

Infant feeding and infant mortality in rural Chile

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During 1969-70, 1 712 rural Chilean mothers were interviewed to see if their feeding practices contributed to infant mortality. There were three times as many deaths among babies given bottles before the age of 3 months as among those who were wholly breast-fed. Nearly half the children had started bottle feeding by that age, and it was thus a major factor in infant mortality. Additional foods, apparently, provided these babies with some protection, whereas continued breast feeding did not. As living standards improved, weaning was accelerated and a higher proportion of children were fed on the bottle alone. The anomalous consequence was that infant mortality rose with income. These observations support the opinion that early weaning is a concomitant of economic development; they also suggest that the risk associated with bottle feeding may be reduced by adding other foods to the diet.

Urgent attention to the epidemiology of early weaning would help prevent infant mortality and birth rates from rising in developing countries where the practice of bottle feeding can be expected to increase with economic progress. Although rural populations are generally not yet affected (Becroft & Bailey, 1965; Cantrelle & Leridon, 1971; Gordon et al., 1964; Harfouche, 1970; Martin et al., 1964; Taba, 1970; Thomson et al., 1966; Urrutia & Mata, 1969; Wyon & Gordon, 1971), both village and urban mothers wean their babies early in Chile (Ariztia, 1955; Monckeberg et al., 1967a³). It has been suggested (Ariztia, 1955; Behar, 1964; Monckeberg, 1970) that this practice might be responsible for Chile's high infant mortality relative to its economic and educational levels and its comprehensive and extensive health services (Behm et al., 1964).

As part of a study of health and fertility in rural Chile (Plank & Milanese, 1973), infant feeding practices were investigated: (1) to measure the effect of early weaning on mortality, (2) to identify characteristics distinguishing mothers who practised early weaning, (3) to clarify the respective roles of maternal milk deprivation and factors associated

with bottle feeding, and (4) to measure the effect on survival of giving bottle-fed babies additional foods.

METHODS

In 1969-70, 96% of the women between 15 and 44 years of age in 15 rural Chilean communities were interviewed in their homes. Data were sought on their reproductive histories, on their housing, and on other environmental and socioeconomic factors that could influence their health and fertility. The 1 712 mothers who had had deliveries in the preceding 5 years were questioned about the obstetrical care received, their infant feeding practices, and the medical attention given the child. Each was asked to state the duration of breast feeding and the reason for discontinuing it; how soon other milk started to be given and its source; and the baby's age when foods other than milk were introduced.

If a woman had had 2 or more deliveries in the period, only the last was the subject of inquiry. Thus, the sample was not representative of the total population under 5 years of age. Neonatal deaths and living children under 4 weeks of age were excluded from the analyses. The level of statistical significance was preset at 0.01.

RESULTS AND DISCUSSION

Weaning

Almost 90% of the women thought that breast feeding was much less common in their localities now than it had been 15 or 20 years ago. This could not be

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³See also: Valiente, S. et al. (1967) *Estudio de la alimentación de prescolares de la Provincia de Curicó*, Departamento de Nutrición, Santiago, Universidad de Chile, Publication 247/67 (mimeographed document).

confirmed and may only reflect the general assumption that early weaning is a recent phenomenon—an assumption shown by Knodel & Van de Walle (1967) to be inapplicable in certain European areas. On the other hand, there may well have been a recent shift toward earlier weaning like that documented by Sanjur et al. (1971) in a Mexican village. The presumed decrease in breast feeding in the study area was ascribed to the convenience of bottles by the majority of respondents, but not one of them cited this as the determining factor in her own case.

A number of benefits were attributed to breast feeding; only 2% of the women were not in favour of it, alleging that human milk was "too weak" or transmitted infections to the baby. More than two-thirds felt that breast feeding should be continued for at least a year, and fewer than 4% advocated its discontinuation in the first 6 months. In practice, however, only 40% of the children who had reached the age of 1 year were receiving any breast milk at all by then and nearly half of them had been completely weaned by 6 months.

