values of the neonatal mortality rates of the two areas. No completely satisfactory explanation of the curious trends of the rates in Puerto Rico is apparent at this time and further study is obviously needed. An additional reason for further investigations is that the general experience of public health workers has been that extension of maternal and child health services in areas with high infant mortality rates is accompanied at first by a decrease in mortality during the second to twelfth months principally, and to a lesser degree by a decline in neonatal mortality.

These differences emphasize the need in Puerto Rico for more

TABLE 2

Infant Mortality Rates (Deaths per 1,000 Live Births) by Age and Groups of Causes, Puerto Rico and Continental U.S.A., 1939

Cause of Death and International List Number (1929 revision)	*Puerto Rico*[a]			*U.S.A.*[b]		
	Total First Year	*Under 1 Month*	*1–11 Months*	*Total First Year*	*Under 1 Month*	*1–11 Months*
All causes	112.5	33.7	78.8	48.0	29.3	18.7
Infectious diseases (1–44, excluding 13)	12.1	3.0	9.1	3.3	0.6	2.7
Respiratory diseases (104–114)	20.6	2.5	18.1	6.6	1.2	5.4
Gastrointestinal diseases (13, 118, 119)	45.2	3.0	42.2	4.6	0.5	4.1
Cong. Malf. and Dis. Early Inf. (157–161)	27.0	23.4	3.6	27.1	24.4	2.7
All other causes	7.6	1.8	5.8	6.4	2.6	3.8

[a]Source: Reports of the Division of Vital Statistics of the Insular Department of Health.
[b]Source: U. S. Bureau of the Census.

effort directed at reducing the mortality from the second to the twelfth month. During this period far more deaths are attributed to gastrointestinal diseases than to all other causes combined. This situation is in striking contrast to that in continental United States, the reported rate for Puerto Rico being over ten times that of the mainland. Great caution is called for in interpreting the figures for Puerto Rico in Table 2, since experience with the new, more complete, death certificate indicates that only 18 percent of infant deaths on the Island are attended by physicians before death. Nevertheless, it is believed that the data are indicative of the true state of affairs. Study of the enteric diseases is an obviously important step in the attempt to solve the problem of the mortality in the second to twelfth month. Many approaches are possible—most important, perhaps, are investigations on diarrhea and dysentery such as those now under way coöperatively by the United States Public Health Service, Insular Health Department, and the School of Tropical Medicine.

Another approach, axiomatic with every worker in child hygiene, is prevention of intestinal disorders through proper feeding. Justifiably increased attention to wise artificial feeding, pointing out its essential simplicity, is a great step forward. Emphasis on this aspect, however, has brought with it the danger of forgetting that the simplest way to feed a baby properly is through nursing at the breast. Although the causes of death in infancy are multiple and no single investigation can hope to throw light on more than one aspect of the problem, it still seemed of value to study breast-feeding habits in Puerto Rico, in the search of possible factors associated with variations in infant mortality.

The infant hygiene clinics of the Insular Department of Health offered a body of records from which valuable information relating to feeding habits could be obtained. Of course, such a group is a selected one in that the clinic population is drawn from the medically indigent, even though this is a very large proportion of the population in Puerto Rico. In addition, these mothers are unique because they have been interested enough to bring their children to the clinic. The fact that there is more inducement for a woman with a baby needing a formula to come to a clinic is particularly important, for in the present phase of this investigation interest centered primarily on whether or not the infant was breast fed. These facts indicate the need for great caution in drawing inferences for the general population.

GEOGRAPHICAL DISTRIBUTION OF INFANT MORTALITY

Any study concerning infant mortality should take into account the geographical distribution of that mortality in the area under study. A map of Puerto Rico with the average infant mortality rates for the five-year period 1935–39 is shown in Figure 2. In the map the municipalities are divided into five groups, those which are blank having an infant mortality rate of 60 to 79; those with light hatching, a rate of 80-99; heavy hatching, 100–19; black background with white hatching, 120–39; and all black, 140 and over.

