Breast-Feeding and Population Growth

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Summary. Abandonment of breast-feeding in parts of the world where contraception is not in common use may mean both higher birthrates and, especially among the poor, higher infant death rates. In this article estimates of the magnitude of these effects are made.

Evidence of a recent trend toward the abandonment of breast-feeding among the urban poor in a number of less developed countries has stirred speculation concerning the demographic impact of a massive shift from the breast to the bottle as the primary infant feeding method in populations where the practice of birth control is far from universal. Discussions have typically focused on the possibility that such a shift would substantially increase fertility, in view of the well-established contraceptive effect of breast-feeding, and would thereby contribute to an increase in population growth rates. Although the enhancement by breast-feeding of the chances of infant survival is also well established and is the subject of much current discussion, the potential impact of changing infant feeding practices on infant and child mortality have generally been excluded from the speculations. Any realistic assessment of the impact of the decline in breast-feeding on population growth must consider fertility and mortality implications jointly.

The Trend Away from Breast-Feeding

The wholesale abandonment of prolonged breast-feeding as the primary method of infant feeding is largely a recent phenomenon even in the more industrialized countries. Vahlquist (*1*) has assembled considerable statistical evidence documenting a dramatic downward trend in European countries since the 1930's. His survey of more recent data for seven European countries indicates that typically only a minority of infants are breast-fed at all past the age of 3 months and many of those who are breast-fed receive supplemental food at the same time. A similar dramatic decline in breast-feeding is evident in the United States. The percentage of infants receiving any breast milk by the time of discharge from the hospital decreased from 65 percent in 1946 to 37 percent in 1956 to 27 percent in 1966 (*2*). There may be some reversal in the trend among middle-class, educated women in the United States and in some European countries (*3*), but clearly the major shift has been away from breast-feeding (*4*, pp. 153–155).

Although prolonged breast-feeding by the infant's own mother was undoubtedly the customary practice in much of Europe's population until quite recently, there were important exceptions. The use of wet nurses was common in some places during the 19th century and even earlier (*5*, *6*). Also, there was probably some decline in breast-feeding as a result of employment of women during the Industrial Revolution (*5*). But the most widespread abandonment of breast-feeding prior to the 20th century was undoubtedly in areas of central Europe including southern Bavaria, parts of Württemberg, Baden, Saxony, Bohemia, and the Austrian Tyrol, where it was customary by the end of the 19th century to breast-feed an infant for only a very short time or not at all (*7*). In place of breast milk infants were typically fed meal paps and sugar water. Although statistical and impressionistic data documenting the custom of not breast-feeding infants in this region are abundant only for the last half of the 19th century and the early part of the 20th, the practice undoubtedly dates from a much earlier time. Nevertheless, it seems reasonable to conclude that by and large, in both Europe and the United States, the shift from breast milk to artificial means of infant feeding was both remarkably recent and rapid.

Even more recent and perhaps more rapid are the changes in infant feeding practices that appear to be under way in many urban and periurban areas of the developing world. Dramatic decreases in the proportions of urban women who breast-feed their infants for prolonged periods have been observed in Chile, Mexico, the Philippines, and Singapore (*8*). The decline is reflected both in lower proportions of infants who are nursed at all and in the shorter periods during which infants are wholly breast-fed. In part the shift to bottle-feeding may be a consequence of the adaptation of urban mothers to working outside the household, but in part it almost certainly reflects a normative change in which breast-feeding is viewed as traditional and backward and bottle-feeding as modern and sophisticated (*4*, *9*). Commercial advertising by milk companies may contribute to this change (*10*, *11*). Prolonged breast-feeding is still usual in rural areas, but improving communication and transportation systems increase the chances that city habits and life-styles, possibly including the shift away from breast-feeding, will penetrate the countryside. Even without a change in habits among rural women, however, the substantial migration from rural to urban areas now under way will assure a further reduction in the proportion of mothers in the contemporary Third World who practice extended breast-feeding.

