Prolonged breast-feeding: no association with increased risk of clinical malnutrition in young children in Burkina Faso

S. Cousens,[1] B. Nacro,[2] V. Curtis,[1] B. Kanki,[3] F. Tall,[2] E. Traore,[4] I. Diallo,[3] & T. Mertens[1]

Reported are our findings from a case–control study of the association between prolonged breast-feeding and clinical malnutrition in an urban setting in West Africa. The cases were children aged 12–36 months who had been hospitalized with a diagnosis of clinical malnutrition. Children of a similar age who lived in neighbouring courtyards were recruited as controls. For 152 case–control pairs in which both children were receiving solid foods, non-breast-feeding was associated with an increased risk of clinical malnutrition (crude odds ratio = 2.37; 95% confidence interval = 1.24, 4.55). This association remained statistically significant after controlling for various potentially confounding variables (P = 0.03).

Our findings suggest that either prolonged breast-feeding may offer substantial protection against clinical malnutrition in the study population or malnutrition leads mothers to stop breast-feeding. These results are inconsistent with those of a number of workers who have reported that prolonged breast-feeding is associated with an increased risk of malnutrition. This inconsistency might have arisen because of differences in the definition of malnutrition used or because of variations in the quantity and quality of weaning foods available in different settings. We found no evidence to support the hypothesis that prolonged breast-feeding may be detrimental to children.

Introduction

A number of studies carried out in Africa, South America and Asia have reported an association between prolonged breast-feeding (>12 months of age) and an increased risk of "malnutrition" (often measured anthropometrically) (*1–4*); other studies have, however, observed no such association between prolonged breast-feeding and nutritional status (*5*).

It is generally agreed that beyond about 6 months of age breast milk alone is insufficient to maintain normal infant growth (*6*). When breast-feeding is continued beyond this age and supplementation is insufficient or absent, malnutrition may result. When this occurs there is a causal link between inadequate supplementation and malnutrition. Such a link is uncontroversial and WHO guidelines recommend that in order to meet their nutritional requirements nearly all children aged >6 months should be receiving complementary foods in addition to breast milk.[a] These guidelines also recommend that children should be breast-fed for at least 1 year, and preferably up to 2 years of age or more. However, it has been suggested that prolonged breast-feeding may adversely affect a child's nutritional status, even when adequate supplementary foods are

[1] Maternal and Child Epidemiology Unit, Department of Epidemiology and Population Sciences, London School of Hygiene and Tropical Medicine, Keppel Street, London WC1E 7HT, England. Requests for reprints should be sent to Mr Cousens at this address.

[2] Service de Pédiatrie, Hôpital National Sanou Souro, Bobo-Dioulasso, Burkina Faso.

[3] Projet Diarrhées, Centre Muraz, Bobo-Dioulasso, Burkina Faso.

[4] Ministère de la Santé, de l'Action Sociale et de la Famille, Bobo-Dioulasso, Burkina Faso.

Reprint No. **5433**

[a] *Indicators for assessing breast-feeding practices: report of an informal meeting, 11–12 June 1991, Geneva, Switzerland.* Unpublished document WHO/CDD/SER/91.14, 1991.

provided, by affecting the child's acceptance of these supplements (*1*) or by disturbing the regulation of appetite (*7*). The suggestion that breast-feeding may be detrimental to the child has provoked strong and sometimes hostile responses (*8, 9*). Because most of the studies reporting an association between prolonged breast-feeding and malnutrition have been observational, with only one investigation including a small, non-randomized element of intervention (*1*), interpreting their findings is difficult. The observed associations may, for example, have arisen through confounding, those mothers with the least resources for supplementing their children's diet continuing to breast-feed for longer, or through "reverse causality", i.e., mothers weaning undernourished children for longer than well-nourished children. We report here our findings from a case–control study conducted in an urban setting in Burkina Faso, where breast-feeding of children beyond 12 months of age is the norm and where malnutrition is reported to be the leading cause of death among hospitalized children aged 1–4 years.[b]

Materials and methods

From 15 January 1990 to 31 March 1991 all children aged 0–36 months who were resident in Bobo-Dioulasso and who had been admitted to the paediatric department of Sanou Souro Hospital were recruited into a study of risk factors for hospitalization with common childhood diseases. At admission all children were examined by a doctor and weighed and measured. An effort was then made to visit all children at home after they had been discharged. Mothers were interviewed by a female fieldworker and data were collected on the following: feeding practices prior to the child's illness; hygiene behaviours; and socioeconomic status. Mothers were asked whether their children were breast-feeding (yes/no), receiving other milk (powdered, cow's, etc., yes/no), "bouillie"[c] (yes/no), and eating "plat familial"[d] (yes/no).

In this population nearly all children are initially predominantly breast-fed (perhaps with other liquids but without non-human milk or food-based fluids).[e] The majority of children are introduced to bouillie when they are aged 3–9 months and to solid foods when they are aged 6–12 months. At 12 months of age >90% of the children are still being breast-fed and weaning is usually completed during the second year of life. By 24 months of age about three-quarters of the children have been fully weaned. The use of baby bottles to give milk or bouillie is uncommon in the study population.

