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BREASTFEEDING IMPROVES SURVIVAL, BUT NOT NUTRITIONAL STATUS, OF 12–35 MONTHS OLD CHILDREN IN RURAL BANGLADESH

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The association between breastfeeding, nutritional status and survival was investigated in a cohort of 1087 children aged 12–35 months from rural Bangladesh followed monthly during 2 years. Mean weight-for-age (%NCHS) of breastfed children was 69.6 per cent (s.d.: 9.3 per cent) compared to 70.6 per cent (s.d.: 10.7 per cent) ($P < 0.001$) for non-breast fed children. This confirms that after 1 year of age, breastfed children tend to be more malnourished than non-breastfed children. Despite this difference in nutritional status, risk of dying, after adjusting for age, was six times higher in non-breastfed malnourished children than in similarly malnourished breastfed children. This suggests that breastfeeding beyond 1 year should be encouraged in communities with a high prevalence of malnutrition, despite the frequently observed association between prolonged breastfeeding and malnutrition.

Although the importance of breastfeeding in infancy is well recognized (Feachem & Koblinsky, 1984), there is still some uncertainty regarding its role in children above 1 year of age. Two studies, one from Rwanda and the other one from Bangladesh, have claimed that breastfeeding is associated with improved survival even after 1 year of age (Lepage, Munyakazi & Hennart, 1981; Briend, Wojtyniak & Rowland, 1988). There are also reports, however, suggesting that after 1 year of age, breastfed children tend to be slightly more malnourished than non-breastfed children (Victora *et al.*, 1984; Brakohiapa *et al.*, 1988; Thoren & Stintzing, 1988; Michaelsen, 1988).

The study from Bangladesh (Briend *et al.*, 1988) also suggested that nutritional properties of breast-milk might not be the most important to improve survival, since mid-upper arm circumference was similar in breastfed and non-breastfed children. Precise comparison of nutritional status of breastfed and weaned children, however, was not possible in this previous study in which mid-upper arm circumference was used as the nutritional indicator.

If breastfeeding can have an impact on survival without markedly improving nutritional status, then the previously reported lower nutritional status of breastfed children should be regarded as of little importance and should not be used to question the value of prolonged breastfeeding in poor communities. Recently, we obtained additional evidence in favour of this hypothesis that we want to report here.

Subjects and methods

Data used for this analysis were collected during a study on the impact of rice-based oral rehydration solutions on the nutritional status of children under 5 years of

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age. The study area, straddling the Chandpur-Comilla highway, is located in the deltaic plain of Bangladesh, near the Meghna river, 70 km from the capital Dhaka. This is a rural community under demographic surveillance since 1979. Growing rice, potatoes, wheat and jute is the main economic activity. The children of this area were equally divided into three groups, each one of them receiving a different oral rehydration treatment for diarrhoea. The three groups were combined for this analysis.

Field work took place from October 1983 to October 1985. Every month, each mother was asked whether the child was still receiving breast-milk or not. A child was considered weaned if fully weaned, receiving no breast-milk at all, and breastfed otherwise. Children were weighed every month with portable spring scales (Salter, UK), which were read to the nearest 50 g and checked regularly with standard weights. Weight-for-age was calculated as the percentage of the median of the NCHS standards (Hamill *et al.*, 1979; WHO Working Group, 1986).

The analysis was made using 'child-months': a child was considered as a survivor if alive at the next visit and entered as a new child for the following month. A total of 1087 children who were aged between 12 and 35 months at any time during the study were included in the analysis, representing a total of 14919 child-months, 69 of them ending by a death.

Comparison of means was made by *t*-test (Armitage, 1971). Relative risks for 2-by-2 tables were calculated with the Miettinen test-based confidence limits and when several 2-by-2 tables were combined, relative risk and chi-square for heterogeneity were calculated using the Mantel-Haenszel method (Breslow & Day, 1980). For multivariate analysis, logistic regression analysis was used. Significance of different risk factors was estimated by comparing the log likelihood statistic (−2 log likelihood ratio) of different logistic models (Kleinbaum, Kupper & Morgenstern, 1982).

