

ment would need to be examined. It is important that women without cervical intraepithelial neoplasia and perhaps those with cervical intraepithelial neoplasia grade I, are not overtreated; a randomised trial is needed to address this issue.

In conclusion, this study shows that cytological surveillance is not an efficient strategy for managing women with mildly abnormal smears and that women with any grade of dyskaryosis should be referred for colposcopy.

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Prolonged breast feeding, diarrhoeal disease, and survival of children in Guinea-Bissau

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Abstract

Objective—To analyse the impact of breast feeding on diarrhoeal disease and survival in children above 1 year of age in Guinea-Bissau, west Africa.

Design—A community study of an open cohort followed up weekly by interviews over 15 months. Data on feeding practices, anthropometry, and survival were recorded for three years.

Setting—301 randomly selected houses in a semiurban area in the capital, Bissau.

Subjects—849 children aged less than 3 years.

Main outcome measures—Incidence and duration of diarrhoea, weight for age, and death of a child.

Results—The incidence of diarrhoea was higher in weaned children than in partially breast fed children, both in 1 year olds (relative risk 1.41; 95% confidence interval 1.23 to 1.62) and in 2 year olds (1.67; 1.29 to 2.15). The mean duration of an episode of diarrhoea was 5.3 days in breast fed children compared with 6.3 days in weaned children ($P=0.001$). Independent of the age of weaning, a similar increase was found in an analysis comparing, for each child, the rate and duration of diarrhoea one month before and one month after weaning. Children with low weight for age were breast fed longer than the better nourished children ($P=0.02$). Children aged 12-35 months who were not breast fed had a 3.5 times higher mortality (1.4 to 8.3) than breast fed children.

Conclusions—The beneficial effects of breast feeding are not restricted to infancy. Though children who are partially breast fed after infancy may have a lower state of nutrition than the weaned ones, the benefit in terms of lower morbidity may be more important for child survival in places with a high morbidity from diarrhoea and with high mortality.

Introduction

It was suggested early in this century¹ and later confirmed in several studies²⁻⁷ that breast feeding was beneficial to the health of infants and that it had a protective effect against diarrhoea in infancy. The health impact of human milk in young children above 1 year of age, however, is controversial. In studies from Bangladesh breast feeding was associated with lower mortality up to the age of 3 years in malnourished children⁸ and a lower prevalence and severity of bloody and chronic diarrhoea.^{8,9} By contrast, several studies have associated prolonged breast feeding with reduced food intake and malnutrition.⁹⁻¹² Because of the association between low state of nutrition and prolonged breast feeding it has been suggested that breast feeding after 18 months of age may be detrimental.¹¹ Such views, however, disregard possible health benefits from prolonged breast feeding. Published data are insufficient to draw conclusions, and in particular little is known about the effect of prolonged breast feeding on child morbidity.

Prolonged breast feeding is common in Guinea-Bissau, where diarrhoea is a major cause of death in early childhood.¹³ We analysed the impact of prolonged breast feeding on the incidence and duration of diarrhoea and on survival in children.

Subjects and methods

FIELDWORK

The community based study described in detail elsewhere^{13,14} was conducted in a semiurban district, Bandim II, in the capital of Guinea-Bissau. An open cohort of 849 children born after 1 June 1984, residing in 301 randomly sampled houses, were included in the

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study, which started January 1987 and ended April 1990. In the first 15 months information on episodes of diarrhoea and feeding patterns was obtained by weekly household interviews. In this period children born in or moving to these houses were also included. Data on nutrition and survival were available for the next 24 months. By using portable spring scales we weighed children about every three months. Children who moved within the area were followed up from their new homes.

In this paper weaning refers to the end of breast feeding, not the introduction of other foods in the diet. A sequence of days with diarrhoea was regarded as one episode, provided that it was separated from previous episodes by at least two days free of diarrhoea.