For each child recruited at the hospital, a child of similar age who lived in a neighbouring courtyard was enrolled as a control. A similar interview was conducted with the mothers of the controls and the control child was also weighed and measured. The fieldworkers, who had received basic medical training and were able to recognize the clinical signs of malnutrition (hair and skin changes, oedema, and extreme wasting), were also asked to assess the control child's nutritional status (malnourished, yes/no).

Anthropometry

All the children were measured lying down, using a measuring board, to the nearest cm and were weighed to the nearest 100 g. Hospitalized children were weighed in a balance. The neighbourhood controls were weighed using a 25-kg suspended spring scale.[f] The ages of the children were calculated by subtracting the child's date of birth from the date on which the measurements were taken. Anthropometric indices were then calculated using the Epi Info Version 5 software package.

Definition of cases and controls

For the purposes of the analyses the two groups of children defined below were identified.

Cases of clinical malnutrition. These consisted of hospitalized children aged 12–36 months who were diagnosed by the examining medical personnel to be suffering from clinical malnutrition (kwashiorkor, marasmic kwashiorkor, or marasmus). Diagnosis of marasmus was based on the presence of severe wasting; kwashiorkor on the presence of oedema with or without skin or hair changes; and marasmic kwashiorkor on a combination of severe wasting and oedema.

Neighbourhood controls. Such children were neighbours of cases of clinical malnutrition as defined above, aged ± 6 months of the age of the case, and not hospitalized at the time of recruitment.

[b] *Plan Quinquennal de Développement Sanitaire du Houet 1991–1995.* Bobo-Dioulasso, Direction Provinciale de la Santé du Houet, 1991.

[c] A porridge or gruel based on millet or maize flour, which is universally used in Burkina Faso as a weaning food.

[d] The food eaten by the rest of the family and which is usually based on *tô*, a solid porridge made from millet or maize flour, or rice, served with a sauce that may or may not contain groundnuts, meat, or fish.

[e] See footnote *a*, p. 713.

[f] CMS Weighing Equipment Ltd, London, England.

The data were first double-entered onto and cleaned on microcomputers in Bobo-Dioulasso and then analysed using the Epi Info Version 5 and EGRET software packages. Conditional logistic regression, retaining the individual matching between cases and their neighbourhood controls (*10*), was used to estimate the odds ratio for the association between prolonged breast-feeding and hospitalization with clinical malnutrition.

Results

From 15 January 1990 to 31 March 1991, 273 children aged 12–36 months who were resident in Bobo-Dioulasso were hospitalized with a diagnosis of clinical malnutrition as defined above. Of these, 204 (75%) were classified as cases of marasmus, 28 (10%) as kwashiorkor, and 40 (15%) as marasmic kwashiorkor; the classification of one child was not recorded. A total of 86 children (32%) died in the hospital. Mortality was highest among the cases of kwashiorkor (14 deaths, 50%), while that among children with marasmus and those with marasmic kwashiorkor was similar (about 30% in both groups). The anthropometric status of all three groups was poor. The mean weight-for-age *z*-score among marasmic children was −4.2 (standard deviation (SD), 0.79), among children with kwashiorkor, −2.75 (SD, 1.01), and among children with marasmic kwashiorkor, −3.80 (SD, 0.75).

Only six (2%) of the cases of clinical malnutrition were diagnosed to have malnutrition alone; a further 110 (40%) had a principal diagnosis of malnutrition in association with other secondary diagnoses. For the remaining 157 children (58%), malnutrition was a secondary diagnosis. The following symptoms were commonly associated with clinical malnutrition: diarrhoea/dysentery (213 children, 78%), vomiting (126, 46%), fever (89, 33%), hepatomegaly (68, 25%), dyspnoea (39, 14%), and lymphadenopathy (37, 14%).

The distribution of the 273 cases of clinical malnutrition by age was as follows: 95 (35%) were aged 12–17 months; 105 (38%) were aged 18–23 months; 49 (18%) were aged 24–29 months; and 24 (9%) were aged 30–36 months. A total of 144 (53%) cases were male. Of the 273 cases, 196 (72%) were followed up at home. Lack of follow-up was strongly linked with mortality. Of the children who left the hospital alive, 81% were followed up at home, compared with only 51% of the children who died in the hospital. Of the 77 children who were not followed up at home, 30 died before contact was established with the family, 9 left the hospital without being discharged, 7 had mothers who refused to take part (3 deaths), 6 could not be traced, and 15 were discharged alive without contact being established with the family. The remaining 10 children were not followed up at home because there were, temporarily, insufficient field staff to complete the visits.

Of the cases followed up at home, 23 had been paired with neighbourhood controls aged <12 months. Data for these case–control pairs were excluded from the subsequent analyses, which are therefore based on 173 pairs of cases and neighbourhood-matched controls, all aged 12–36 months.