This map reveals some interesting facts. The western part of the Island, the coastal regions, with certain exceptions, and a corridor along the Military Road to Ponce, all have high rates. The central region and the eastern portion are the notably low areas. Since the infant mortality rate is calculated per 1,000 live births, any under-reporting of births would make it appear that the infant mortality rate was greater. Statistical tests indicate that it is very unlikely that these differences are based on errors in the reporting of either births or deaths.

Area studied. With the map as a guide, three municipalities were selected in which to start the study: Ciales, an inland, chiefly rural municipality with a population in the census of 1940 of 22,906 and a five-year average infant mortality rate of 83; Guayama, on the southern coast, with a total population of 30,511, including a town of 17,000, and a five-year rate of 146; and Río Piedras, near San Juan, population 68,290, including a city of 20,000, with a five-year rate of 126.

Methods. The material studied was the infant and preschool records found in the active and pending files of the public health units. The information tabulated was that of the status of the child at the time of *first admission* to Health Department service, before any specific benefit could have been obtained from that service. From each record the following information was obtained: exact age, sex, whether residence was rural or urban, age of mother, and whether the feeding was breast, mixed, or artificial. A master table was prepared for each municipality from which summary tables were later derived.

The work has not gone far enough to demonstrate any definite relationship in this study between infant feeding and infant mortality, but certain interesting observations have been made which merit presentation.