Of the mothers who had weaned their infants at under 6 months, more than half claimed that their milk production was inadequate. But, in view of the close association between early weaning and socio-economic conditions (see below), "inadequate" would seem to be a very relative criterion. Of the babies weaned at between 6 months and 1 year, 11% were taken off breast feeding because of a new pregnancy. Only 1 of the 18 women concerned, however, had exclusively breast-fed her child during the 2 preceding months, as compared with 49 of 158 women weaning their children for other reasons during the second 6 months. It seems that an increased probability of conception ought to be counted among the risks of starting supplements to breast feeding (Jain et al., 1970; McKeown & Gibson, 1954; Perez et al., 1971; Sharman, 1951; Udesky, 1950).

Employment of the mother, often cited as an important reason for weaning (Ariztia, 1955; Aykroyd, 1971; Bower, 1958; Vahlquist, 1955), was an insignificant factor in the communities studied. Of the 17% who were gainfully employed, fewer than half worked outside the home, and only 16 women claimed that their jobs kept them from breast feeding. Breast-feeding practices showed little variation according to marital status, and, contrary to what has been observed in some other regions (Knutsson & Melbin, 1969; Cowgill & Hutchinson, 1963), boys were suckled no longer than girls.

Table 1. Proportion of infants surviving at 6 months who were weaned before that age, by maternal age and parity, rural Chile, 1969-70 *

Maternal age (years)	Parity	Number of children included in study	Proportion (%) weaned before 6 months
< 25	1-2	240	57.5
	3-4	129	46.5
	5-7	28	46.4
	≥ 8	2	50.0
	Total: 399		Av.: 53.1
25-34	1-2	108	56.5
	3-4	138	45.6
	5-7	189	42.8
	≥ 8	112	48.2
	Total: 547		Av.: 47.3
≥ 35 years	1-2	33	39.4
	3-4	34	55.9
	5-7	82	36.6
	≥ 8	188	38.5
	Total: 337		Av.: 39.9
all age groups	1-2	381	55.6
	3-4	301	47.2
	5-7	299	41.5
	≥ 8	302	42.2

* Four mothers did not supply complete information.

With advancing age and parity, the duration of breast feeding was significantly longer (Table 1). Of the two variables involved, parity was shown to be the more significant (Mantel, 1963). From the physiological standpoint, early weaning would be expected to result in a higher parity at younger ages by reducing birth intervals, as Kamal et al. (1969) observed among Egyptian women. The pattern found in Chile thus appears to be determined by social rather than biological factors, the high parity, late weaning group being composed of poorer, less educated women who married earlier, used effective contraception less, and depended to a greater extent on breast feeding for economic and family planning reasons. It is possible, however, that the generally younger age at first pregnancy of high parity Chilean women favoured the establishment and maintenance of a more adequate production of milk (Dean, 1951; Hytten, 1954; Miller, 1952).

Breast feeding decreased significantly as maternal education and paternal income rose (Table 2). Although these two variables were interdependent, the correlation with education continued to be highly

Table 2. Proportion of infants surviving at 6 months who were weaned before that age, by maternal education and paternal income, rural Chile, 1969-70 *

Maternal education (years)	Paternal income (escudos ^a)	Number of children included in study	Proportion (%) weaned before 6 months
< 3	< 300	197	35.5
	300-549	108	40.7
	≥ 550	9	44.4
	Total: 314		Av.: 37.6
3-5	< 300	166	45.8
	300-549	138	46.4
	≥ 550	24	33.3
	Total: 328		Av.: 45.1
≥ 6	< 300	91	54.9
	300-549	83	59.0
	≥ 550	115	70.4
	Total: 289		Av.: 62.3
all groups	< 300	454	43.2
	300-549	329	47.7
	≥ 550	148	62.8

* Children of married women who provided income data.

^a Ten escudos were worth about US\$1.00.

significant when the data were standardized for income, whereas earnings were no longer significant when adjustment was made for years of schooling (Mantel, 1963). Education was also more closely correlated with the duration of breast feeding than was parity, again suggesting that infant feeding practices in the study population were largely determined by psychosocial factors.

Dried milk

Of children being weaned or already weaned, 66% received partially defatted dried milk regularly under the National Health Service's distribution programme. Another 6% were eligible, but according to their mothers they refused the milk, or it "didn't agree" with them. The total figure, nevertheless, fell short of the Service's target of supplying dried milk for 85% of weanlings and preschool children.

There was some criticism of the programme for not doing more, and the target figure was later raised to 100%. According to Jelliffe & Jelliffe (1971), however, the distribution of dried milk probably encourages early weaning. Their hypothesis was not tested directly, but only 22% of infants under supervision at local health posts and thus eligible for dried

milk began bottle feeding before 4 weeks as compared with 33% of other infants. Their mothers tended to be older, poorer, and less educated than others, however, and possibly would have continued breast feeding even longer if alternative milk had not been so readily available.