Breast-Feeding and Fertility

Although it has long been suspected that breast-feeding has a suppressing effect on fertility, only recently has a solid base of evidence been collected. Prolonged lactation protects against pregnancy mainly by delaying the return of ovulation. The underlying mechanism is believed to operate through the anovulatory effect of prolactin and other hormones secreted in response to the infant's suckling (*12*). There are now a large number of studies which confirm that lactation prolongs the period of postpartum amenorrhea. Much of this evidence has been summarized in recent review articles (*13*, *14*). There have also been suggestions that breast-feeding re-

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duces fecundability after the return of menstruation (*15*), but this aspect of the relationship has yet to be firmly established. In addition, the fertility-reducing effect of breast-feeding is enhanced in cultures where intercourse is taboo during lactation.

In the absence of lactation and under a variety of conditions of modernization and health, postpartum amenorrhea averages about 2 months (*16*); longer averages have been reported for a few populations. How much it is extended by prolonged breast-feeding, however, seems to vary considerably both between and within populations (*17, 18*). Averages of 18 months or longer have been reported for rural samples in Indonesia, Zaire, Somalia, and Bangladesh (*17, 19, 20*). More typically the average duration of amenorrhea in lactating women is considerably shorter, often under a year, although virtually always substantially longer than the 2 months usual in the absence of lactation (*18*). Table 1 presents the results of three studies which exemplify the substantial differences between populations in this respect.

Several hypotheses have been advanced to explain why there appears to be so much variation in the effect of breast-feeding on the duration of postpartum amenorrhea both between and within populations. Frisch (*21*) has suggested that nutrition is an important determinant. She assumes that a minimum level of stored energy is required for the maintenance of regular ovulatory cycles and that the energy demands of lactation prolong amenorrhea more in undernourished mothers than in better-nourished mothers. Recent evidence from both Guatemala and Bangladesh confirms that poorly nourished women experience longer amenorrhea associated with lactation than do better-nourished women, but the differences between nutritional groups within the same population do not appear to be large (*22, 23*). Variations in breast-feeding practices seem to be a more important determinant. The more prolonged, frequent, and intense the suckling, the longer the period of amenorrhea (*12*). The ovulation-suppressing effect of lactation appears to be considerably weaker in women who supplement breast-feeding with bottle-feeding, quite likely because infants on mixed feeding regimes suckle less frequently and less intensely. The nutritional status of the mother may also have an indirect effect if poorly nourished mothers produce less breast milk and more prolonged and intense suckling is required of their infants (*23*).

Although lactation is not highly reliable as a contraceptive for individual women, it can have a large effect at the societal level (*13*), especially where the practice of birth control is not widespread. Recent estimates suggest that the total woman-years of protection against pregnancy provided by breast-feeding in the third world is quite substantial and may well be larger than the total amount of contraceptive protection achieved through family planning programs, at least up to 1974 (*8, 18*). The impact on fertility rates of reduced use of breast-feeding would depend on the length of amenorrhea associated with breast-feeding prior to the change as well as the prevalence of birth control.

Potter (*16*) estimates that the substitution of bottle-feeding for breast-feeding in the absence of any practice of birth control would reduce the average birth interval by 14 percent in a population where nutrition is ample and where breast-feeding extends amenorrhea by a little more than 5 months, on the average. In contrast, in a population where nutrition is marginal and amenorrhea among nursing mothers averages 17 months, the average birth interval would be reduced by 40 percent. Reductions in the average birth interval by these amounts are equivalent to raising fertility by 16 and 64 percent, respectively (*24*).