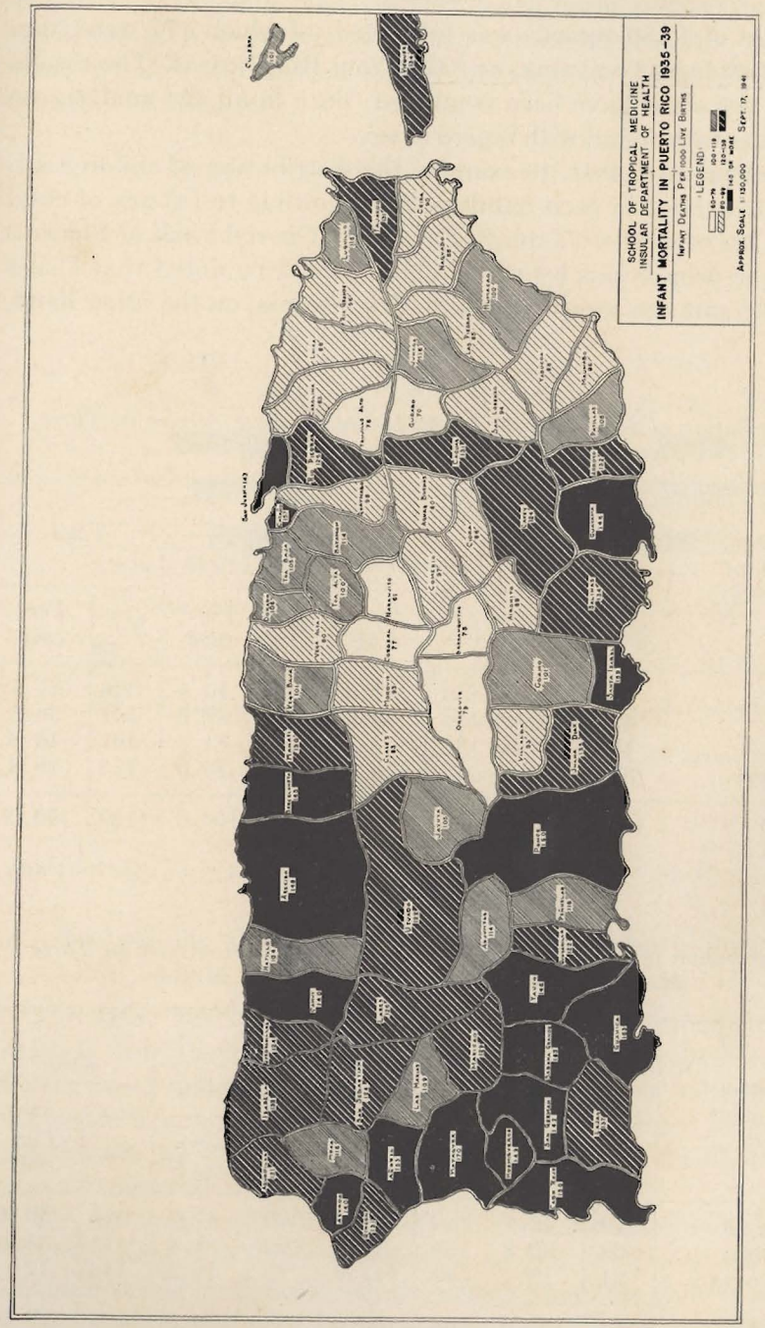

FIGURE 2
INFANT MORTALITY IN PUERTO RICO, 1935–39, BY EACH MUNICIPALITY

RESULTS

A total of 1,189 records was tabulated, of which 171 were from Ciales, 360 from Guayama, and 658 from Río Piedras. The results for the two sexes have been combined, since in all the analyses no differences were found with regard to sex.

It is of interest, first, to examine the distribution of children admitted to service in each municipality according to (*a*) age of child and (*b*) age of mother (Table 3, Figure 3). The right half of Figure 3 shows the proportions by age of child. It will be noted that Ciales and Guayama are almost identical. Río Piedras, on the other hand,

TABLE 3a

Distribution of Infants Admitted to Infant Hygiene Service in Three Municipalities of Puerto Rico by Age of Child

Age of Infant (Months)	*Municipality*						*Total*	
	Ciales		*Guayama*		*Río Piedras*			
	No.	*Percent*	*No.*	*Percent*	*No.*	*Percent*	*No.*	*Percent*
Under 2	72	42.1	150	41.6	108	16.4	330	27.7
2–3	47	27.5	110	30.5	280	42.6	437	36.8
4–5	14	8.2	40	11.1	143	21.7	197	16.6
6 and over	38	22.2	60	16.9	127	19.3	225	18.9
Total	171	100.0	360	100.0	658	100.0	1189	100.0

TABLE 3b

Distribution of Infants Admitted to Infant Hygiene Service in Three Municipalities of Puerto Rico by Age of Mother

Age of Mother (Years)	*Municipality*						*Total*	
	Ciales		*Guayama*		*Río Piedras*			
	No.	*Percent*	*No.*	*Percent*	*No.*	*Percent*	*No.*	*Percent*
Under 25	72	42.1	183	50.9	380	57.7	635	53.4
25–34	68	39.8	134	37.2	209	31.8	411	34.6
35 and over	31	18.1	43	11.9	69	10.5	143	12.0
Total	171	100.0	360	100.0	658	100.0	1189	100.0

is strikingly different. Here, a very much lower proportion of children was admitted during the first two months of life. Although many possible explanations of this difference have been offered, none is entirely satisfactory.