The mean weight-for-age *z*-score of the neighbourhood controls was −1.28 (SD, 1.02), with 24% of controls having scores >2 SD below the mean of the reference population, and six children (3%) having scores >3 SD below the mean. The mean height-for-age *z*-score for the controls was −1.42 (SD, 1.35), with 29% having scores >2 SD below the mean of the reference population, and 21 (12%) children having scores >3 SD below the mean. The mean weight-for-height *z*-score of the controls was −0.57 (SD, 1.07), with 8% of children having scores >2 SD below the mean of the reference population and one child having a score >3 SD below the mean. One child in the control group was recorded as malnourished by the fieldworker.

The distribution of the cases and controls according to age, sex, and some socioeconomic indicators is shown in Table 1. The age distribution of cases and controls was similar up to the age of 20 months. For the age range 21–23 months there were more cases than controls (45 versus 19), while for the age range 24–36 months there were more controls than cases (70 versus 47). More cases than controls were male (51% versus 46%). The indicators of socioeconomic status suggest that, despite the neighbourhood matching, cases came from somewhat poorer households than controls; for example, the families of cases were less likely than those of controls to own a radio (42% versus 52%) or television (16% versus 21%). Cases were also more likely than controls to have mothers who had received no formal education (71% versus 63%).

A smaller proportion of cases than controls had vaccination cards (75% versus 84%). The mothers of cases were more likely than those of controls to report using the traditional practices of "lavements" (anal purging, 88% versus 71%) and "gavages" (force-feeding with medicinal infusions, 49% versus 29%); these findings may simply indicate that the cases were receiving treatment for illness. Cases were less likely than controls to have a younger brother or sister (5% versus 12%) but more likely to have a mother who was pregnant (27% versus 14%). Case–control status was strongly associated with a history of measles in the previous 6 months (20% of cases versus 8% of controls).

Table 1: **Distribution of the 173 cases of clinical malnutrition aged ≥12 months and their neighbourhood controls, according to age, sex, and socioeconomic and demographic factors**

	No. of cases	No. of controls
Age (months)		
12–14	21 (12)[a]	23 (13)
15–17	24 (14)	26 (15)
18–20	36 (21)	35 (20)
21–23	45 (26)	19 (11)
24–29	30 (17)	46 (27)
30–36	17 (10)	24 (14)
Sex		
Male	88 (51)	80 (46)
Female	85 (49)	93 (54)
Father's employment		
Regular wage	104 (60)	110 (64)
Irregular wage	44 (26)	46 (27)
Unwaged	24 (14)	16 (9)
Mother's education		
None	122 (71)	109 (63)
Primary school	29 (22)	48 (28)
Secondary school	12 (7)	16 (9)
Possessed a radio		
Yes	71 (42)	90 (52)
No	99 (58)	82 (48)
Possessed a TV		
Yes	27 (16)	37 (21)
No	146 (84)	136 (79)
"Lavements" practised[b]		
No	21 (12)	50 (29)
Sometimes	96 (55)	95 (55)
Everyday	56 (32)	28 (16)
"Gavages" practised[c]		
No	89 (51)	123 (71)
Sometimes	58 (34)	35 (20)
Everyday	26 (15)	15 (9)
Measles in last 6 months		
No	139 (80)	159 (92)
Yes	34 (20)	14 (8)
Possessed a vaccination card		
Yes	129 (75)	145 (84)
No	44 (25)	28 (16)
Attendance at health education sessions		
None	54 (32)	47 (27)
1–6	80 (47)	80 (45)
≥7	36 (21)	45 (26)
Mother pregnant		
Yes	46 (27)	25 (14)
No	125 (73)	147 (86)
Index child has younger sibling		
Yes	9 (5)	20 (12)
No	162 (95)	152 (88)
No. of co-wives		
None	113 (65)	120 (71)
1	35 (21)	46 (27)
2	19 (11)	4 (2)
3	3 (2)	0 (0)

[a] Figures in parentheses are percentages.
[b] Anal purging.
[c] Force-feeding with medicinal infusions.

Based on the premise that children who were being given solid foods were more likely to be receiving varied and adequate supplements than those not receiving solid foods, we grouped the cases and controls into the following feeding categories:

— solid foods (plat familial), with or without porridge (bouillie), but not breast milk;
— solid foods, with or without porridge, and breast milk; and
— no solid foods.

The distribution of cases and controls according to these categories is shown in Table 2. The proportion of cases who received no solid foods was greater than that of controls, although the difference was not statistically significant ($P = 0.07$). Of the 18 cases who did not receive solids, three were receiving breast milk only, one was receiving breast milk and other milk, six were receiving breast milk together with porridge, one was receiving breast milk with other milk and porridge, and seven were receiving porridge only. The following data apply to the three controls who were not receiving solid foods: a boy aged 12 months (weight, 8.5 kg; length, 69 cm), who was predominantly breast-fed; a girl aged 13 months (weight, 9.0 kg; length, 78 cm), who was receiving breast milk and porridge; and a boy aged 24 months (weight, 13.6 kg; length, 87 cm) who was predominantly breast-fed. None of these three controls was classified as malnourished by the fieldworker; also their weights relative to their heights do not suggest that any of these children were marasmic.

