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Mothers prolong breastfeeding of undernourished children in rural Senegal

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Background	Breastfeeding, when prolonged beyond infancy, is a risk factor for low nutritional status in most cross-sectional samples from less developed countries. Therefore, it has been suggested that prolonged breastfeeding impairs growth. To test whether, on the contrary, breastfeeding is prolonged because the child is already undernourished, nutritional status prior to weaning was compared according to age at weaning.
Methods	Precise dates of birth and weaning were collected weekly through continuous demographic surveillance in a rural area of Senegal. Weight and length at 9–10 months were measured during vaccination sessions (coverage: 78%) from 1989 to 1996. Eight infants weaned before 9 months were excluded, and the duration of breastfeeding of the remaining 4515 children was compared according to nutritional status at 9–10 months by survival analysis.
Results	Length-for-age during infancy was associated with duration of breastfeeding: the median duration was 25.0 months for z-scores <–2, 24.1 months for z-scores –2 to –1, 23.4 months for z-scores –1 to 0 and 22.7 months for z-scores >0 (P for trend <0.0001). Weight-for-length during infancy was also associated with duration of breastfeeding (P for trend <0.0001), though the differences among groups were smaller. The relationships remained at the same significance levels after adjustment for season of birth, mother's age, parity, height, occupation and education.
Conclusion	Duration of breastfeeding is not determined by characteristics of the mothers only. Women prolong breastfeeding for undernourished children and reduce the duration for well-nourished children, probably because they are aware of the mortality risk following weaning.

Keywords	Breastfeeding, childhood malnutrition, reverse causality, developing countries
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The relationship between prolonged breastfeeding and nutritional status of young children in developing countries has been subject to debate for the last 10 years. Many cross-sectional community studies have reported lower weight-for-age, height-for-age and weight-for-height among breastfed children compared to weaned children between the ages of 12 and 36 months.[1–7] A recent analysis of 19 national Demographic and Health Surveys showed that, in most countries, breastfed children aged 9–36 months were shorter and lighter than weaned children.[8] Only a few studies have described better nutritional status for breastfed children above 1 year of age.[9–11]

The commonly found negative relationship is often strong and cannot be explained merely by confounding by poverty.[1,7,8] This observation has lead some authors to consider that prolonged breastfeeding without adequate complementary feeding impairs growth and nutritional status, and thus to recommend weaning in case of malnutrition.[12] This suggestion is very dangerous because of the clear evidence of reduced risk of mortality associated with prolonged breastfeeding, especially among malnourished children.[4,6,10]

An alternative explanation for the observed negative relationship between breastfeeding and nutritional status might be that mothers breastfeed longer when their children are malnourished.[8,13,14] In this case, the low nutritional status would be the cause, rather than the consequence, of prolonged breastfeeding, and the implications for public health programmes

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would, of course, be totally different. There is, in fact, some evidence that mothers prolong breastfeeding selectively for malnourished children.[4,6,15–17]

The aim of this study was to test whether the nutritional status at 9–10 months was associated with age at weaning, which for 99% of the children in this area occurs after 12 months of age and for 50% after 24 months.[18] The study was conducted in a rural area of Senegal in West Africa, where a negative relationship between prolonged breastfeeding and nutritional status (weight-for-height and height-for-age) from 18 to 36 months of age has been described previously.[19]

Methods

Fieldwork

The Niakhar study area is a rural area in Central Senegal covering a population of 28 800. A detailed description of the study area has been published previously.[20] Information on births and weaning, here defined as the complete cessation of breastfeeding, has been collected weekly since 1987 through continuous demographic surveillance by home visits from field workers. Age at weaning was computed from dates at weaning and birth dates.

Data on the nutritional status of infants were collected monthly in the three dispensaries of the area, since all infants aged 9–10 months were called in for vaccination against measles and yellow fever. Written invitations were given to the children's parents 1 week before the sessions. The infants were weighed naked on Seca baby scales to the nearest 10 g, while recumbent length was measured on a locally made wooden board to the nearest mm. Mothers were weighed, while dressed, on an electronic Tefal scale to the nearest 100 g, and their height was measured without head cloth to the nearest mm.

Eligible infants were defined as those who had resided in the study area since birth, were still breastfed at the time of vaccination sessions, and were called in for vaccination between December 1989 and June 1996. All eligible infants who attended the vaccination sessions and had complete anthropometric measurements were included in the study.