STATISTICAL METHODS

The total number of days at risk of diarrhoea was classified by age of child (intervals of two months) and feeding practices (exclusively breast fed, breast feeding plus supplementary food, or no breast feeding). The incidence of diarrhoea was estimated in each stratum as the number of initiated episodes per 100 days at risk. The recovery rate was the number of terminated episodes per 100 days with diarrhoea. The impact of age and mode of feeding on the incidence and recovery rates were analysed in two log linear Poisson models. The response variables were the number of initiated and the number of terminated episodes of diarrhoea; maximum likelihood techniques were applied.¹⁵ A considerable part of the population was mobile, and all periods of absence were excluded from the analysis of morbidity.

In a separate analysis we investigated data on 162 of the 167 children who were weaned during the study period. Using logarithmic transformation in a paired *t* test we compared the incidence and recovery rates

30 days before weaning with the rates 30 days after weaning. Periods of 30 days were chosen since the incidence in a larger interval would be confounded by the general effect of age.

Survival analysis techniques were used for comparing duration of breast feeding of children with and without low weight for age. These data were analysed further in a Cox's proportional hazards regression analysis with child age as the underlying time scale, entry as age at weight measurement, and exit as age at weaning or censoring. Ninety six of the children who were weaned during the study period were weighed before (0-100 days) and after (30-130 days) weaning. The immediate impact of weaning on weight for age was analysed by a paired *t* test.

The survival of children weaned after 12 months of age was estimated by proportional hazards regression with age as the underlying time scale and breast feeding as a time dependent covariate. The effects were expressed as the mortality ratios, and the programs BMDP 11 and 21 (BMDP statistical software, Cork, Republic of Ireland) were used for survival analysis and ANTHRO (Centers for Disease Control, Atlanta) for the calculation of weight for age Z scores.

Results

INCIDENCE AND DURATION OF DIARRHOEAL DISEASES

A total of 3612 episodes were initiated on 138 982 diarrhoea free days—that is, the incidence was 2.6 episodes per 100 days at risk. Recovery from diarrhoea was recorded in 3480 episodes on 21 163 days with diarrhoea, which equals 16.4 per 100 days with diarrhoea, or a mean duration of 6.1 days (1/0.164). The prevalence was 13.2%. The average child would experience eight episodes of diarrhoea annually and have diarrhoea for about 50 days.

FEEDING PRACTICES AND NUTRITIONAL STATUS

All infants were breast fed, and from shortly after birth they received small quantities of water and herbal infusions. Data on these practices were not recorded in the follow up. At three to seven months (25% and 75% quartile) supplementation started with gruel (rice, millet, and other cereals) and mash. Breast feeding was continued throughout infancy, and over 90% of the children were still breast fed at 15 months of age. The median age of weaning was 22 months, and a quarter still received maternal milk at 27 months. Formula feeding was rare.

Of 354 breast fed children aged 10-17 months, 59 with very low weight for age (score ≤ -2.5) were breast fed for a median of 24.1 months compared with 22.3 months for children with Z score > -2.5 ($P=0.04$, log rank test). Information on ethnic group, maternal education, and mother's age was available from 294 of the 354 children. Table I shows a multivariate analysis of risk factors for stopping breast feeding; children with very low weight for age before weaning had a relative risk of weaning of 0.6 (95% confidence interval 0.4 to 0.9, $P=0.016$, likelihood ratio test) compared with children with Z score > -2.5 .

Table II shows the prevalence of low weight for age by mode of feeding and age in children aged 18-29 months. In the table each child was included only once in an age group. There was a tendency in all age groups towards higher prevalence of malnutrition in breast fed than in weaned children. Children weaned during the study, however, showed no change in Z score at the time of weaning. The mean Z score was -1.45 before and -1.49 after weaning ($n=96$, $P=0.53$). A regression analysis showed no effect of age on the change in Z score; the ages were from 13 to 32 months.

