

BREAST-FEEDING, WEIGHT GAINS, DIARRHEA, AND MALNUTRITION IN THE FIRST YEAR OF LIFE¹

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To examine the hypothesis that breast-feeding promotes infant growth while helping to prevent diarrheal disease and malnutrition, a study was conducted on 207 Chilean infants who were born at the San Francisco de Borja Hospital in Santiago and who were periodically examined at a local health center. This article reports the results of that study.

Introduction

Despite lack of agreement among specialists as to the ideal length of the breast-feeding period, it seems clear that most Chilean mothers have tended to keep that period very short. Various studies demonstrate the point. For example, a 1968 study of 600 infants seen at both urban and rural health centers of the Northern Santiago Health Area reported that by two months of age 50% of these infants were already being fed breast-milk substitutes (1). Another study, conducted between September 1975 and August 1976, found that only half of a group of study subjects (1,050 infants from various social strata) were being breast-fed for three months (2).

It has been asserted that in Chile, as in other Latin American countries, one of the foremost causes of malnutrition is the brevity and insufficiency of breast-feeding (1). This assertion gives emphasis to the need for encouragement and prolongation of breast-feeding—not only to avert nutritional deficiency, but also to reduce the infections that often occur as a consequence of malnutrition.

If we use available information to postulate that breast milk helps an infant to grow (increase in weight and length) and reduces morbidity from diarrhea and malnutrition during its first year of life, then we should expect that breast-fed infants observed from month to month would show greater average gains in weight and length, would tend to have fewer diarrhea episodes, and would experience a lower rate of malnutrition than infants fed breast-milk substitutes.

Materials and Methods

For purposes of testing this hypothesis we selected 207 infants born within the population assigned to the Nogales Health Center for primary care serving the Central Santiago Health Area. All of these infants were born between 29 April 1975 and 8 October 1976, and all were registered at the Nogales Center within their first 20 days of life.

In order to avoid interference from variables other than those being studied, certain selection criteria were adopted. These criteria were as follows:

- 1) For the study infants:
 - a) a birth-weight of at least 2,500 g;
 - b) normal delivery;
 - c) an Apgar score of at least eight;
 - d) no serious illness in the first seven days of life; and
 - e) no hospitalization after the initial discharge;

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- 2) For the infants' mothers:
 - a) normal pregnancy lasting at least 38 weeks; and
 - b) no presentation of any important disease condition such as diabetes, syphilis, jaundice, preeclampsia, or Rh incompatibility.

These criteria were applied to each infant that came to be registered for health monitoring purposes at the Nogales Center and that had been delivered at the San Francisco de Borja Hospital—the facility attended by 90% of the mothers receiving prenatal care at the Nogales Center. In each case, the relevant information was obtained from the birth card.

Before initiation of the study, meetings were held with the maternal health personnel involved in order to ensure uniform criteria—with regard to both recording of relevant data and measurement of the infant's weight and length. All the study infants being normal newborns, these measurements were performed with adequate techniques upon which the team of maternal health personnel agreed.

In addition, a system for obtaining and recording data was established at the Nogales Center that ensured the reliability and accuracy of the data. This included establishment of measurement criteria, uniform definitions, and an instrument calibration system, as well as training for the nursing team that was responsible for monitoring the infants' health and that had agreed to participate in the study.

So far as the actual selection process was concerned, all the infants who met the aforementioned criteria and who were registered at the Nogales Center between 29 August 1975 and 8 October 1976 were included in the study. This resulted in selection of 85 boys and 122 girls. It should be noted, however, that sex was not one of the variables considered, it being supposed that babies of both sexes would receive equal treatment as far as breast-feeding was concerned. Therefore, the observed disproportion in the number of male and female infants selected was one resulting from a natural rather than a planned selection process.

Regarding the gathering of basic data after the selected infants left the hospital, guidelines established by the Chilean Ministry of Health (3) state that infants should be brought in for a checkup once a month during the first six months of life and thereafter in the eighth, tenth, and twelfth months. At each checkup the following data were recorded: the infant's weight and length, the type of milk being fed at the time of the checkup, feeding changes since the last checkup, and morbid conditions presented since the last checkup. Therefore, in conducting the present study, this information was obtained from the selected infants' clinical histories and was entered on forms especially designed for the purpose. In addition, the homes of 44% of the study children were visited at the end of the monitoring period in order to obtain socioeconomic information (4) about each child's family group that would permit socioeconomic characterization of the group.