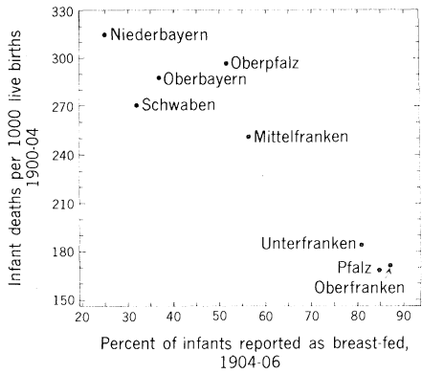

Fig. 1. Infant mortality rates, 1900–04, and breast-feeding practice, 1904–06, in the eight provinces of Bavaria. [Data from (*7*) and (*26*)]

Breast-Feeding and Infant Survival

The advantages of breast-feeding over artificial feeding for promoting infant survival have long been recognized in the developed countries (*1, 4, 5, 25*). In those areas of central Europe where it was customary for women not to breast-feed their infants, public officials and medical doctors regarded the prevailing infant feeding practices as the major factor in the high infant mortality in those regions.

A remarkable survey of infant feeding practices conducted by the Bavarian Statistical Bureau between 1904 and 1906 provides striking evidence of the relation to infant mortality (*26*). Bavarian law required that every child be brought to a public center for vaccination no sooner than 3 months after birth and no later than the calendar year following the year of birth. On that occasion information was obtained about whether the child had been (or was being) breast-fed and when it had been (or probably would be) weaned. The survey documented the sharp regional differences in breast-feeding practices within Bavaria. In Fig. 1 the infant mortality rates in 1900–04 in the eight provinces of Bavaria are plotted with the percentage of breast-fed infants reported in the survey. A clear negative association between breast-feeding and infant mortality is apparent. A regression analysis of these same data based on the 108 Bavarian districts for which information was available yields highly statistically significant results. A 10 percent reduction in the percentage of mothers who breast-fed is associated with an increase of 21 infant deaths per 1000 births; according to the regression equation, with 100 percent breast-feeding the infant mortality rate would have been 148, and in the total absence of breast-feeding 355.

A number of studies in Europe and the United States since the end of the 19th century afford direct comparisons of the mortality risks of breast-fed infants and artificially fed infants. Results of some of these studies are summarized in Table 2. The data are not strictly comparable in all respects and how the mortality rates were calculated is not always clear (*27*). In most cases the omission of records for the first few days or weeks of life causes an understatement of mortality for both categories of feeding. Nevertheless, the results consistently show that the chances of surviving to age 1 year were substantially higher for breast-fed than for artificially fed infants. The extent of the difference, however, varies considerably from study to study. In Berlin and Barmen around the turn of the century, deaths before age 1 were 30 percent higher among the artificially fed than among the breast-fed, but the advantages of breast-feeding are clearly diminished in the more recent studies. The few studies which give separate results for infants receiving mixed feeding indicate that the mortality risks for such infants were intermediate between those of wholly breast-fed and wholly bottle-fed babies.

Unfortunately, there are few studies on the effect of feeding practices on in-

fant mortality in Third World countries today. The scattered studies that do exist suggest that in present-day less developed countries artificially fed infants have much higher death rates than breast-fed infants. In a study conducted in the Khanna district of the rural Punjab, all but one of the 20 infants artificially fed from birth died before reaching age 1, compared to 12 percent of the breast-fed infants (*28*). In 15 rural communities in Chile, postneonatal deaths were three times as frequent among infants who started bottle-feeding in the first 3 months as among those exclusively breast-fed during that time (*29*). A considerably higher relative risk of dying has been reported for children breast-fed less than 6 months than for those breast-fed longer, in a study done in 1975 in Guatemala City (*30*). Wray (*31*) has estimated indirectly from data for four areas in different countries included in a Pan American Health Organization study that mortality risks during the second 6 months of life are from 6 to 14 times higher for children breast-fed less than 6 months than for those breast-fed longer.

The advantages of breast-feeding are that breast milk is nutritionally ideal, at least for the first 6 months, provides some immunity from disease, and is clean (*32*). Thus the impact of breast-feeding on infant mortality risks depends on the nutritional quality of substitute foods, the sanitary conditions surrounding artificial feeding, and the overall health conditions of the infant's environment. These factors are certainly far from optimal in most of the less developed world today. As they improve, the mortality differences between breast-fed and artificially fed infants should diminish and may well become as insignificant as they probably are today in much of the developed world. There are of course a number of other benefits of breast-feeding not directly related to chances of survival which may or may not persist (*4*), but such benefits are not pertinent to the present discussion. The scanty evidence available suggests, however, that the survival advantages of breast-feeding are still as substantial today in much of the Third World as they were in the past in Europe and the United States (*31, 33*).