Weaning and mortality

Postneonatal deaths were significantly more frequent (relative risk, 3 to 1) among infants who started bottle feeding in the first three months than among those exclusively breast-fed during that time (Table 3). The investigation did not include an evaluation of the part played by qualitative and quantitative deficiencies associated with bottle feeding. These are known to interact (Newman, 1906; Scrimshaw et al., 1968), and Monckeberg (1970), in an investigation carried out in rural Chile in summer, found bacteriological contamination in 80% of bottles used for feeding babies and also observed that undernutrition was common (Monckeberg et al., 1967b). An indeterminable part of the higher mortality associated with bottle feeding was an artifact due to the inclusion of low weight, high risk infants for whom supplementary milk was medically prescribed. However, in view of the socioeconomic correlates of bottle feeding and the related mortality (see below), this factor was probably relatively unimportant.

Judging from the death rates, infants given bottles as a supplement to breast feeding fared no better than those who received no breast milk at all beyond

Table 3. Mortality in the first year among infants surviving at 4 weeks, 3 months, and 6 months of age, by type of milk given, rural Chile, 1969-70

Age	Type of milk	Number of survivors	Deaths between age indicated and 52 weeks	
			No.	Rate per 1000 survivors
4 weeks	breast only	1231	36	29.2
	breast plus bottle	125	7	56.0
	bottle only	215	13	60.5
3 months	breast only	798	11	13.8
	breast plus bottle	240	9	37.5
	bottle only	413	16	38.7
6 months	breast only	398	4	10.0
	breast plus bottle	285	4	14.0
	bottle only	604	12	19.9

the fourth week. Potentially protective factors in human milk (Mata et al., 1967, 1971) seemed to have no bearing on postneonatal mortality. Earlier authors (Grulee et al., 1934; Howarth, 1905; Newman, 1906; Robinson, 1951) reported better survival rates with "mixed" breast and bottle feeding, but defined their cohorts retrospectively, thus including many infants who had been suckled exclusively for months before starting bottle feeding. In the Chilean study, a prospective approach was adopted and it was found that "mixed" feeders had no advantage as regards survival.

As it was possible that deaths among "mixed diet" children occurred only after breast feeding stopped, all records were analysed week by week up to the end of the ninth month for each child to determine the total time spent on each regimen and the corresponding death rates. There were 86.5 deaths per 1 000 person-years of breast plus bottle feeding and 85.4 deaths per 1 000 person-years of bottle feeding alone. Between 4 and 12 weeks of age, which might be a critical period as regards the need for mother's milk and when other foods would not yet have intervened, the respective rates were 167.1 and 169.3. Again, there was no evidence that the continuation of breast feeding afforded any protection once bottle feeding began.

Non-milk foods

The modal age for introducing any food other than milk (and the starchy additives occasionally used to stretch out powdered milk) was 6 months. Fewer than 40% of the infants were given additional foods any earlier. Mothers who started bottle-feeding

early tended to introduce other foods sooner, too. Only 24% of the infants who were breast-fed, but not bottle-fed, were given anything but milk during the first 6 months, as compared with 45% of the bottle-fed infants.

Newman (1906) observed undernutrition and excess mortality among English infants who were exclusively breast-fed for 9 months or more, and Wyon & Gordon (1971) found that among Punjabi children, despite a lower incidence of diarrhoea, the risk of death was significantly greater if a milk-only diet was continued beyond the sixth month. Maternal milk alone evidently cannot meet the infant's needs after the first 6 months (Dean, 1959). The anomalous finding in Senegal (Cantrelle & Leridon, 1971) of a higher mean age of weaning for children dying in infancy than for those who survived suggests that there, as in Chile, prolonged breast feeding may have been associated with a significant delay in starting other foods.