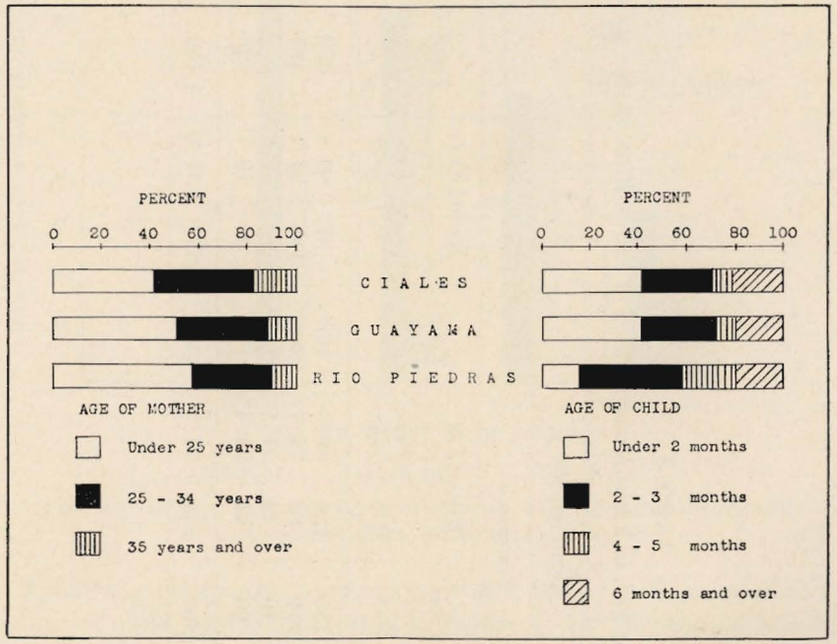

FIGURE 3

DISTRIBUTION OF INFANTS ADMITTED TO INFANT HYGIENE SERVICE IN THREE MUNICIPALITIES IN PUERTO RICO

(*a*) By Age of Mother (*b*) By Age of Infant

The other half of the figure shows the distribution by age of mother. Río Piedras and Guayama are relatively similar, while Ciales has a definitely lower proportion of younger mothers. This difference is great enough to be statistically significant when compared with the other two municipalities. Again no satisfactory explanation is available.

The figures have also been analyzed from the standpoint of both factors, and it was found that within each municipality the age of the mother has no influence on the age at which the child is first admitted; that is, the older mothers bring their children in at about the same age after birth as the younger mothers.

TABLE 4

Number and Percent of Infants Breast Fed, in Three Municipalities of Puerto Rico, by Age of Child

Age of Child (Months)	Municipality								Total		
	Ciales			Guayama			Río Piedras				
	Total Children	Breast Fed		Total Children	Breast Fed		Total Children	Breast Fed		Total Children	Breast Fed	
		No.	Percent		No.	Percent		No.	Percent		No.	Percent
Under 2	72	65	90.3	150	134	89.3	108	87	80.6	330	286	86.6
2–3	47	42	89.4	110	80	72.7	280	188	67.1	437	310	70.9
4–5	14	12	85.7	40	23	57.5	143	79	55.2	197	114	57.8
6 and over	38	10	26.3	60	21	34.4	127	25	19.7	225	56	24.9
Total	171	129	75.5	360	258	71.5	658	379	57.6	1,189	766	64.5

FIGURE 4

PERCENTAGE OF INFANTS BREAST FED BY AGE OF CHILD IN THREE MUNICIPALITIES OF PUERTO RICO

Table 4 presents the proportion breast fed in each municipality by age of child, and is illustrated in Figure 4. In the original tabulation, feeding was recorded as breast, mixed, and artificial. These terms are used only with regard to type of milk and are not affected by whether or not solid foods are given. For the sake of simplicity in the analysis, infants on mixed feeding have been grouped with those on artificial feeding. Therefore, in both the text and the tables, "breast fed" means that the sole source of milk was the breast. There are two things to be noted in this graph. First, the proportion breast fed declines with advancing age of child. Second, there is the striking difference between Ciales, an area of relatively low infant mortality, and the other two municipalities. The proportion breast fed in Ciales is definitely higher than in the other two communities in the two to three months group, and the difference is even greater in the four to five months group. Although the total records from Ciales were only 171, the differences are statistically significant. Río Piedras is consistently the lowest in every age group.

The next association studied was that between proportion of infants breast fed and the age of the mother (Table 5, Figure 5).

TABLE 5

Number and Percent of Infants Breast Fed, in Three Municipalities of Puerto Rico, by Age of Mother

Age of Mother (Years)	Municipality											
	Ciales			Guayama			Río Piedras			Total		
	Total Children	Breast Fed		Total Children	Breast Fed		Total Children	Breast Fed		Total Children	Breast Fed	
		No.	Per-cent		No.	Per-cent		No.	Per-cent		No.	Per-cent
Under 25	72	58	80.6	183	129	70.5	380	222	58.4	635	409	64.4
25–34	68	49	72.0	134	98	73.1	209	122	58.4	411	269	65.4
35 and over	31	22	71.0	43	31	72.1	69	35	50.7	143	88	61.5
Total	171	129	75.5	360	258	71.5	658	379	57.6	1,189	766	64.5