Results

Basic Characteristics of the Study Group

As already noted, the study subjects included 85 boys and 122 girls. Regarding birth-weights, 28% of those selected weighed 2,500-2,990 g at birth, 45.4% weighed 3,000-3,490 g, and 26.6% weighed 3,500-4,190 g. Regarding birth-length data, these were obtained for only 160 of the 207 study infants, the lengths of the other 47 having either not been measured or not registered at the hospital. All the measurements recorded fell between 44 and 55 cm, with 8.8% of the recorded lengths being in the 44-47 cm range, 74% being in the 48-51 cm range, and 16.8% being in the 52-55 cm range.

Differences in birth-weight tended to be accompanied by differences in length. Specifically, most (77%) of the infants in the lowest weight group had birth-lengths between 46 and 49 cm; most (87%) of those in the intermediate weight group had birth-lengths between 48 and 51 cm; and most (79%) of those

in the highest weight group had birth-lengths between 50 and 53 cm.

Regarding the mothers of the study infants, 17.8% were less than 20 years of age, 56.7% were in the 20-29 year group, 17.8% were in the 30-39 year group, and 7.7% were over 39 years of age. Seventy-eight per cent of the mothers were legally married. Most of the mothers had little education, 15% having had less than four years of school and 65% having had no more than six.

A third of the infants in the study group were first-borns, 22% were second-borns, and 44% were born to mothers who had previously delivered between two and nine children. In a similar vein, one-quarter of the children belonged to small families with fewer than four members, while 44% were living in larger families with six to 17 members.

Eighty-five per cent of the children lived in homes provided with drinking water and sewerage facilities. However, less than half of their families had an adequate number of beds, and in more than a fifth of the families the members slept three or more to a bed. Also, only a third of the families lived in houses that contained more than one room per three family members, and 15% of the homes contained five or more persons per room.

In general, it appeared that while most of the children lived in homes equipped with good drinking-water and excreta disposal facilities, these advantages were offset by a high frequency of overcrowding resulting from small houses, large families, or both. By and large the study children's families had a socioeconomic status that could be characterized as low, the father usually being a casual laborer or unskilled worker.

Preliminary analysis of the collected data showed that there were no significant socioeconomic differences capable of greatly influencing the results (in terms of growth, diarrhea episodes, or malnutrition), either among study infants breast-fed less than four months or among those breast-fed for longer periods. Indeed, positive and negative socioeconomic factors were found in all the families visited;

and after assigning point scores to the aforementioned factors relating to the child, the mother, the father, and the home, it was possible to determine that 90% of the study children's families could be uniformly categorized as having a socioeconomic status that was low.

Duration of Breast-Feeding

With regard to both the duration and nature of breast-feeding, the type of feeding provided for each infant was determined during the month-to-month checkups at the Nogales Center. As indicated in Table 1, fully a fifth of the study infants received artificial milk substitutes during their first month of life, either alone or as a supplement to their mother's milk. By the third month this proportion had risen to 43%, by the sixth it had risen to 64%, and by the twelfth it had reached 91%.

The median duration of breast-feeding unsupplemented by artificial milk was three months and three weeks. However, the length of nonexclusive breast-feeding (both unsupplemented and supplemented with artificial substitutes) tended to be considerably greater, the median duration being eight months. These findings coincide with those of other studies using broader sample populations, which indicate that less than 50% of the children involved received unsupplemented breast-milk beyond four months of age (2).

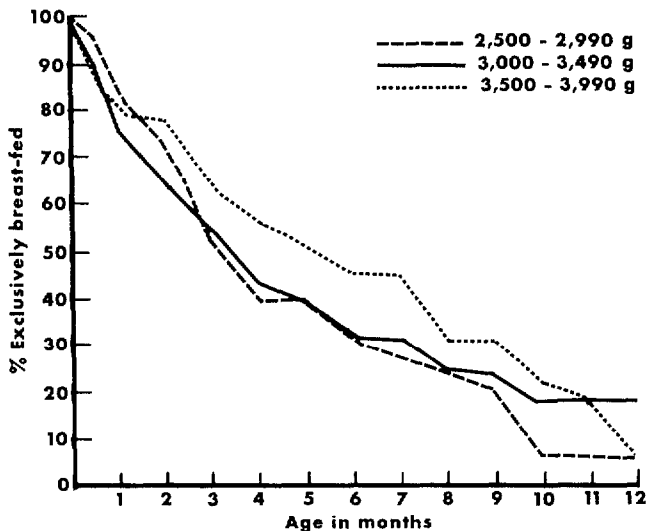
Birth-Weight and Duration of Breast-Feeding