Fertility and Mortality Implications Combined

Clearly any widespread abandonment of breast-feeding within the Third World could have a substantial effect on both fertility and mortality. It is the net result of the two effects together that will determine the impact on population growth. Yet most speculation on the demographic implications of the trend toward bottle-feeding has focused largely on its potential to increase fertility. The detailed assessment by Potter (*16*) of fertility changes that could be expected from a shift from prolonged breast-feeding to bottle-feeding in the absence of contraception has already been mentioned. Jain and his colleagues estimated from data for Taiwan that lactation prevents as many as 20 percent of the births that would occur if there were no lactation at all (*34*, p. 269). Some have even translated the implied fertility increases directly into population increases, completely ignoring any associated mortality effects (*3*, p. 1234; *35*).

Table 1. Duration of postpartum amenorrheal periods in nursing mothers in three populations. All results are obtained by application of the life table method. Data for the Punjab villages and the Havu tribe included some women who weaned prior to the return of menstruation; in both studies, however, about 90 percent of the women were still lactating 1 year after childbirth. [Data from (*20, 36*)]

Months since childbirth	Proportion of nursing mothers who had resumed menstruating		
	Boston, 1963	Punjab villages, 1955–59	Havu tribe, Zaire, 1974–75
0	.00	.00	.00
3	.26	.14	.05
6	.61	.26	.11
9	>.70	.40	.22
12	*	.57	.33
18	*	.83	.51
24	*	.93	.86
Median months of amenorrhea†	5.3	10.6	17.7

*Not available. †Calculated from more detailed data where available.

One way to estimate the net demographic implications of a shift from breast- to bottle-feeding in the absence of contraception is to combine the results from contemporary studies on the impact of breast-feeding on postpartum amenorrhea, such as those included in Table 1, with the results presented in Table 2 on the effect of infant feeding practices on the chances for survival to age 1 year that were obtained for studies done for earlier periods in developed countries (since direct data on mortality risks associated with infant feeding practices in developing countries are lacking). Because there is a considerable range in both the fertility and the mortality effects of different infant feeding practices, the net demographic effect will depend on the particular combination chosen. The results must of course be considered speculative.

In order to represent the range of mortality effects, data from three different studies have been chosen: the Berlin study of 1895–96 to represent the high end of the range, the 1936–42 Liverpool study for the low end, and the 1911 Boston study for an intermediate estimate. In all three cases breast-fed infants had a higher chance of surviving than artificially fed infants, but the extent of the advantage differed greatly. All three esti-

Table 2. Mortality rates and survivorship to age 1 year in breast-fed and artificially fed infants. Most of these rates do not include deaths in the first few days or weeks of life; mortality is therefore underestimated and survival overestimated. Only the rates for the eight U.S. cities in 1911–16 represent mortality from birth; deaths that occurred before any feeding are proportionately allocated to the two feeding categories. The rates for Berlin, Barmen, Hanover, Cologne, and the eight U.S. cities were derived by applying life table techniques to mortality rates given by single months of age. [Data from (*25, 31, 37, 38*)]

Study area	Date	Mortality (per 1000)		Survivors to age 1 (per 1000)		
		Breast-fed	Artificially fed	Breast-fed	Artificially fed	Difference
Berlin, Germany	1895–96	57	376	943	624	319
Barmen, Germany	1905	68	379	932	621	311
Hanover, Germany	1912	96	296	904	704	200
Boston, Mass.	1911	30	212	970	788	182
Eight U.S. cities *	1911–16	76	255	924	745	179
Paris, France	1900	140	310	860	690	170
Cologne, Germany	1908–09	73	241	927	759	168
Amsterdam, Holland	1904	144	304	856	696	160
Liverpool, England	1905	84	134	916	866	144
Eight U.S. cities †	1911–16	76	215	924	785	139
Derby, England	1900–03	70	198	930	802	128
Chicago, Ill.	1924–29	2	84	998	916	82
Liverpool, England	1936–42	10	57	990	943	47
Great Britain	1946–47	9	18	991	982	9

*Comparison of breast-fed infants with infants artificially fed from birth. †Comparison of breast-fed infants with all infants artificially fed in the period of observation.