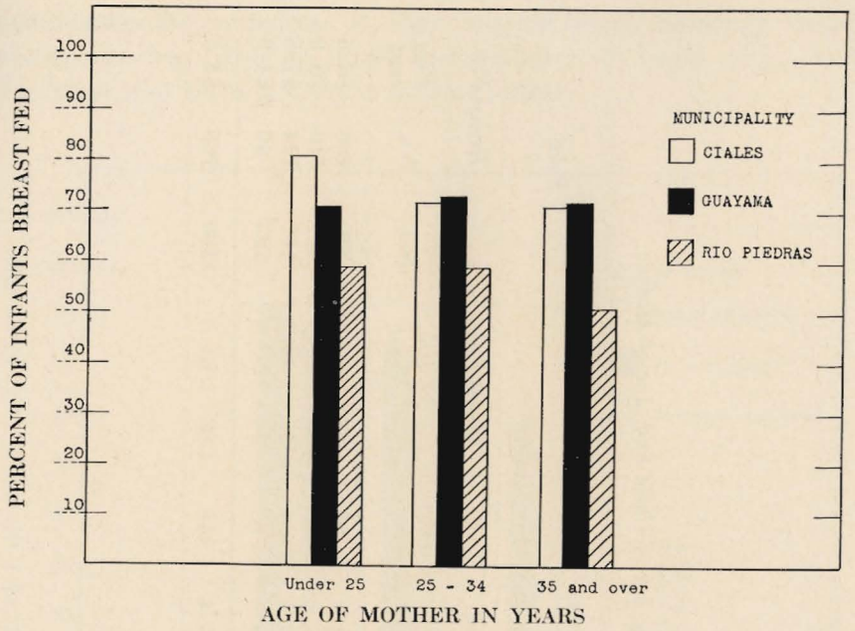

FIGURE 5

PERCENTAGE OF INFANTS BREAST FED BY AGE OF MOTHERS IN THREE MUNICIPALITIES OF PUERTO RICO

Again, Ciales is highest and Río Piedras, lowest. The main advantage for Ciales lies in the youngest age group, of which, it will be remembered, Ciales had relatively less than the other two municipalities. The repeatedly low Río Piedras figures are consistent with the general observation that this municipality has a lower proportion of breast-fed infants.

The material regarding the relationship of both age of mother and age of child is given for the study as a whole (Table 6, Figure 6). Similar analysis of each municipality made separately showed insignificant differences, and the trends were all similar. In order, therefore, to increase the numbers as well as to avoid over complication of the graph, the data were combined.

In the first age group of the children there is a decreasing proportion breast fed with the advancing age of the mother. This trend is definite enough to be significant statistically. On the other hand, in the group of children six months and over, it appears that the older mothers have the highest proportion of breast-fed children. In this group, the difference according to age of mother only approaches

TABLE 6

Number and Percent of Infants Breast Fed, by Age of Child and Age of Mother

Age of Child (Months)	Age of Mother (in Years)											
	Under 25			25–34			35 and over			Total		
	Total Children	Breast Fed		Total Children	Breast Fed		Total Children	Breast Fed		Total Children	Breast Fed	
		No.	Per cent		No.	Per cent		No.	Per cent		No.	Per cent
Under 2	179	163	91.0	115	95	82.5	36	28	77.8	330	286	86.6
2–3	230	157	68.3	157	118	75.2	50	35	70.0	437	310	70.9
4–5	102	58	56.8	71	43	60.6	24	13	54.2	197	114	57.8
6 and over	124	31	25.0	68	13	19.1	33	12	36.4	225	56	24.9
Total	635	409	64.4	411	269	65.4	143	88	61.5	1189	766	64.5

significance. Nevertheless, it may suggest that, although older women are less likely to nurse their children to begin with, once they start they seem to keep on nursing longer.