As Figure 1 shows, the average feeding patterns for the infants in distinct birth-weight groups were somewhat different. That is, during the first three months of life the percentage of 2,500-2,990 g and 3,000-3,490 g infants who were exclusively breast-fed dropped quite rapidly, so that by three months of age only 55% were still being fed in this manner. In contrast, the decline in breast-feeding of the heaviest (3,500-3,990 g) birth-weight group was slower, so that over 55% were still being exclusively breast-fed until four months of age.

Table 1. The percentages of study infants receiving breast-milk, artificial substitutes, or both 15 days after birth and during each month of the first year of life.

Age	% of infants being fed the indicated types of milk			Total No. of study children
	Breast-milk only	Breast-milk and artificial substitutes	Artificial substitutes only	
15 days	91.8	6.8	1.4	207
1 month	79.2	15.0	5.8	207
2 months	71.1	18.8	10.1	207
3 "	57.0	27.5	15.5	207
4 "	47.4	30.9	21.7	207
5 "	42.9	30.9	26.2	207
6 "	35.9	27.7	36.4	206
7 "	34.5	26.7	38.8	206
8 "	26.7	22.3	51.0	206
9 "	25.2	20.9	53.9	206
10 "	15.5	20.9	63.6	206
11 "	14.6	20.9	64.5	206
12 "	8.9	15.7	75.4	206

Figure 1. The percentages of infants in each of the indicated birthweight groups that were being exclusively breast-fed during each month of their first year of life.



By and large the pattern of declining breast-feeding for the two lower birthweight groups was very similar up to the ninth month, when about a quarter of the infants in both groups were still being exclusively breast-fed. How-

ever, in the tenth month the proportion of the 2,500-2,990 g group being exclusively breast-fed fell to 5%, while that of the 3,000-3,490 g group fell only to 18%.

Meanwhile, the percentage of exclusively

breast-fed infants in the 3,500-3,990 g birth-weight group remained consistently higher than in the other two groups, the proportion exclusively breast-fed being 45% at seven months of age and 30% at nine months of age. However, from the ninth month on the proportion dropped rapidly, until it became the same as that found in the lowest-weight group at the end of the first year.

Regarding the median duration of breast-feeding in each birth-weight group, the data in Table 2 show that exclusive breast-feeding had stopped for half the infants in the two lower birth-weight groups by the time they reached three and a half months of age, while half the infants in the heaviest group (3,500-4,190 g) continued to receive breast-milk alone until they were over five months old. Breast-feeding augmented with artificial supplements tended to continue much longer—until around eight months of age for half the infants in all three groups.

Weight Gains

During the first year of life (after the first fortnight) the infants tended consistently to gain weight, although the gains tended to be slower at later ages. The theoretical norms were found by taking each infant group's average birth-weight and adding weighted increments corresponding to Stuart's P_{50} (1, 5,

6). Cumulatively, these theoretical increments totaled 600 g at one month, 1,500 g at two months, 2,400 g at three months, 4,200 g at six months, 5,700 g at nine months, and 6,600 g at 12 months (Table 3).

At each month of life, the study infants for whom feeding data were available were classed according to whether they had received artificial milk substitutes up to that time and whether they had stopped receiving breast-milk. The difference between each infant's weight and its birth-weight was found, the infants were grouped according to age (by month) and type of feeding, and average weight gains were computed for each group. In observing these data it should be noted that after the sixth month the data obtained for months 8, 10, and 12 tended to be more valid than those obtained for months 7, 9, and 11, because there were no checkups by routine appointment in the latter odd-numbered months, and so attendance at the Nogales Center in those months was largely conditioned by factors that could be regarded as negative—primarily communicable diseases and malnutrition.

A comparison of the average weight gains in the three feeding groups clearly revealed greater weight gains among the breast-fed infants. In addition, and in contrast to the infants who were not breast-fed, the breast-fed infants exhibited weight gains up to the seventh month of life that were superior to the anticipated norms.