Among children who were eating solid foods, receipt of breast milk was associated with a reduced rate of malnutrition (odds ratio (OR) = 0.47; 95% confidence interval (CI), 0.25, 0.87; $P = 0.02$). In order to investigate further the hypothesis that prolonged breast-feeding, even when supplemented by solid foods (as a proxy for adequate supplementation), may increase a child's risk of malnutrition, we analysed data for the 152 case–control pairs in which both children were receiving solid foods.

Table 2: **Distribution of the 173 cases of clinical malnutrition and their neighbourhood controls, aged 12–36 months, according to feeding mode**

	No. of cases	No. of controls	Odds ratio[a]
Solid foods without breast milk	99 (57)[b]	87 (50)	1.0 —
Solid foods with breast milk	56 (32)	83 (48)	0.47; *0.25, 0.87*[c]
No solid foods	18 (10)	3 (2)	3.54; *0.91, 13.7*[c]

[a] Estimated using conditional logistic regression, controlling for age group (12–14, 15–17, 18–20, 21–23, and 24–36 months).
[b] Figures in parentheses are percentages.
[c] Figures in italics are 95% confidence intervals.

Table 3 shows the distribution of these cases and controls with regard to other types of food. More controls than cases were receiving breast milk, and the vast majority of children in both groups were receiving porridge. Slightly more cases than controls were being given milk other than breast milk. When age and supplementation with porridge or other milk are taken into account, it appears that children not receiving breast milk suffered clinical malnutrition about twice as frequently as children who were (OR = 2.37; 95% CI = 1.24, 4.55; $P = 0.01$). The association between the absence of breast-feeding and the occurrence of malnutrition appeared to vary with age (likelihood ratio statistic = 3.61; 1 degree of freedom; $P = 0.06$). For children aged 12–23 months the estimated odds ratio for non-breast-feeding was 3.23 (95% CI = 1.52, 6.83; $P = 0.002$) and for children aged 24–36 months it was 0.83 (95% CI = 0.24, 2.89; $P = 0.77$). Relatively few children aged 24–36 months were still breast-feeding (7 cases (15%) and 8 controls (12%)).

Table 3: **Distribution of the 152 cases of clinical malnutrition aged 12–36 months who were receiving solid foods, and their neighbourhood controls, with regard to other types of food received**

	No. of cases	No. of controls	Odds ratio[a]
Breast milk			
Yes	53 (35)[b]	70 (46)	1.0 —
No	99 (65)	82 (54)	2.37; *1.24, 4.55*[c]
Porridge			
Yes	148 (97)	144 (95)	1.0 —
No	4 (3)	8 (5)	0.22; *0.05, 1.22*
Other milk			
Yes	36 (24)	28 (18)	1.0 —
No	115 (76)	124 (82)	0.90; *0.49, 1.65*

[a] Estimated using a conditional logistic regression model containing terms for breast milk (yes/no), porridge (yes/no), other milk (yes/no), and age (12–14, 15–17, 18–20, 21–23, 24–36 months).
[b] Figures in parentheses are percentages.
[c] Figures in italics are the 95% confidence interval.

In order to exclude, as far as possible, confounding as an explanation for the observed association between non-breast-feeding and increased rates of malnutrition, we developed a conditional logistic regression model that included confounding variables. Initially, potential confounding variables were entered one at a time into a basic model containing terms for breast-feeding, porridge, other milks, and age; the effect on the estimated odds ratio for non-breast-feeding of entering the potential confounder was noted. Those variables that produced a change in the odds ratio of 0.14 (equivalent to approximately a 10% change in the estimate of the magnitude of the association between non-breast-feeding and clinical malnutrition) or more when entered alone were then entered into the model in a stepwise fashion. If their inclusion altered the current estimate of the odds ratio for non-breast-feeding by ≥0.14, they were retained in the model; otherwise they were dropped and the next variable was entered.

Table 4 shows the results for the final model that was developed. After adjusting for confounding variables, breast-feeding status remained associated with case–control status ($P = 0.03$), with children not receiving breast-milk having an approximately three-fold higher risk of malnutrition than those receiving it. A term representing an interaction between breast-feeding status and age range (12–23 months, 24–36 months) was then fitted to the final model (Table 4). This term did not approach statistical significance, i.e., there was no evidence of an interaction.

Discussion

For the study children, among whom chronic undernutrition, as measured by height-for-age z-scores, was widespread, we found no evidence that continuing to breast-feed beyond 12 months of age while giving solid food supplements was associated with an increased risk of clinical malnutrition. In contrast, the combination of prolonged breast-feeding and supplementation with solid foods was associated with a 70% reduction in the rate of clinical malnutrition (95% CI = 13–89%). One possible explanation for this association is that continuing to breast-feed beyond 12 months while offering solid food supplements protected children against clinical malnutrition. This could have arisen as discussed below.