Because of the practice of early weaning in Chile, it was possible to extend the association between non-milk foods and survival back into the second trimester. Exclusively breast-fed children were not included in the analysis because they differed significantly from the high-risk bottle-fed children in respect of mortality as well as feeding. Although the death rates for bottle-fed babies were similar, whether they continued to receive breast milk or not, mortality was about 70% higher during both the second and third trimesters for those of them who were not being given any other food (Table 4). The difference, though not statistically significant, concurred with the earlier finding that, in

Table 4. Total deaths and death rates per 1 000 person-years on different types of diet in the second and third trimesters of life, rural Chile, 1969-70

Age (weeks)		Basic diet 1: breast plus bottle		Basic diet 2: bottle only		Basic diets 1 and 2	
		with other food	without other food	with other food	without other food	with other food	without other food
13-25	person-years	19.2	50.9	37.6	100.3	56.8	151.3
	deaths	1	3	2	10	3	13
	death rate per 1 000 person-years	52.2	58.9	53.1	99.7	52.8	85.9
26-38	person-years	51.9	15.6	125.3	29.0	177.2	44.7
	deaths	3	2	6	2	9	4
	death rate per 1 000 person-years	57.8	128.0	47.9	68.9	50.8	89.5
both groups	person-years	71.0	66.5	163.0	129.4	234.0	195.9
	deaths	4	5	8	12	12	17
	death rate per 1 000 person-years	56.3	75.1	49.1	92.7	51.3	86.8

Table 5. Postneonatal deaths and death rates, by maternal age and parity, rural Chile, 1969-70 *

Maternal age (years)	Parity	Number of children included in study	Deaths between 4 and 52 weeks	Death rates per 1000 children
< 25	1-2	240	8	
	3-4	129	4	
	5-7	28	1	
	≥ 8	2	0	
		Total: 399	Total: 13	32.6
25-34	1-2	108	6	
	3-4	138	6	
	5-7	189	7	
	≥ 8	112	5	
		Total: 547	Total: 24	43.9
≥ 35	1-2	33	2	
	3-4	34	2	
	5-7	82	2	
	≥ 8	188	13	
		Total: 337	Total: 19	56.4
all age groups	1-2	381	16	42.0
	3-4	301	12	39.9
	5-7	299	10	33.4
	≥ 8	302	18	59.6

* Four mothers did not supply complete information.

terms of mortality, the risk from introducing additional foods is outweighed by the benefit.

Other factors associated with infant mortality

These data tend to corroborate the impression that "suitable infant feeding . . . is a greater factor than any other single thing" in preventing first-year deaths (Newman, 1906). Even the higher mortality among the children of older mothers (Table 5) appeared to depend on diet. While it is true that these mothers breast-fed their children longer, the crucial factor was evidently the introduction of bottle feeding rather than the duration of breast feeding, and mothers of all ages began bottle feeding at about the same time. Those over 35, however, were significantly less likely (31.5% as compared with 41.6%) to have introduced other foods by the end of the first 6 months, and nearly all the excess infant mortality related to maternal age occurred later than that.

As shown in a study of infant mortality and standards of living by Behm (1962), economic forces greatly affect a child's chances of survival. However,

at the economic level of these rural communities (only 10% of the fathers earned more than the equivalent of US\$75 a month), whatever protection additional income might have afforded was evidently nullified by accelerated weaning. Although the less impoverished tended to introduce non-milk foods sooner, too, the proportion of infants receiving bottles but no additional foods at 6 months—those in greatest danger—rose from 34% to 44% as income increased; this was paralleled by a rise in the infant death rate from 42 to 54 per 1 000 infants (Table 6).

Among children whose mothers had had more than 6 years' schooling, the effects of the progressively earlier weaning associated with better maternal education were apparently attenuated by the timely introduction of other foods. As the mothers' educational level rose, the proportion of children who were bottle-fed but received no other food at 6 months increased from 33% to 45% and then fell to 37%, and the mortality followed a similar curve (Table 6).

Sanitary conditions—presumably because of their association with income and education—were better in the homes where infant deaths occurred. There

Table 6. Postneonatal deaths and death rates, by maternal education and paternal income, rural Chile, 1969-70 *

Maternal education (years)	Paternal income (escudos ^a)	Number of children included in study	Deaths between 4 and 52 weeks	Death rates per 1000 children
< 3	< 300	197	7	
	300-549	108	4	
	≥ 550	9	1	
		Total: 314	Total: 12	38.2
3-5	< 300	166	10	
	300-549	138	7	
	≥ 550	24	3	
		Total: 328	Total: 20	61.0
≥ 6	< 300	91	2	
	300-549	83	5	
	≥ 550	115	4	
		Total: 289	Total: 11	38.1
all groups	< 300	454	19	41.9
	300-549	329	16	48.6
	≥ 550	148	8	54.1

* Children of married women who provided income data.