As the data in Tables 3 and 4 indicate, the infants fed on breast-milk alone showed average weight gains that not only equaled the desired gains but actually exceeded them significantly up to the fifth month of age. In the sixth and seventh months the average gains were not so great but remained above expectations. However, from the eighth month onward the situation was reversed, with the breast-fed group registering smaller gains, on the average, than those desired.

Breast-feeding versus bottle-feeding. As the data in Table 5 show, it may be said with 95% confidence (7) that at least to the eighth month of

Table 2. The median duration of breast-feeding and mixed feeding among the study infants, by birthweight group.

Birthweight group	Median duration of breast-feeding (alone)	Median duration of breast-feeding (alone or in combination with artificial substitutes)
2,500-2,990 g	3 months, 1 week	7 months, 3 weeks
3,000-3,490 g	3 months, 2 weeks	8 months
3,500-4,190 g ^a	5 months, 1 week	8 months, 2 weeks

^aOnly five of the 55 children in this group weighed between 4,000 and 4,190 g.

Table 3. The average weight gains of infants receiving breast-milk only, a combination of breast-milk and artificial substitutes, and artificial substitutes only, by age in months, showing one standard deviation and the number of infants in each group.

Age in months	Cumulative gain expected (in grams)	Average weight gain in grams (showing the standard deviation and the No. of infants involved) among study infants fed as indicated									Total No. of infants
		Breast-fed			Mixed feeding			Artificial feeding			
		\bar{X}^a	SD	n	\bar{X}^a	SD	n	\bar{X}^a	SD	n	
1	600	779.1	357.9	156	469	436.9	29	515.3	415.7	12	197
2	1,500	1,770.9	535.7	139	1,449.1	622.5	33	1,067.0	506.5	20	192
3	2,400	2,587.6	622.8	109	2,299.1	758.0	53	1,922.3	802.8	26	188
4	3,000	3,314.8	696.6	90	3,040.7	768.0	63	2,634.6	948.9	42	195
5	3,600	3,832.7	798.6	61	3,780.6	860.3	43	3,230.5	1,040.5	38	142
6	4,200	4,282.7	816.8	67	4,235.3	905.0	49	3,810.8	969.7	68	184
7	4,700	4,873.9	966.6	23	4,704.1	295.4	17	4,006.1	1,129.2	35	75
8	5,200	5,145.6	830.6	46	4,987.6	942.5	38	4,651.4	1,133.7	96	180
9	5,700	4,875.7	796.7	14	5,248.8	959.8	12	4,792.4	1,336.3	45	71
10	6,000	5,773.0	781.8	27	5,470.0	895.5	37	5,464.8	1,268.8	110	174
11	6,300	5,907.8	606.5	9	5,559.2	999.0	12	5,247.1	1,325.8	45	66
12	6,600	6,386.7	738.1	18	5,813.6	868.5	32	6,031.7	1,228.6	149	199

^aThe average of the difference between each infant's birth-weight and its weight at the indicated age.

Table 4. A comparison of the average weight-gains observed in the exclusively breast-fed infants and those expected (Stuart's P_{50}), by month of life.

	Age of breast-fed infants (in months)									
	1	2	3	4	5	6	7	8	10	12
t observed ^a	6.95	5.96	3.14	4.29	2.28	0.83	0.86	-0.44	-1.51	-1.23
n	156	139	109	90	61	67	23	46	27	18
t expected (\neq)	1.66	1.66	1.66	1.66	1.67	1.67	1.71	1.68	1.71	1.74

^aStudent's *t* test is used to compare the means of samples when the population variance is unknown

Table 5. Z values obtained upon comparing average weight gains of infants receiving breast-milk only, breast-milk plus artificial substitutes, and artificial substitutes only. (These are normal standard values used to compare the means of samples when the sample sizes are over 30.)

Age in months	Values of Z for the average weight-gain differences between groups of infants fed with		
	Breast-milk alone versus artificial substitutes alone	Breast-milk alone versus breast-milk plus artificial substitutes	Breast-milk plus artificial substitutes versus breast-milk alone
1	2.45 ^a	4.13 ^a	-0.30
2	5.53 ^a	3.00 ^a	2.32 ^a
3	4.62 ^a	2.57 ^a	2.04 ^a
4	4.64 ^a	2.30 ^a	2.41 ^a
5	3.24 ^a	0.32	2.60 ^a
6	3.06 ^a	0.29	2.40 ^a
8	2.64 ^a	0.82	1.62
10	1.21	1.41	0.02
12	1.20	2.36 ^a	-0.95

^aStatistically significant

life infants fed with breast-milk made a significantly greater average weight gain than those fed with artificial substitutes. Though the findings from the tenth month onward do not have this level of statistical significance, they do appear to have practical significance.