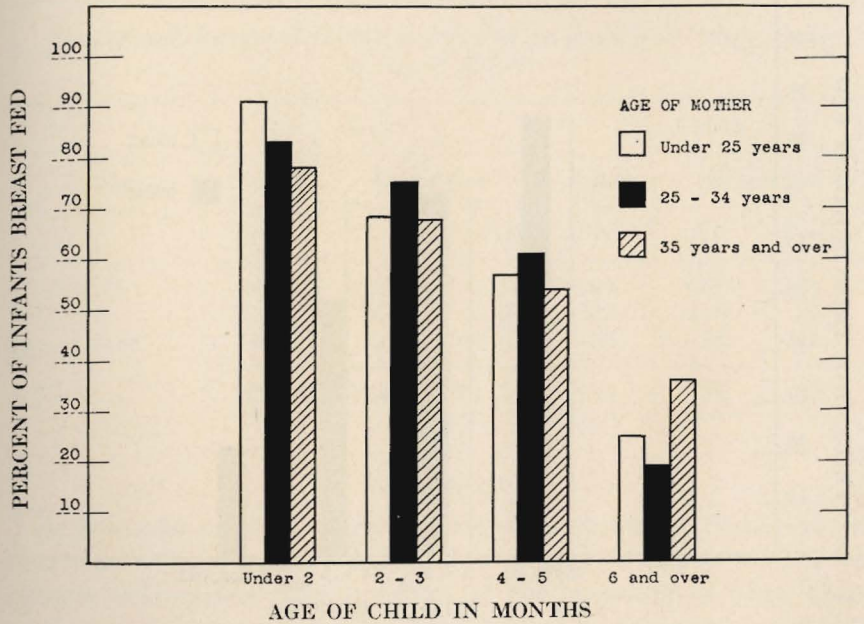

FIGURE 6

PERCENTAGE OF INFANTS BREAST FED BY AGE OF CHILD AND AGE OF MOTHER

One expects weaning to take place naturally from the eighth month on. Accordingly, it is necessary to be sure that the advantage for the over-thirty-five years group is not due to weighting with infants from six to eight months. Analysis for this factor shows consistently higher figures for the older age group and indicates that, as a matter of fact, the mother in the thirty-five-years-and-over group had the lowest proportion of infants six to eight months.

The data regarding rural-urban difference are also presented for the whole study since individual analyses showed similar trends (Table 7, Figure 7). There is clearly little difference in the early months of life, but in both older age groups the proportion breast fed is higher for inhabitants of rural areas. These differences are significant and would suggest that rural mothers tend to nurse their babies longer. There is no evidence that the rates for older infants

in the rural areas are weighted with older mothers, who, as shown above, tend to have the highest proportion of infants breast fed at age of six months and over.

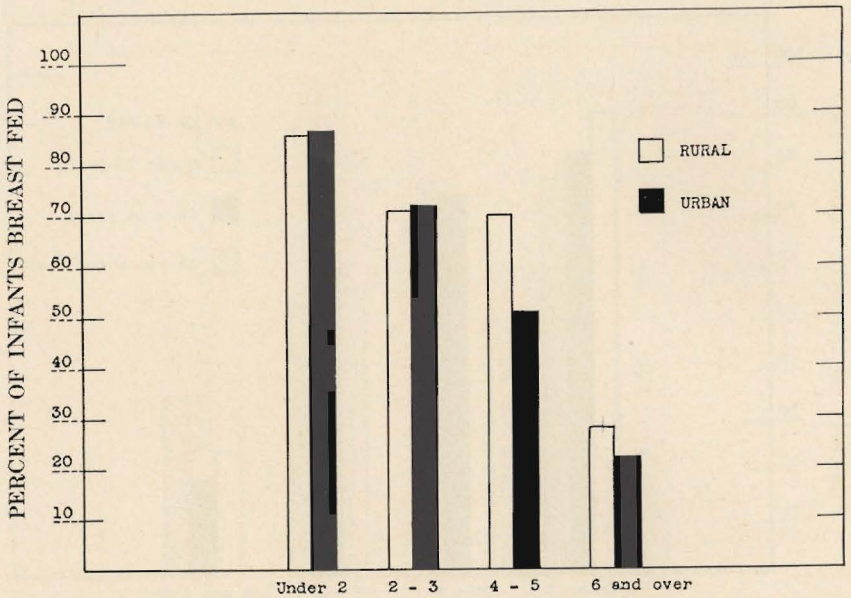

FIGURE 7

PERCENTAGE OF INFANTS BREAST FED BY AGE IN URBAN AND RURAL AREAS

TABLE 7

Number and Percent of Infants Breast Fed, in Rural and Urban Areas, by Age of Child

Age of Child (Months)	*Rural*			*Urban*		
	Total Children	*Breast Fed*		*Total Children*	*Breast Fed*	
		No.	*Percent*		*No.*	*Percent*
Under 2	107	92	86.0	223	194	87.0
2–3	163	115	70.5	274	195	71.2
4–5	70	49	70.0	127	65	51.2
6 and over	99	28	28.3	126	28	22.2
Total	439	284	64.7	750	482	64.3

A similar analysis regarding proportion breast fed according to age of mother, in rural and urban areas (Table 8), showed no difference between the two areas.