^a Ten escudos were worth about US \$1.

were 48.1 post-neonatal deaths per 1 000 infants in houses with running water (17% of the total) as compared with 32.3 in those without it; the rate was 36.0 in houses with some sort of sewage system (83% of the total) as compared with 30.0 in those that had none. The families affected lived in less overcrowded conditions than others, with fewer members per room and per bed, and their homes were more likely to be supplied with electricity.

Prenatal medical care was taken as an index of the accessibility and use of health services. The

risk of postneonatal death (relatively unaffected by prenatal care) was higher if mothers had visited a private physician or prenatal clinic during pregnancy than if they had had professional care only at delivery or not at all (37.5 as compared with 27.3 per 1 000 infants).

The inverse relationships of the infant mortality rates to family income, environmental factors, and medical care reinforce the conclusion that the differential mortality observed was attributable to bottle feeding and neglect of supplementary foods.

ACKNOWLEDGEMENTS

The authors gratefully acknowledge the support received from the Rockefeller Foundation and the US Agency for International Development, the technical assistance of the Department of Public Health and Social

Medicine of the University of Chile, the cooperation of the Directors and personnel of the Chilean National Health Service, and the statistical help given by Dr James Warram.

RÉSUMÉ

ALIMENTATION ET MORTALITÉ DES NOURRISSONS EN MILIEU RURAL AU CHILI

Les pratiques en matière d'alimentation des nourrissons, leur contexte et leurs conséquences ont été étudiés en 1969-70 dans 15 collectivités rurales du Chili grâce à une enquête à domicile auprès de 1712 femmes ayant accouché au cours des cinq années précédentes.

Sur 1451 enfants ayant atteint au moins l'âge de 3 mois, près de la moitié avaient déjà reçu un allaitement artificiel. Le risque de mortalité post-néonatale était chez eux trois fois plus élevé que chez les enfants nourris uniquement au sein durant cette période. Manifestement, le danger pour la survie des enfants résultait de la mise en route du processus de sevrage et non de son achèvement; l'allaitement naturel poursuivi conjointement à l'allaitement artificiel ne conférait aucune protection apparente. En revanche, l'administration aux nourrissons d'aliments autres que le lait semblait accroître leurs chances de survie; durant les 2^e et 3^e trimestres de la vie, les taux de mortalité étaient d'environ 70% plus élevés chez les nourrissons recevant du lait pour seule nourriture que chez ceux qui bénéficiaient d'un régime varié.

L'emploi de l'allaitement artificiel était d'autant plus précoce que l'éducation de la mère était plus poussée et que les revenus du chef de famille étaient plus élevés. Cette tendance se reflétait dans les taux de la mortalité post-néonatale. Bien qu'allant de pair avec un souci accru de donner précocement au nourrisson une nourriture variée, avec de meilleures conditions d'hygiène, un recours plus

régulier aux soins médicaux et une fréquence moindre de l'alcoolisme, l'élévation du niveau de vie avait comme conséquence paradoxale une mortalité plus forte chez les nourrissons.

Les mères relativement âgées ou ayant eu de nombreuses grossesses allaitaient leurs enfants plus longtemps que les autres mais introduisaient les biberons dans l'alimentation à peu près au même moment. De ce fait, les taux de mortalité étaient du même ordre chez tous les nourrissons pendant les 6 premiers mois, indépendamment de l'âge ou du degré de parité de la mère. Après cette période, cependant, les femmes âgées de plus de 35 ans étaient moins enclines à varier l'alimentation de leurs enfants et le taux de mortalité s'élevait chez ces derniers.

Dans les collectivités étudiées, les conditions économiques, les services de santé et l'hygiène étaient d'un niveau supérieur à celui de la plupart des zones rurales des pays en développement, mais insuffisant pour que le sevrage précoce des nourrissons ne mette pas leur existence en grave danger. On peut s'attendre à ce que dans d'autres régions les progrès économiques entraînent aussi un abandon prématuré de l'allaitement maternel. Les présentes observations donnent à penser que les inconvénients de cette pratique pourraient être atténués par l'introduction d'aliments autres que le lait dans le régime des nourrissons.

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