Breast-feeding alone versus mixed feeding. Breast-feeding alone also appeared more beneficial, though to a lesser degree, than breast-feeding supplemented by artificial substitutes. Comparison of infants receiving these different types of feeding (see column 3 of Table 5) revealed average weight gain differences that were statistically significant during the first four months of life. These weight gain differences then became relatively minor in the fifth and sixth months before increasing and becoming statistically significant again at the twelfth month.

Mixed feeding versus bottle-feeding alone. Data for the group fed with a combination of breast-milk and artificial substitutes are not easy to correlate reliably with those for the exclusively breast-fed or bottle-fed groups. In this regard, some have expressed the view that introducing the bottle is injurious whether breast-feeding is continued or not. However, the weight-gain findings of this study suggest that mixed feeding is not as deleterious as exclusive dependence on bottle-feeding, because the average weight gains of children receiving mixed feedings were significantly greater in the second through sixth months than those fed on artificial substitutes alone (see column 4 of Table 5). However, the observed weight gain difference at nine months, while noteworthy, was not statistically significant at the 95% confidence level (7); and from the ninth to the twelfth months the bottle-fed infants made a greater average weight gain than infants receiving mixed feedings.

Breast-feeding alone, mixed feeding, and bottle-feeding alone. Another view of this matter can be obtained by combining the infants receiving mixed feedings with those receiving breast-milk only and comparing this combined group with the group being exclusively

bottle-fed, as is done in Figure 2. This comparison shows a significant difference between the average weight gain of the two groups up to the eighth month of life, with the breast-fed infants making the greater gain. From the ninth to the eleventh month the difference diminished notably, however, and by the twelfth month it had disappeared.

Similarly, the infants receiving mixed feedings can be combined with those being exclusively bottle-fed, and this combined group can be compared with the group receiving breast-milk only. This comparison (see Figure 3) shows a notably greater cumulative average weight gain by the exclusively breast-fed group that the bottle-fed group failed to overcome in the first twelve months of life.

Length Gains

Another purpose of our study was to determine whether length gains during the first year of life were favored by breast-feeding. Length measurements do give a fairly accurate idea of infant growth. However, length tends to increase less regularly than weight, and a lack of length gain does not mean that growth has stopped.

The "desired" increase in the study infants' length was 4 cm the first month, 3 cm the second, and 3 cm the third; 2 cm per month in the second quarter, and 1.5 cm per month in the second half-year (6).

Unfortunately, however, it was only possible to obtain birth-length data for 160 of the study infants, and in many months the number of length measurements obtained was relatively small. Nevertheless, the limited data available (see Table 6) did not point to any statistically significant differences between the average length gains of infants being breast-fed, bottle-fed, or both (7). It may thus be inferred that these different types of feedings had no obvious measurable effect on gains in length.

Figure 2. A month-by-month comparison of cumulative average weight-gains by partially or wholly breast-fed infants versus those receiving only artificial substitutes. The solid line shows the "expected" cumulative average weight gain.