Table 4: **Results of a conditional logistic regression analysis of the association between breast-feeding and malnutrition among the 152 cases of clinical malnutrition aged 12–36 months and their neighbourhood controls**

Age group (months)	Breast–feeding	Odds ratio[a]
Whole population		
12–36	Yes	1.0 —
	No	3.27; *1.15, 9.32*[b]
With interaction term		
12–23	Yes	1.0 —
	No	3.81; *1.22, 11.9*
24–36	Yes	1.0 —
	No	1.74; *0.24, 12.4*

Likelihood ratio statistic for interaction between breast-feeding and age: 0.52, 1 df, $P = 0.47$

[a] The following variables were retained in the conditional logistic regression model as confounders:

— age: 12–14, 15–17, 18–20, 21–23, 24–29, 30–36 months;

— employment status of father: regular wage, irregular wage, unwaged;

— possession of a radio : yes, no;

— latrine in the courtyard: yes, no;

— number of co-wives: 0, 1, 2 or 3;

— number of children of the same mother: 1, 2 or 3, ≥4;

— mother pregnant: yes, no;

— "lavements" used: no, sometimes, everyday;

— "gavages" used: no, sometimes, everyday; and

— history of measles: yes, no.

[b] Figures in italics are the 95% confidence intervals.

• First, the nutritional content of breast milk may help to protect children, especially in settings where weaning foods are scarce and/or of poor quality (*11*). Few data are available on the contribution of breast milk to the nutrition of children aged ≥ 12 months. For a small sample of children aged 15–23 months in Indonesia, Blankhart calculated that those who were breast-fed received 17–54% of their total caloric intake and 13–54% of their total protein intake from breast milk (*12*). Brakohiapa et al. estimated that breast-fed Ghanaian children aged ≥12 months obtained about 25% of their energy requirements and 50% of their protein requirements from breast milk (*1*). Prentice & Paul, reporting on rural Gambian children aged 12–18 months, found that breast milk contributed substantially to their daily energy intakes and estimated that replacing it with local weaning foods would lead to a 50% reduction in intake of fat (*13*). The relative importance of breast milk to a child's diet clearly depends, to some extent, on what other sources of nutrition are available. These findings suggest, however, that in some communities the nutritional content of breast milk may play an important role in protecting a child against malnutrition well into the second year of life.

• Second, the immunological protection offered by breast milk may prevent children from succumbing to infections that could have a deleterious nutritional effect. Prentice, in a review of the potential benefits and disadvantages of breast-feeding in older children, reported that the importance of the antimicrobial factors in breast milk to children aged ≥12 months has not been studied in enough detail to draw any firm conclusions (*9*). In more than half of the cases in our study, malnutrition was a secondary diagnosis, and almost all the children with a primary diagnosis of malnutrition had associated pathologies. These data are consistent with, but do not prove, the hypothesis that the immunological protection offered by breast milk may be important beyond 12 months of age.

• Third, children who fall ill may continue to accept breast milk but refuse other foods. Breast-feeding might thus reduce the negative impact of illness on nutritional status. For example, in Bangladesh, Hoyle et al. found that children aged 6–35 months who had been hospitalized with diarrhoea had similar intakes of breast milk as healthy controls but that their weaning food intakes were lower (*14*).

The association that we have reported between prolonged breast-feeding and reduced risk of clinical malnutrition must, however, be interpreted with caution. Our study was not designed specifically to investigate this association and there are, therefore, many shortcomings in our data. For example, as far as supplements are concerned, we collected information only on a few broad categories of foods but not on the quantities offered. Also, we equated the provision of solid food supplements with "adequate supplementation", based more on the supposition that a child who was not receiving sufficient supplements rather than on any evidence that the diet of children receiving any solid foods was unlikely to be receiving solid foods really was adequate. The mothers of cases were asked about their child's diet prior to the onset of illness; therefore if mothers considered that their child had been ill for several months, their replies could have referred to feeding practices at a younger age than the responses of the mothers of controls. Such data deficiencies are, however, unlikely to account for the apparent protective effect of prolonged breast-feeding against malnutrition.

One alternative explanation for the observed association is that clinical malnutrition (or the morbidity preceding clinical malnutrition) leads mothers to stop breast-feeding, i.e., malnutrition causes non-

breast-feeding rather than the reverse. We asked mothers who were not breast-feeding the age of their children when they had stopped. The data obtained showed substantial "heaping" at 12, 18, and 24 months of age and should, therefore, be treated with caution. By subtracting the age at which a child stopped breast-feeding from the child's current age, we may, nevertheless, obtain a crude estimate of how long the child had been weaned. On the basis of these data we estimated that 57% of weaned cases had been weaned in the 3 months prior to the interview, compared with 30% of weaned controls ($P = 0.0005$). A common reason for stopping breast-feeding in the study population was that the mother had become pregnant again. If the cases and controls of such mothers are excluded from the analyses, 67% of weaned cases had been weaned in the previous 3 months compared with 44% of controls ($P = 0.04$). The observation that cases tended to have been weaned more recently than controls is consistent with the hypothesis that some mothers stop breast-feeding children who fall ill or fail to thrive; however, it is also consistent with the hypothesis that a proportion of children in the study population had very marginal nutritional status, and that the removal of an important source of nutrition and immunological protection (breast milk) can lead to the onset of clinical malnutrition.