TABLE I—Multivariate analysis of risk of stopping breast feeding in relation to nutritional state before weaning and other explanatory variables (Cox's proportional hazards regression)

Covariate	No (%)	Relative risk* (95% confidence interval)
Nutritional state†:		
Z score > -2.00 †	201 (68.4)	1.0
Z score -2.49 to -2.00	50 (17.0)	1.0 (0.7 to 1.4)
Z score ≤ -2.50	43 (14.6)	0.6 (0.4 to 0.9)
Sex:		
Boy	137 (46.6)	1.0
Girl	157 (53.4)	0.9 (0.7 to 1.2)
Mother's age:		
15-19 Years	50 (17.0)	1.0
20-29 Years	175 (59.5)	0.9 (0.7 to 1.3)
30 Years or above	69 (23.5)	0.7 (0.5 to 1.1)
Ethnic group:		
Other	242 (82.3)	1.0
Balante	52 (17.7)	0.6 (0.4 to 0.8)
Maternal education:		
None	139 (47.3)	1.0
1-5 Years in school	103 (35.0)	1.6 (1.2 to 2.1)
6-12 Years in school	52 (17.7)	1.9 (1.4 to 2.8)

*Exp (β), β is the regression coefficient in multivariate analysis.

†Weight for age Z score (standard of National Center for Health Statistics, Washington, DC).

TABLE II—Prevalence of low weight for age by mode of feeding and age

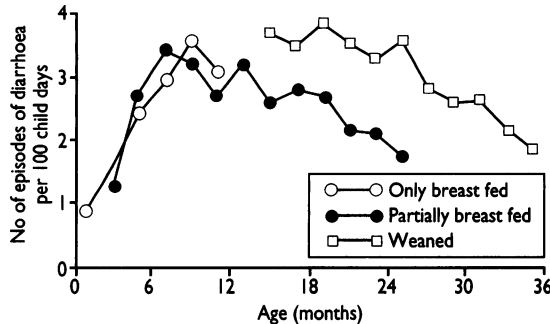
Method of feeding by age (months)	No of children	Mean Z score*	Proportion (%) below Z score of -2	Relative risk† (95% confidence interval)†	P value
18-20:					
Breast fed	173	-1.51	32.4	1.2 (0.8 to 1.7)	0.48
Weaned	89	-1.43	28.1		
21-23:				1.4 (1.0 to 2.0)	0.03
Breast fed	136	-1.52	40.4		
Weaned	148	-1.39	28.4		
24-26:				1.2 (0.8 to 1.7)	0.51
Breast fed	72	-1.49	30.6		
Weaned	215	-1.31	26.5		
27-29:				1.9 (1.3 to 3.2)	0.02
Breast fed	26	-1.67	42.3		
Weaned	282	-1.22	33.0		

*Mean weight for age Z score (standard of National Center for Health Statistics, Washington, DC).

†For low weight for age for breast fed children.

INCIDENCE AND RECOVERY RATES BY AGE AND FEEDING PRACTICE

The figure shows the incidence of diarrhoea by age and mode of feeding. The incidence increased from about one episode per 100 days at risk in children less than 4 months of age to a maximum of three episodes in children 10 months old. The effect of age was significant ($P < 0.001$). There was no difference in rates of diarrhoea between those infants who received supplementary food and the exclusively breast fed infants when we adjusted for the age effect ($P = 0.76$).



Incidence of diarrhoea in exclusively breast fed (○—○), partially breast fed (●—●), and weaned children (□—□), 849 children followed for 438 child years, Bissau, Guinea-Bissau

There was a higher rate of diarrhoea in weaned than in breast fed children above 1 year of age; the relative risk was 1.41 (1.23 to 1.62) in 1 year old children and 1.67 (1.29 to 2.15) in 2 year olds. When children who had a younger sibling were excluded there was no effect on these results. The figure shows that during the second year of life the incidence decreased from three to two episodes per 100 days at risk in breast fed children, whereas the incidence was higher and declined more slowly in the weaned children.