Table 3. Estimated average number of live births and survivors to age 1 year within a 25-year reproductive span, under varying assumptions about the effects of alternative infant feeding practices on fertility and mortality.

Assumption		Estimated average number in total reproductive span				Change due to shift from prolonged breast-feeding to artificial feeding (%)	
		Live births‡		Survivors to age 1§			
Impact of feeding practices on mortality*	Impact of breast-feeding on fertility†	Prolonged breast-feeding	Wholly artificial feeding	Prolonged breast-feeding	Wholly artificial feeding	Live births	Survivors to age 1
High	High	7.84	12.88	7.39	8.04	+64.3	+ 8.7
	Medium	9.52	12.88	8.98	8.04	+35.3	−10.5
	Low	11.33	12.88	10.68	8.04	+13.6	−24.8
Medium	High	7.77	12.88	7.54	10.15	+65.8	+34.7
	Medium	9.46	12.88	9.18	10.15	+36.1	+10.7
	Low	11.31	12.88	10.97	10.15	+13.9	− 7.5
Low	High	7.72	12.88	7.64	12.15	+66.8	+58.9
	Medium	9.43	12.88	9.33	12.15	+36.6	+30.1
	Low	11.29	12.88	11.18	12.15	+14.1	+ 8.7

*Based on the following studies included in Table 2: high, Berlin 1895–96; medium, Boston 1911; low, Liverpool 1936–42. †Based on the median lengths of postpartum amenorrhea reported in the three studies shown in Table 1: high, 17.7 months; medium, 10.6; low, 5.3. ‡Estimated by dividing a 25-year reproductive span by the estimated average birth interval found by adding 21.3 months (see text) to the number of months of postpartum amenorrhea assumed to characterize each category. In the case of prolonged breast-feeding, the average intervals are adjusted to allow for the effect of infant deaths; it is assumed that intervals following an infant death are characterized by 5, 4, and 3 months of postpartum amenorrhea respectively for the categories of high, medium, and low effects of breast-feeding on fertility. The probability of an infant death in an interval is assumed to be equal to the mortality risks of breast-fed infants shown in Table 2 for each of the studies on which the three mortality impact categories are based. §Estimated by multiplying the number of live births by the probability of surviving to age 1 given in Table 2 for each of the studies on which the three mortality impact categories are based.

mates of the mortality impact ignore any advantages breast-feeding may have had for survival past age 1, but this is probably of minor importance because the major effect of feeding practices on mortality is felt in the first year of life.

In order to assess the impact on fertility of a shift from breast-feeding to bottle-feeding, we can start by comparing the length of the average birth interval that would result under each feeding pattern if no contraception was being practiced and assuming alternative durations of amenorrhea associated with prolonged breast-feeding. The interval between live births can be broken down into three components: a period of postpartum amenorrhea immediately following a birth; a period between the resumption of menstruation and the next conception; and a period of gestation. In addition, some time must be allowed for an occasional intervening spontaneous abortion, miscarriage, or stillbirth. Potter (*16*) estimates that under conditions of less than ideal nutrition the menstruating interval lasts about 10 months; gestation requires about 9 months, and an additional 2.3 months on the average are taken up by pregnancy wastage. This adds up to 21.3 months, to which the period of postpartum amenorrhea must be added. If in the absence of breast-feeding amenorrhea lasts 2 months, the average birth interval without breast-feeding would be 23.3 months.