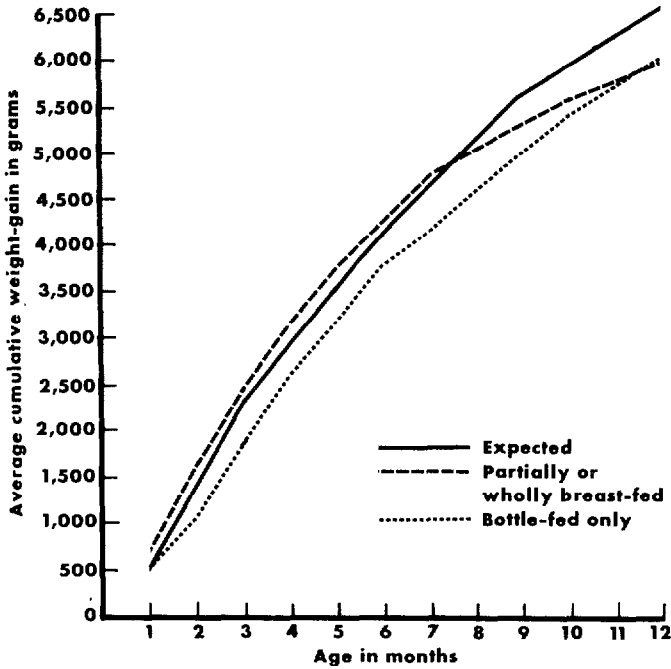
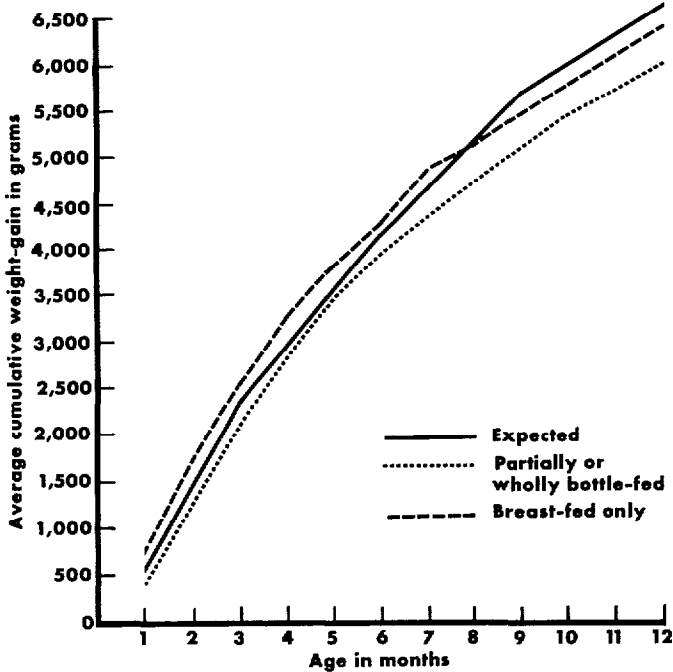


Table 6. Average length-gains by study infants being breast-fed, bottle-fed, or both. Only very limited numbers of study children were measured in some months. Nevertheless, the lack of any significant differences among the three groups leads to the conclusion that the type of milk fed did not influence length-gains among these study children.

Age in months	Exclusively breast-fed children		Breast-fed and bottle-fed children		Exclusively bottle-fed children		All study children measured	
	Avg. length gain (cm)	No. measured	Avg. length gain (cm)	No. measured	Avg. length gain (cm)	No. measured	Avg. length gain (cm)	No. measured
1	4.25	16	- ^a	2	- ^a	1	4.16	19
2	6.78	54	5.89	9	- ^a	3	6.70	66
3	10.08	59	9.74	19	9.38	8	9.94	86
4	11.58	40	11.50	28	11.50	12	11.54	80
5	14.71	28	14.79	19	14.88	8	14.76	55
6	15.58	38	15.60	25	15.26	31	15.39	94
8	18.32	38	18.09	32	17.89	54	18.07	124
10	20.26	19	20.15	26	21.00	25	20.64	70
12	22.79	14	21.63	24	22.83	95	22.61	133

^aInsufficient number of cases.

Figure 3. A month-by-month comparison of cumulative average weight-gains by partially or wholly bottle-fed infants versus those receiving breast-milk only. The solid line shows the "expected" cumulative average weight gain.



Diarrhea Morbidity

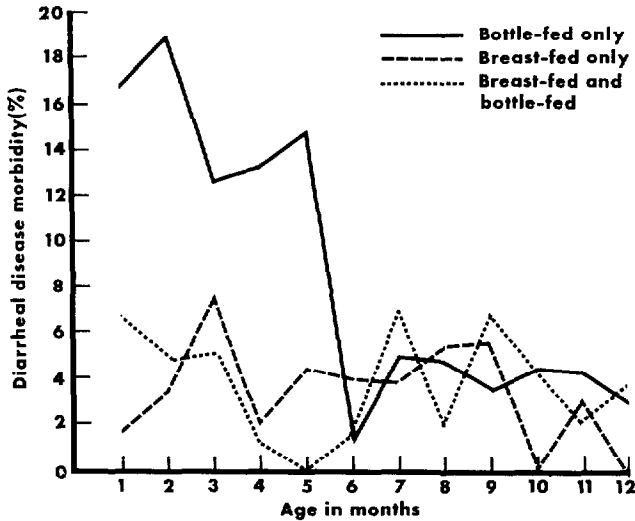
It is generally accepted that diarrheal disease is associated with maternal ignorance or neglect of the rules of hygiene, the quality of the family's drinking-water, and a variety of environmental factors. Since mother's milk is ingested directly by the infant, it is not exposed to handling that could taint it; and since it contains maternal antibodies, the infant's ability to cope with infections tends to be enhanced. It is therefore expected that an infant whose sole source of nourishment is breast-milk will tend to experience fewer episodes of diarrheal disease than will children nourished in other ways (8, 9).