The mean duration of diarrhoea was 6.6 days in breast fed infants compared with 5.3 days in breast fed children above 1 year of age ($P < 0.001$). There was no difference in duration between 1 and 2 year olds. At these ages, however, weaning had a significant impact on the duration of diarrhoea: the mean duration of an episode was 6.3 days—that is, one day longer than those who were breast fed ($P = 0.001$). The introduction of supplementary food in infancy had no impact on the duration of diarrhoea.

INCIDENCE AND RECOVERY ONE MONTH BEFORE AND ONE MONTH AFTER WEANING

Compared with the incidence one month before weaning the incidence after was the same in 45 children, higher in 73 children, and lower in 44. Table III shows the change in incidence by age. On average the incidence increased by a factor of 1.45 (1.12 to 1.88), and this increase did not depend on the age of weaning.

A change in recovery rates could be investigated only in 59 children who experienced at least one day of diarrhoea during the last month before the first month after weaning. Compared with the duration one month

TABLE III—Immediate change in incidence of diarrhoea 30 days after weaning compared with 30 days before (paired analysis of 162 children from cohort in Bissau)

Age at weaning (months)	Incidence of diarrhoea after weaning			Incidence ratio (after/before)† (95% confidence interval)
	Increased	Decreased	Same	
2-15	11	4	3	1.32 (0.60 to 2.89)
16-19	23	6	8	2.55 (1.48 to 4.40)
20-23	22	17	13	1.31 (0.83 to 2.07)
24-35	17	17	21	1.13 (0.72 to 1.77)
All ages	73	44	45	1.45 (1.12 to 1.88)

*Number of initiated episodes per 100 days at risk.
†Relative risk of diarrhoea in weaned children.

before the duration increased in 37 children, decreased in 20, and was unchanged in two. On average the duration increased by a factor of 1.70; this increase was marginally significant (0.99 to 2.91).

CHILD MORTALITY IN RELATION TO BREAST FEEDING

A total of 691 children between 12 and 35 months of age were followed for 840 child years, during which 48 deaths were recorded. Weaned children had a 2.6 (1.1 to 6.2) times higher mortality than breast fed children. This excess mortality was independent of the age at weaning ($P = 0.70$, likelihood ratio test). Furthermore, there was no significant difference in this age range between the excess mortality 0-180 days and more than 180 days after weaning ($P = 0.37$, likelihood ratio test). The causes of death were the same in breast fed and weaned children.

Data on ethnic group and maternal age and education were available for 571 of the 691 children. These variables were included in a multivariate model. The effect of the mother's age was not significant and was excluded from the reduced model (table IV). The relative mortality for weaned children was 3.5 (1.4 to 8.3, $P = 0.005$) after adjustment for the confounding effects of maternal education and ethnic group.

TABLE IV—Multivariate analysis of risk of death in 571 children aged 12-35 months by mode of feeding, ethnic group, and maternal education (Cox's proportional hazards regression analysis)

Covariate	Length of follow up (child years)	No of deaths	Relative mortality (95% confidence interval)*
Feeding mode:			
Breast fed	284	15	1.0
Weaned	425	29	3.5 (1.4 to 8.3)
Ethnic group:			
Other	591	33	1.0
Balante	118	11	1.8 (0.9 to 3.6)
Maternal education:			
None	340	24	1.0
1-5 Years in school	238	16	0.8 (0.4 to 1.6)
6-12 Years in school	131	4	0.3 (0.1 to 1.0)

*Exp (β), β is regression coefficient in multivariate analysis.

Discussion

The incidence of diarrhoea, eight episodes per child per year, was high compared with the median estimate of 4.9 (range 1.6 to 9.9) episodes per child per year in sub-Saharan Africa.¹⁶ The high morbidity from diarrhoeal diseases in Bandim II, a crowded semiurban area, is in line with the previously reported high mortality from diarrhoea.¹³ A peak morbidity in children aged 6-11 months, slowly decreasing, has been found by other workers.¹⁶

The prolonged breast feeding (a quarter of all children at 27 months) allowed us to compare partial breast feeding with no breast feeding in the age range 12-35 months. Apart from the remarkably higher incidence of diarrhoea in weaned children the clear decline in the rates of diarrhoea in breast fed children in the second year of life was also surprising since the older children were breast fed irregularly and their main diet was as for adults.