The association we have observed may have arisen because of confounding. Mothers who continued to breast-feed may, for example, have offered their children larger quantities of other foods or foods of better quality. Alternatively, mothers who breast-fed longer may have been more "caring" in the sense that they made greater efforts to protect their child from illness, resulting in happier children with better appetites. It is often held that in developing countries breast-feeding is commoner and more prolonged among the most socioeconomically disadvantaged families. If this is the case, it is unlikely that mothers who breast-feed the longest will be able to offer their children better or larger quantities of supplements than mothers who stop breast-feeding earlier. An analysis of our cases and controls aged ≥24 months, among whom breast-feeding was relatively rare, reveals that those children who were still being breast-fed came from households that were less likely to have a radio (29% versus 44%), a father with a regular income (47% versus 60%), and a mother who had attended school (13% versus 34%). It is probably unlikely in this population that mothers who breast-feed longest are also able to offer their children a better supplementary diet than those who stop breast-feeding earlier.

Selection bias could account for the observed association if mothers were more likely to bring non-breast-fed children to the hospital rather than breast-fed children; if non-breast-fed children were more likely to be admitted than breast-fed children; or if malnourished, breast-fed children were more likely to die (and thus less likely to be followed up) than malnourished, non-breast-fed children. A total of 84% of controls had vaccination cards compared with 74% of cases ($P = 0.03$). This indicates that a very high proportion of the controls used government health facilities on at least some occasions and suggests that most, if not all, of them would have been brought to the hospital if clinically malnourished. There is no barrier to the admission of breast-fed children in this setting since mothers usually stay in the hospital to look after their child. For the cases that were followed up, mortality among the breast-fed (24%) was similar to that among the non-breast-fed (26%). It seems unlikely that the choice of control group substantially biased the estimate of the odds ratio obtained, and selection bias seems a less likely explanation for the observed association than reverse causality, confounding, or a protective effect of breast-feeding.

A number of workers have reported an increased prevalence of "malnutrition", based on anthropometric measures, associated with breast-feeding beyond 12 months. For example, in Ghana, Brakohiapa et al. observed that among children aged 12–24 months breast-feeding was associated with a twofold increase in the prevalence of malnutrition (weight-for-length ≤80% of the NCHS reference value) (*1*); socioeconomic status was not controlled for in this analysis. In Botswana, Michaelsen reported that among children aged ≥18 months breast-feeding was associated with an increased prevalence of malnutrition (defined as a weight-for-age >2 SD below the NCHS reference value); again, potential confounding variables were not controlled in this analysis (*7*). Ng'andu & Watts observed that among children aged 12–23 months in Zambia breast-feeding was associated with lower height-for-age (*15*). This analysis did control for a number of potential confounding variables, as did the study by Victora et al., who observed that in Brazil prolonged breast-feeding was associated with an increased prevalence of low weight-for-height (weight-for-height >1 SD below the median of the reference population) (*4*). On the other hand, Briend et al. in Bangladesh observed a statistically significant difference in arm circumference among children aged 12–36 months between those who were breast-fed and those who were not (*16*); the magnitude of this difference was, however, small (79.5% of the median versus 79.0%).

Our findings appear to be inconsistent with most of those described above. Victora et al. have proposed that one reason for the apparent inconsisten-

cies between the results of studies of prolonged breast-feeding and nutritional status is that the effect of breast-feeding on growth may be modified by socioeconomic status, and in areas where alternative foods to breast milk are unsafe, low in nutrients, or in short supply, breast-fed children may grow faster than those who are non-breast-fed. If, on the other hand, alternative foods are plentiful and safe, children who are breast-fed beyond 12 months of age may receive fewer nutrients than children who have been weaned (*11*). Bobo-Dioulasso is probably best characterized as a setting in which alternative foods are often low in nutrients, sometimes scarce and, on occasions, probably unsafe.