In our own study, marked differences were found between diarrheal disease morbidity in wholly or partly breast-fed children and chil-

dren who were entirely bottle-fed (see Figure 4). Specifically, the rate of diarrheal morbidity in any given month during the first year of life was generally below 8% in both the wholly breast-fed and partly breast-fed groups, while during the first five months of life it ranged from 12.5 to 19% in the solely bottle-fed group. From the sixth month on the diarrheal morbidity in all three groups was comparable, generally averaging below 5% for the three groups combined.

It is noteworthy that during the first five months of life those infants who received mixed feedings had a diarrheal disease rate similar to the wholly breast-fed infants. This finding indicates that breast-feeding, even in combination with bottle-feeding, helped to reduce the frequency of diarrheal disease episodes in the first half-year of life. Conversely,

Figure 4. Diarrheal disease morbidity during the first 12 months of life among study infants who were breast-fed, bottle-fed, or both.



however, mother's milk appeared to have no influence on diarrheal disease morbidity during the second half-year of life.

Malnutrition (8, 10)

By comparing the weights of study children that were obtained at checkups during the first 12 months of life with weights in the Sempé Table (3), we found that the percentage of study children classifiable as malnourished in any given month ranged from 3.1 to 10.1% among the exclusively breast-fed group, from 7.0 to 25.0% among the breast-fed and bottle-fed group, and from 21.7 to 33.3% among the exclusively bottle-fed group (Table 7).

When the rates obtained for breast-fed and bottle-fed infants were compared by Student's *t* test (7), all of the monthly differences were found to be significant. Similarly, when the rates for infants receiving mixed feedings were compared to those for breast-fed infants, the differences observed in the second, third,

fourth, seventh, tenth, eleventh, and twelfth months were found to be significant. And comparison of monthly differences between the infants receiving mixed feedings and the exclusively bottle-fed infants showed those observed in the first and in the fourth through ninth months to be significant. On the basis of these findings it may be concluded that the type of milk fed to an infant during its first year of life is associated with the probability of malnutrition in that period.

When the bottle-fed and mixed-feed groups are combined, the observed rate of malnutrition begins at 14.6% in the first month and rises to 25% in the twelfth. Comparison of the monthly rates for this group with those for the exclusively breast-fed group yields differences that are statistically significant in all months of life except the first.

Also, when the data for the mixed-feed group are merged with those for the breast-fed infants, the combined monthly rates range from 7.2% in the first month to 18% in the twelfth. The differences between these month-

Figure 5. Percentages of malnourished study infants observed among the groups receiving breast-milk only, breast-milk plus artificial substitutes, and artificial substitutes only, by month of life.

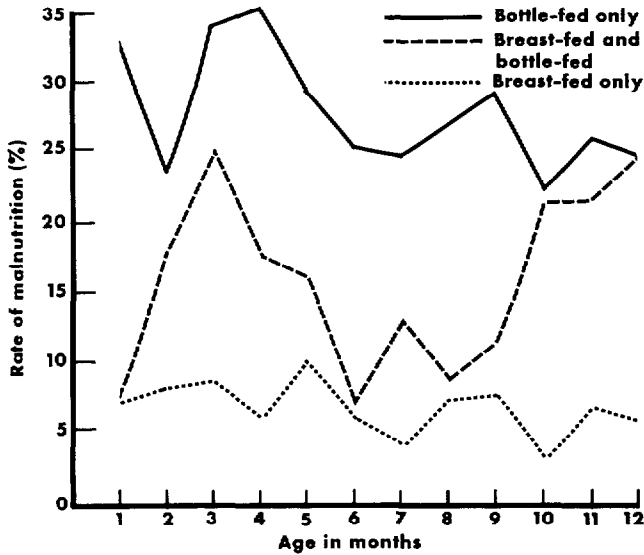


Table 7. Percentage of infants classifiable as malnourished, using the Sempé Table, among the three feeding groups studied during the first 12 months of life.