If we ignore any possible effects breast-feeding has on the birth interval other than on the postpartum amenorrhea component, we can easily calculate the average birth interval under conditions of prolonged breast-feeding and under different assumptions about its effect on amenorrhea. With such high, medium, and low effects as are shown by the three studies presented in Table 1, we would need to allow for 17.7, 10.6, and 5.3 months of amenorrhea, respectively, during the average birth interval under conditions of prolonged breast-feeding. This yields birth intervals of 39.0, 31.9, and 26.6 months. Since an infant death would interrupt breast-feeding and thus reduce the period of amenorrhea within the interval in which the death occurred, a slight adjustment needs to be made to allow for this effect. (See Table 3 for a description of that adjustment.)

On the basis of these estimates of average birth intervals, the number of live births that would result during a typical reproductive span of 25 years under alternative infant feeding practices can easily be estimated. The results are shown in Table 3 along with the number of survivors to age 1, estimated by multiplying the number of live births by the survival rates (from Table 2) in the three studies chosen to represent high, medium, and low mortality effects.

Of particular interest are the changes in the number of live births and number of children surviving to age 1 that are implied by a complete shift from prolonged breast-feeding to artificial feeding. Because this shift would result in a shortening of postpartum amenorrhea, if contraception were not adopted to compensate the average birth interval would decrease and the average woman would have a larger number of live births in any given reproductive span. The estimated increases range between 14 and 67 percent, depending on the duration of amenorrhea attributed to breast-feeding.

When we focus on the survivors to age 1, the results are substantially altered; it even appears possible that a shift away from breast-feeding could lead to a decrease rather than an increase in the number of infants who survive to their first birthday. The results depend very much on the particular assumptions made concerning both the mortality and the fertility effects of infant feeding practices. The potential change in surviving infants ranges from an increase of almost 60 percent to a 25 percent decrease. Not all combinations of assumptions are equally likely, however. Whether through direct or indirect causation, in populations with poor nutrition periods of postpartum amenorrhea associated with breast-feeding tend to be long. Where nutrition is poor it seems reasonable to expect that the mortality impact of a shift to artificial feeding would also be high. The combination of a high fertility and mortality effect as shown in our results means that a 64 percent increase in live births would be reduced to a less than 10 percent increase in children surviving to age 1, and if breast-feeding has advantages past age 1 even this slight increase in survivors could be negated. Smaller effects on mortality, on the other hand, would probably be associated empirically with smaller effects on fertility. Thus with a medium mortality and fertility effect, a 36 percent increase in live births would translate into an 11 percent increase in survivors to age 1. The general implication, then, is that most, if not

all, of the increase in fertility to be expected from a shift from breast- to bottle-feeding would be counteracted by the reduced chances of survival associated with artificial means of infant feeding. It is even possible that a rapid shift away from breast-feeding could lead to a decrease in the number of surviving children if the mortality effect were high and the fertility effect moderate. Such a combination is not implausible.

Conclusion

The foregoing analysis is intended only to suggest the order of magnitude of the potential demographic impact of the changing infant feeding practices that are apparently under way in the Third World. Nevertheless, the results clearly point out the need to consider the fertility and the mortality implications jointly. The fact that any fertility increases resulting from a widespread abandonment of breast-feeding among the poorer strata are likely to be substantially muted by lower survival chances for the artificially fed infants is no reason, however, to view the situation with any less alarm. Increasing infant deaths is a very costly way indeed, from a humane point of view, to prevent population growth rates from rising. In addition, there are other advantages besides mere survival that stem from breast-feeding, including benefits to the mental and physical development of the infant and economic advantages for the parents (*4*, *11*).

There is no reason to expect, of course, that conditions within the Third World will remain static. It seems likely that modern contraceptive practices will be increasingly adopted, in response to the same "modernizing" forces that are resulting in the abandonment of breast-feeding. This should lessen the fertility impact of changing feeding practices, although a substantial increase in infant mortality due to a rapid shift to artificial feeding could retard the spread of family planning. On the other hand, as health conditions improve the mortality impact should also diminish. In the long run both sets of circumstances will probably change together, and the future demographic impact of changing infant feeding patterns will depend on just how coincident they are.

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