An important difference between our study and those that have reported a link between prolonged breast-feeding and low anthropometric status is the outcome measure used. The 273 cases of malnutrition that we identified were all examined by medical personnel in a hospital setting and were considered to show clinical signs of malnutrition. In the study in Ghana a cut-off point of 90% of the median weight-for-age was used to define cases of malnutrition (*1*). A total of 63 out of 202 children (31%) were "malnourished" according to this criterion, but the authors supplied no further details of the weights-for-age distribution of these children. A total of 91% of our cases had weight-for-age <70% of the median of the reference population. In the study in Brazil a cut-off point of 1 SD below the median weight-for-height of the reference population was used; only 6% of cases thus identified fell >2 SDs below the median of the reference population (*4*). A total of 87% of our cases were ≥3 SDs below the median weight-for-height of the reference population, and 43% were ≥4 SDs below the median. Thus, the anthropometric status of our "cases of malnutrition" was much poorer than that of cases identified in Brazil or Ghana, for example. There is now quite a large body of evidence to suggest that, after the first 2–3 months of life, breast-fed children tend to gain weight more slowly than children fed formula milks. There is, however, no reason to believe that these growth rates are detrimental or represent the outcome of suboptimal dietary intake (*17*). This may apply also at older ages, breast-fed children growing more slowly (as observed in Brazil and Ghana, but with a lower risk of clinical malnutrition (as observed in Burkina Faso), than non-breast-fed children.

Few studies seem to have appeared that have examined the association between prolonged breast-feeding and the clinical signs of malnutrition. Our findings are consistent with those reported by Mahalanabis, who observed that among children in Bangladesh prolonged breast-feeding was associated with a reduced risk of xerophthalmia, and that this protective effect continued into the third year of life (*18*). This association remained statistically significant after controlling for a number of potentially confounding variables. On the other hand, Oomen et al. reported that prolonged breast-feeding was associated with clinical malnutrition in Indonesia (*3*). Rohde suggested that this finding might be explained by the continuation of breast-feeding in impoverished households that are unable to provide adequate alternative foods (*19*).

In summary, we have found no evidence to suggest that in Burkina Faso breast-feeding beyond 12 months of age, while solid food supplements are also offered, is associated with an increased risk of clinical malnutrition. Rather, prolonged breast-feeding in this setting may be associated with a substantial reduction in the risk of clinical malnutrition. We cannot, however, exclude that the observed association is due to reverse causality—mothers stopping breast-feeding of their sick/malnourished children.

Acknowledgements

The study was the result of a collaborative effort between the Ministry of Health, Burkina Faso (Paediatric Department, Bobo-Dioulasso), the London School of Hygiene and Tropical Medicine, England, Centre Muraz (Organisation de Coopération et de Coordination pour la Lutte contre les grandes Endémies), Burkina Faso, and University of Bordeaux II, France.

The study was supported primarily by the Science and Technology for Development Programme of the European Community (contract TS-2-M-0087, UK). We also thank the following for their financial contributions: UNICEF, Ouagadougou; the Ministry of Health, Burkina Faso; and the Overseas Development Administration of the United Kingdom. Special thanks are due to the teams of individuals at Direction de l'Education pour la Santé et l'Assainissement, Bobo-Dioulasso, the Paediatric Department, Sanou Souro Hospital, Bobo-Dioulasso, and the Biology Laboratory, Centre Muraz, Burkina Faso.

Finally, Dr A. Hill and Dr J. Martines are thanked for their helpful comments on earlier versions of this article.

Résumé

Allaitement maternel prolongé: pas d'association avec une augmentation du risque de malnutrition clinique chez le jeune enfant au Burkina Faso

Des études réalisées en Afrique, en Amérique du Sud et en Asie relèvent une association entre l'allaitement maternel prolongé et une augmentation du risque de malnutrition. Même s'il est large-

ment admis que le lait maternel seul ne suffit pas à assurer une croissance normale du nourrisson au-delà de l'âge de six mois environ, l'hypothèse avancée, selon laquelle l'allaitement maternel prolongé, même lorsqu'une alimentation complémentaire suffisante est offerte, pourrait nuire à l'état nutritionnel de l'enfant, a provoqué de vives réactions. Nous rapportons ici les résultats d'une étude cas-témoins de l'association entre l'allaitement maternel prolongé et la malnutrition clinique, réalisée au Burkina Faso (Afrique de l'Ouest), où l'allaitement maternel est fréquemment prolongé et où la malnutrition est la cause majeure de décès chez les enfants hospitalisés âgés de un à quatre ans.

Etaient considérés comme cas des enfants de 12 à 36 mois hospitalisés à Bobo-Dioulasso avec un diagnostic de malnutrition clinique. Pour chaque cas, on a pris comme témoin un enfant d'âge analogue, habitant dans une cour voisine. Les mères des cas et des témoins ont été interrogées sur l'alimentation de leur enfant, leurs habitudes en matière d'hygiène domestique et la situation socio-économique de la famille. Les enfants ont été pesés et mesurés.

Au total, 173 paires de cas-témoins âgés de 12 à 36 mois ont été recrutées. Un plus grand nombre de cas que de témoins ne recevaient aucune alimentation solide complémentaire (18 contre 3). L'étude étant axée sur l'association entre l'allaitement maternel prolongé en présence d'une alimentation complémentaire suffisante et la malnutrition clinique, ces 18 cas et 3 témoins ont été exclus des analyses ultérieures. Parmi les 152 paires dans lesquelles le cas comme le témoin recevaient une alimentation solide, l'absence d'allaitement au sein était associée à un risque accru de malnutrition clinique (odds ratio (OR) = 2,37, intervalle de confiance à 95%: 1,24–4,55). Cette association était légèrement renforcée (OR = 3,27) et restait statistiquement significative, après élimination de diverses variables confondantes potentielles ($P = 0,03$).