Age in months	Malnutrition among study infants who were:									Malnutrition among all the study infants weighed		
	Breast-fed only			Breast-fed and bottle-fed			Bottle-fed only			No. of infants weighed	No. mal-nourished	% mal-nutrition
	No. of infants weighed	No. mal-nourished	% mal-nutrition	No. of infants weighed	No. mal-nourished	% mal-nutrition	No. of infants weighed	No. mal-nourished	% mal-nutrition			
1	166	12	7.2	29	2	6.9	12	4	33.3	207	18	8.7
2	147	12	8.2	39	7	17.9	21	5	23.8	207	24	11.6
3	118	10	8.5	57	14	24.6	32	11	34.4	207	35	16.9
4	98	6	6.1	64	11	17.2	45	16	35.6	207	33	15.9
5	89	9	10.1	63	10	15.9	54	16	29.6	206	35	17.0
6	74	4	5.4	57	4	7.0	75	19	25.3	206	27	13.1
7	71	3	4.2	55	7	12.7	80	20	25.0	206	30	14.6
8	55	3	5.5	46	4	8.7	105	29	27.6	206	36	17.5
9	52	3	5.8	43	5	11.6	111	33	29.7	206	41	19.9
10	32	1	3.1	42	9	21.4	129	28	21.7	203	38	18.7
11	30	2	6.7	42	9	21.4	131	34	26.0	203	45	22.2
12	18	1	5.6	32	8	25.0	149	37	24.8	199	46	23.1

ly rates and those for the bottle-fed group are statistically significant in all months except the tenth and twelfth, indicating that breast-feed-

ing helps to reduce malnutrition in the first year of life, even when it is supplemented with bottle-feeding.

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SUMMARY

To test the hypothesis that breast-feeding promotes infant growth while reducing rates of diarrheal disease and malnutrition, the authors studied a group of infants born in Santiago, Chile, at the San Francisco de Borja Hospital that were registered at a local health center within 20 days of birth. The 207 infants selected for inclusion in this study, all born in 1975-1976, weighed at least 2,500 grams at birth, were delivered normally, had an Apgar score of eight or better, experienced no serious illness in the first seven days of life, and were never hospitalized; also, all of their mothers had normal pregnancies lasting at least 38 weeks, and none of the mothers showed evidence of having any important morbid condition capable of influencing fetal health.

Birth data were obtained from the infants' birth cards. Data regarding weight gains, feeding practices, diarrheal disease episodes, and malnutrition were obtained from recorded medical information set down at the time of each infant's checkups at the health center. Subsequently, at the end of the one-year monitoring period, visits were made to 44% of the infants' homes in order to obtain socioeconomic information; this information showed that most (90%) of the families involved had a low socioeconomic status.

Month-by-month assessment of the study infants' weights indicated that as a group those who were exclusively breast-fed made better weight

gains than those who were breast and bottle-fed, and much better gains than those who were exclusively bottle-fed. The average weight gains of solely breast-fed infants were distinctly better than those given a combination of breast and bottle-feeding; however, this latter mixed feeding did not appear as deleterious, on the average, as bottle-feeding alone.

Regarding diarrhea, between 12.5 and 19% of the exclusively bottle-fed infants experienced a diarrheal disease episode each month during the first five months of life. This percentage was much lower (generally below 8%) for the solely breast-fed group, and also for the group receiving a combination of breast and bottle-feedings. This latter finding indicates that breast-feeding, even in combination with bottle-feeding, helped to reduce the frequency of diarrheal disease episodes among the study infants during their first five months of life.

The malnutrition picture, assessed by comparing the study children's weights to those listed in the Sempé Table, was somewhat different. Specifically, the rate of malnourishment in any given month ranged from 3 to 10% among the solely breast-fed children, from 7 to 25% among the breast and bottle-fed children, and from 22 to 33% among the solely bottle-fed children. On the basis of these findings it may be concluded that the type of milk fed to an infant during its first year of life was associated with the probability of malnutrition in that period.

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