Weaning is a complex social and cultural process, and our observations could be confounded by several factors. One way of dealing with this would be to search for possible confounders and adjust for these in the analysis. Even doing so, however, would have some problems since residual confounding caused by factors of which we have little knowledge could have a major impact on the results. Instead, we conducted the paired analysis in which the incidence and duration of diarrhoea one month before weaning were compared with the incidence and duration one month after weaning. This analysis, in which each child served as

its own control, confirmed that both incidence and duration of diarrhoea increased after weaning, independent of the child's age. There is thus good evidence to suggest that the association is causal.

ADVANTAGES AND DISADVANTAGES OF PROLONGED BREAST FEEDING

The main advantage of prolonged breast feeding is probably its protective effect against infectious diseases, including diarrhoea. This anti-infective property of prolonged breast feeding is supported by evidence that the protective components of human milk may increase in concentration at the end of breast feeding.^{17,18} In addition, child care and hygienic practices may be improved by the frequent contact between a lactating mother and her child.

Several studies have associated prolonged breast feeding with malnutrition.⁹⁻¹² Table II, which presents the data cross sectionally, shows a similar association. The longitudinal analysis (table I), however, suggests that mothers who have malnourished children (measured before weaning) lactate for a longer time than mothers with better nourished children. Furthermore, the paired analysis showed no change in nutritional status after weaning. Hence, the high prevalence of low weight in children who have been breast fed for a long time is explained by a selection, as suggested by others.^{19,20}

In our study prolonged breast feeding was important not only for morbidity but also for child survival. Despite the selection of better nourished children for the weaned group, there was a 2.6 times higher mortality (rising to 3.5 after adjustment for confounders) in weaned children than in breast fed children. Because of the small number of deaths in the children for whom we had information on weight for age the confounding effect of nutritional state could not be estimated. The excess mortality associated with weaning would probably be even larger if we could adjust for the selection of well nourished children in the weaned group.

Prolonged breast feeding is a controversial issue. Should priority be given to energy intake or to the protective properties of breast feeding? The study from Ghana suggested that breast fed children who eat well may be weaned at about 18 months without adverse effects on their health.¹¹ Feachem and Koblinsky concluded that there was no protective effect of breast feeding on diarrhoea above 1 year of age.² But data on morbidity associated with prolonged breast feeding in sub-Saharan Africa are scarce. In contrast with Feachem and Koblinsky we observed a clear increase in the incidence and duration of diarrhoea after weaning in 1 and 2 year old children. There was also significantly improved survival of breast fed children. These findings are in line with the lower mortality in breast fed children which has been observed in malnourished Bangladeshi children.⁶ We could not detect any negative impact of prolonged lactation on nutritional state. Rather, malnourished children were breast fed for a long time, which may be essential to keep them alive.

CONCLUSIONS

We conclude that the benefits of maternal milk and breast feeding are not restricted to infancy. Though children who are breast fed in their second and third year of life may have a lower energy intake than the weaned ones, the benefits in terms of lower morbidity are more important for child development and survival, in particular in places with high morbidity from diarrhoea and high mortality in childhood. Weaned children constitute a risk group in need of special attention, and there is little evidence to discourage breast feeding in the second and third years of life in

Clinical implications

- The benefits of human milk in infancy are well recognised
- Several studies, however, have associated breast feeding after 1 year of age with reduced energy intake and malnutrition
- The present study shows that children breast fed after infancy have lower morbidity from diarrhoea and a better survival than weaned children
- The association between prolonged breast feeding and malnutrition was explained by a selection: children with low weight were breast fed longer than better nourished children
- In developing countries breast feeding should be encouraged not only among infants but also in young children above 1 year

cultures in which prolonged breast feeding is a natural practice.

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