Results

On average, children had a lower weight-for-age when breastfed than when weaned: 69.6 per cent (s.d.: 9.3 per cent) *vs* 70.6 per cent (s.d.: 10.7 per cent), $P < 0.001$. This difference was larger at younger ages but persisted up to 3 years of age (Fig. 1).

For 622 children who were weaned during the study, it was possible to compare their nutritional status for the last visit during which they were breastfed with that of other visits. Children, on average, had a higher weight-for-age when they were about to be weaned than when they were not: 70.4 per cent (s.d.: 9.7 per cent) *vs* 69.6 per cent (s.d.: 9.2 per cent), $P < 0.05$.

Despite their better nutritional status, weaned children had a relative risk of dying of 2.6 (95 per cent confidence limits: 1.7–4.2, $P < 0.001$) compared to breastfed children. Estimated prevented fraction (Kleinbaum *et al.*, 1982) was 38 per cent.

Breastfed children were younger and younger ages experienced a higher mortality; adjusting for age yielded an even higher relative risk (Table 1). The protective effect of breastfeeding was apparent only in severely malnourished children (Table 1). This became clear when risk of dying in relation to weight-for-age was estimated by two separate univariate logistic models for breastfed and weaned children (Fig. 2).

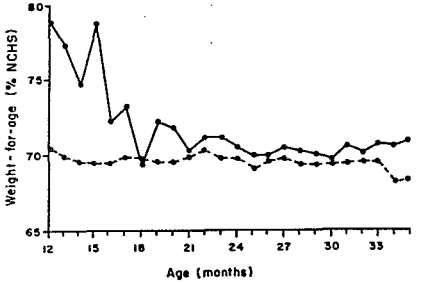

Fig. 1. *Comparison of weight-for-age in breastfed (○---○) and weaned (●——●) children aged 12–35 months.*

Table 1. *Risk of dying in breastfed and weaned children in relation to age and nutritional status.*

A. Stratifying by age

Age groups (months)		*Breastfed*	*Weaned*	*Relative risk (95% CL)*
12–17	Child months	2561	114	6.1 (2.0–18.7)
	Deaths	11	3	
18–23	Child months	2987	665	4.5 (1.7–11.7)
	Deaths	7	7	
24–29	Child months	2365	1908	3.7 (1.6–8.8)
	Deaths	6	18	
30–36	Child months	1257	3062	3.1 (0.8–12.5)
	Deaths	2	15	

Pooled estimate of odds ratio: 3.9 (2.3–6.8)
Chi-square for heterogeneity: 0.68, 3 df, n.s.

B. Stratifying by nutritional status

Nutritional categories				
Weight-for-age, < 60% NCHS	Child months	1230	851	4.2 (2.3–7.6)
	Deaths	12	35	
Weight-for-age, ⩾ 60% NCHS	Child months	7940	4898	0.9 (0.4–2.2)
	Deaths	14	8	

Pooled estimate of odds ratio: 2.5 (1.6–4.01)
Chi-square for heterogeneity: 8.22, 1 df, $P < 0.01$.

To estimate the association between weaning and risk of dying when other factors are taken into account, a logistic regression analysis was done including age, low weight-for-age and breastfeeding as risk factor. Weight-for-age was used as a dummy variable (1 for weight-for-age less than 60 per cent, 0 for weight-for-age of 60 per cent or more) to assess its interaction with breastfeeding. Breastfeeding was not significantly related to survival when the interaction term between breastfeeding and low weight-for-age was introduced and was not present in the final model (Table 2). For malnourished children, weaning was associated with a relative risk of dying of 6.0 (95 per cent CL: 3.0–12.4) compared to breastfed malnourished children.

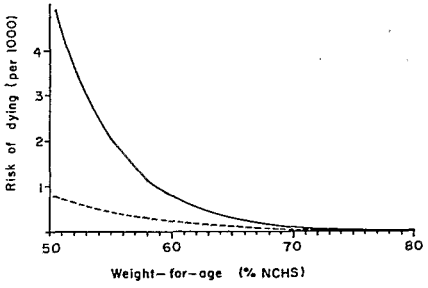

Fig. 2. *Risk of dying in relation to weight-for-age (% NCHS) in breastfed (----) and non-breastfed (————) children as described by two separate univariate logistic models.*

Discussion

Since this study is an observation study, all possible confounding factors must be examined before claiming that any observed association is causal (Lilienfeld & Lilienfeld, 1980; Breslow & Day, 1980).