Nos observations indiquent que l'allaitement maternel prolongé peut offrir une protection notable contre la malnutrition clinique dans la population étudiée. Mais il se pourrait aussi que la malnutrition de l'enfant (ou la maladie précédant la malnutrition) incite la mère à arrêter de l'allaiter. Les biais de sélection et les facteurs confondants semblent des explications moins plausibles. Nos observations vont à l'encontre de celles d'un certain nombre d'auteurs qui rapportent que la prolongation de l'allaitement au sein est associée à un risque accru de malnutrition. Ce désaccord peut être dû à une différence de définition de la malnutrition, ou à une différence au niveau de la quantité et de la qualité des aliments de sevrage utilisés dans différents contextes. Nos résultats n'appuient aucunement l'hypothèse selon laquelle l'allaitement maternel prolongé, en présence d'une supplémentation appropriée, serait nuisible à l'enfant. Au contraire, ils tendent à montrer que cette pratique peut protéger l'enfant de la malnutrition clinique.

References

1. **Brakohiapa, L.A. et al.** Does prolonged breastfeeding adversely affect a child's nutritional status? *Lancet*, **2**: 416–418 (1988).
2. **Martorell, R. et al.** Characteristics and determinants of child nutritional status in Nepal. *American journal of clinical nutrition*, **39**: 74–86 (1984).
3. **Oomen, H.A.P.C. et al.** [Diet, health, and nutritional state of young children]. *Berita kementerian kesehatan Republik Indonesia*, **3**: 5 (1954) (in Indonesian) (cited by J.E. Rohde in ref. *19*).
4. **Victora, C.G. et al.** Is prolonged breast-feeding associated with malnutrition? *American journal of clinical nutrition*, **39**: 307–314 (1984).
5. **Seward, J.F. & Serdula, M.K.** Infant feeding and infant growth. *Pediatrics*, **74**: 728–762 (1984).
6. **Winikoff, B.** Weaning: nutrition, morbidity, and mortality consequences. In: Presten, S.H. *Biological and Social Aspects of Mortality and the Length of Life. Proceedings of a seminar at Fiuggi, Italy, 13–16 May 1980.* Liège, Ordina Editions, 1982, pp. 113–150.
7. **Michaelsen, K.F.** Value of prolonged breastfeeding. *Lancet*, **2**: 788–789 (1988).
8. **Rohde, J.E.** Breastfeeding beyond twelve months. *Lancet*, **2**: 1016 (1988).
9. **Prentice, A.** Breast feeding and the older infant. *Acta paediatrica Scandinavica* (suppl.) **374:** 78–88 (1991).
10. **Breslow, N.E. & Day, N.E.** *Statistical methods in cancer research, vol. 1: the analysis of case–control studies.* Lyon, International Agency for Research on Cancer, 1980, pp. 248–279.
11. **Victora, C.G. et al.** Prolonged breastfeeding and malnutrition: confounding and effect modification in a Brazilian cohort study. *Epidemiology*, **2**: 175–181 (1991).
12. **Blankhart, D.M.** Measured food intakes of young Indonesian children. *Journal of tropical pediatrics*, **8**: 18–21 (1962).
13. **Prentice, A. & Paul, A.A.** Contribution of breastmilk to nutrition during prolonged breast-feeding. In: Atkinson, S.A. et al., ed. *Human lactation 4: breastfeeding, nutrition, infection and infant growth in developed and emerging countries*, St. John's, ARTS Biomedical, 1990, pp. 87–102.
14. **Hoyle, B. et al.** Breast-feeding and food intake among children with acute diarrheal disease. *American journal of clinical nutrition*, **33**: 2365–2371 (1980).
15. **Ng'andu, N.H. & Watts, T.E.E.** Child growth and duration of breast feeding in urban Zambia. *Journal*

of epidemiology and community health, **44**: 281–285 (1990).
16. **Briend, A. et al.** Breast feeding, nutritional state, and child survival in rural Bangladesh. *British medical journal*, **296**: 879–882 (1988).
17. **Dewey, K.G. et al.** Adequacy of energy intake among breast-fed infants in the DARLING study: relationships to growth velocity, morbidity and activity levels. *Journal of pediatrics*, **119**: 538–547 (1991).
18. **Mahalanabis, D.** Breast feeding and vitamin A deficiency among children attending a diarrhoea treatment centre in Bangladesh: a case–control study. *British medical journal*, **303**: 493–496 (1991).
19. **Rohde, J.E.** Human milk in the second year. Nutritional and economic considerations for Indonesia. *Paediatrica Indonesesia*, **14**: 198–207 (1974).