TABLE 8

Number and Percent of Infants Breast Fed, in Rural and Urban Areas, by Age of Mother

Age of Mother (Years)	*Rural*			*Urban*		
	Total Children	*Breast Fed*		*Total Children*	*Breast Fed*	
		No.	*Percent*		*No.*	*Percent*
Under 25	231	149	64.5	404	260	64.3
25–34	148	99	66.9	263	170	64.6
35 and over	60	36	60.0	83	52	62.7
Total	439	284	64.7	750	482	64.3

DISCUSSION

As has been pointed out earlier, the data on which the tables and charts have been constructed are too meager to act as a basis for definite deductions. The question of the meaning of even these preliminary findings regarding breast feeding, however, inevitably comes up and deserves some answer.

It has been assumed that breast feeding for the greatest possible number of children in Puerto Rico is desirable, among other reasons, for its simplicity and the established fact that gastrointestinal disorders are observed, by and large, in a much higher proportion of artificially than breast-fed infants.

This assumption is supported by the indication that Ciales, a municipality with a comparatively low infant mortality rate, appears to have a higher percentage of breast-fed infants, nursed for a longer time, than the other two municipalities studied. Whether or not this inference is supported by later work there is no reason why other areas should not attempt to match, at least, the proportion of infants breast fed observed in Ciales. The fact that more younger mothers in Ciales appear to nurse their babies may be a lead for public health workers to pay special attention to this group elsewhere. Furthermore, the impression that it is the older mothers who nurse longest, again points to the need for more effort among the others.

If one were to follow impressions current in the Island a greater disproportion would have been expected between the rural and urban populations. In so crowded an area as Puerto Rico many families live in areas classified as rural which, to all intents and purposes, are semi-urban agglomerations. Thus urban-rural distinctions frequently lose their significance. One of the important factors in successful breast feeding, however, is proper diet for the mother, and work at the School of Tropical Medicine has shown that there are differences between the dietary habits of farm and city people in Puerto Rico. It would be of considerable interest to investigate possible relationship between these diets and breast feeding.

It seems pertinent to re-emphasize the fact that even though great advances in knowledge and methods in recent years have made artificial feeding safer, nevertheless, the practice of nursing babies should be encouraged by all possible means. Weaning before the usual age should not be advised nor consent given to a mother's request to do so without a good reason. It is of the utmost importance that the proper technique of breast feeding be taught to all mothers, especially to primiparas, as errors in technique may lead to unnecessary artificial feeding. Doctors and nurses should become more familiar with the requisites for successful breast feeding, including proper diet, physical condition and habits of the mother, and desire plus ability to such, in the child.

SUMMARY AND CONCLUSIONS

An examination of official statistics concerning infant mortality in Puerto Rico reveals at least two unusual facts: first, a disproportionately rapid decline in the neonatal mortality rate with little change in the rate for the rest of the first year; and second, a curious geographical distribution. Although many factors are associated with the deaths of children under one year of age, the present analysis has been limited to one factor of importance—feeding habits. For the purposes of this investigation there were selected three municipalities of the Island representing rural and urban areas with both high and low infant mortality rates. The data were obtained from the infant and preschool records found in the active and pending files of the public health units of these municipalities. Information concerning age, sex, age of mother, residence, and type of feeding was tabulated as of the time of first admission to service.

While the study has not gone far enough to warrant any more than preliminary suggestions, certain tendencies are apparent from the data:

1. The proportion of breast-fed infants is high in the first two months of life and appears to have an early, rapid decline.
2. An area of relatively low mortality showed the highest percentage of breast-fed infants and the longest duration of nursing as compared with the other two areas, where the mortality was high.
3. The older the mother, the less likely is she to nurse her baby, but, once started, she tends to continue nursing longer.
4. Mothers in rural areas also tend to nurse their babies longer.

A plea is made for more encouragement of breast feeding.