Several factors suggest that the higher degree of malnutrition observed in breastfed children is not due to breastfeeding itself. First, this difference seems to precede weaning, since children on average were already significantly better nourished when they were about to be weaned suggesting that mothers tend to

delay weaning when their children are malnourished. Secondly, in Bangladesh, women of low socio-economic status tend to breastfeed longer (Huffman *et al.*, 1980), which also could explain a higher degree of malnutrition among breastfed children. Thirdly, the observed difference, although highly significant statistically, is small in absolute terms, which suggests that it can be the result of confounding factors. Actually, the comparison of nutritional status between breastfed and weaned children is so biased that our data are still compatible with the hypothesis that breastfeeding slightly improves nutritional status beyond 1 year. Finally, there is no sound biological hypothesis to explain why breastfed children should be more malnourished after 1 year of age than weaned children. Breast-milk has the highest energy density (calculated on the basis of dry weight) of all the foods taken by children of this age in rural Bangladesh (Brown *et al.*, 1982) and its proteins have the highest biological value (Jelliffe & Jelliffe, 1977).

On the other hand, the association between weaning and risk of dying is less likely to be due to confounding factors and seems to be causal. First, severely malnourished weaned children had a risk of dying six times higher than similarly malnourished breastfed children and the strength of this association itself suggests that it is causal. If it were not, one would have to assume the existence of a confounding factor closely related to the risk of dying and at least six times more frequent among breastfed than among weaned children (Lilienfeld & Lilienfeld, 1980), which seems unlikely. Secondly, the protective effect of breastfeeding is visible only in severely malnourished children and observing an association in a subgroup of individuals is also in favour of a causal relationship (Breslow & Day, 1980). A protective effect of breastfeeding visible only in severely malnourished children was also found in a previous study, which was also consistent with this one regarding the levels of relative risk associated with weaning (Briend *et al.*, 1988). Thirdly, the tendency mothers have to wean better nourished children and the reported higher frequency of breastfeeding among the poorest women (Huffman *et al.*, 1980) should result in an underestimation of the strength of the association between breastfeeding and risk of dying (Habicht, Da Vanzo & Butz, 1986). Finally, it seems biologically plausible that breastfeeding improves survival in severely malnourished children, without markedly improving their nutritional status. Breast-milk has anti-infectious properties which may attenuate the effect of infections, especially diarrhoea, which are common in malnourished children (Jelliffe & Jelliffe, 1977). During diarrhoea, breastfeeding may help to prevent dehydration which tends to be more frequent in malnourished children (Black *et al.*, 1984). Also, breast-milk is given in small frequent feeds and is well accepted by sick children (Hoyle, Yunus & Chen, 1980), which presumably helps to prevent hypoglycaemia, a frequent cause of death among severely malnourished sick children (Hirschorn *et al.*, 1966).

Table 2. *Relative risk associated with absence of breastfeeding estimated after adjusting for age and nutritional status by a logistic regression model.*

Risk factor	*Regression coefficient*	*Relative risk*	*95% CL*
Weight-for-age < 60%	1.62**	5.1	2.5–10.3
No breast-feeding for children with weight-for-age < 60%	1.80**	6.0	3.0–12.4
Age, months	−0.05*		
Constant	−5.17**		

* $P < 0.05$; ** $P < 0.001$.

Estimation of the prevented fraction suggests that advocating weaning at 12 months of age, if successful, in this population with a high prevalence of malnutrition, would result in a 38 per cent increase in child mortality. We urge that in no circumstances should the mother of a malnourished child be advised to stop breastfeeding in an attempt to improve his nutritional status. We also suggest that family planning programmes may have some impact on child survival in populations with a high prevalence of malnutrition, pregnancy being a major cause of early cessation of breastfeeding (Huffman *et al.*, 1980).

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