The surveillance data, extracted from the database, included the period from 1 December 1989 to 30 June 1996. All deaths, outmigrations and weaning events of infants included (and of eligible infants not included) were used, together with socio-environmental variables such as religion and birth rank of the child, and the age, educational level and occupation of parents. Unreliable ages at weaning (<12 months, >36 months) and missing dates of weaning of children aged over 30 months old were checked.

Analysis

Age at weaning was estimated by survival analysis (Kaplan–Meier). Infants who were lost to follow-up before weaning by either death or outmigration, and those who were still not weaned at the end of the follow-up (i.e. those who were right-censored), were thus used in the analysis until the date of loss to follow-up or of end of follow-up. Infants included in the analysis were compared to the other eligible infants who were not included in terms of socio-environmental variables and age at weaning.

Age at weaning of included infants was then analysed in relation to socio-environmental variables, season and nutritional status during infancy using four groups (<–2, –2 to –1.01, –1 to 0, >0 z-scores of the NCHS/WHO reference). Finally, the relationship between age at weaning and nutritional status during infancy was adjusted for potentially confounding socio-environmental variables by Cox's proportional hazards regression. BMDP 1L and 2L (BMDP statistical software, Cork) were used for survival analysis, Epi-Info 6.0 was used for χ^2 tests for trend of prevalences, and ANTHRO (CDC, Atlanta) was used for the calculation of weight-for-length and length-for-age z-scores.

Results

Sample size and characteristics

During the study period, 5819 infants aged 9.0–10.4 months were called in for vaccination. Among them, 1202 were absent, either because they were travelling with their mothers (N = 668) or because their parents refused vaccination (N = 534), eight were already weaned at that time (two because their mothers had died, two because their mothers were pregnant and four for unknown reasons), while 42 had incomplete anthropometric measurements. Fifty-two infants were excluded from the analysis because of an imprecise date of weaning, leaving 4515 children (78%) in the analysis.

The infants not included differed from the included infants in several ways: they more often lived in hamlets (76.5% versus 71.7%, $P < 0.001$); they were more often Muslim (85.2% versus 78.0%, $P < 0.001$); and their mothers were more likely to have an occupation outside the home (18.7% versus 9.1%, $P < 0.001$) and less likely to have participated in field work during the last rainy season (88.1% versus 93.3%, $P < 0.001$). Sex, birth rank and the parents' age and education did not differ from those of included infants. Their median age at weaning was 23.5 months, which was not significantly different from the median of included infants (23.7 months).

Among the 4515 infants included, age at weaning was known for 3557 (78.8%), while 216 (4.8%) had died before weaning and 84 (1.8%) had outmigrated before weaning. At the end of the study period, 658 (14.6%) were still not weaned. Among the 3557 weaned children, 575 (16.2%) mothers reported being pregnant again, 2976 mothers reported they were not pregnant and six children were weaned because their mothers had died.

Nutritional status in late infancy

At the time of assessment of nutritional status, mean age was 9.7 months (SD: 0.3, range: 9.0–10.4), mean length-for-age was –0.97 z-scores (SD: 0.99) and mean weight-for-length –0.94 z-scores (SD: 0.92). The prevalences of stunting (length-for-age <–2 z-scores) and wasting (weight-for-length <–2 z-scores) were 13.7% (95% CI: 12.7–14.7) and 11.6% (95% CI: 10.6–12.6), respectively.

Age at weaning

Median age at weaning was 23.7 months (quartiles 21.7 and 25.9 months). Age at weaning was significantly linked to several characteristics of child and mother (Table 1) and to education and field work of the father. The mother's body mass index 9 months post-partum was not associated with age at weaning, nor was the sex of the child or the parents' religion. Among children followed until weaning, those whose mothers declared

Table 1 Selected variables associated with age at weaning (in months)

Variable	Group	Median	N
Residence	Village	23.5	1281*
	Hamlet	23.8	3234
Season of birth	Dec–Feb	24.3	1071**
	March–May	23.4	1199
	June–Aug	22.9	1007
	Sept–Nov	24.5	1238
Birth rank	1	22.1	587***
	2–3	23.6	1080
	4–5	23.9	1446
	6–9	24.3	1083
	≥10	24.3	319
Maternal age (yr)	<20	22.6	515***
	20–24	23.2	1013
	25–29	23.6	978
	30–34	23.9	1181
	35–39	24.7	513
	≥40	25.0	315
Maternal height (cm)	<150	24.6	107***
	150–159	24.0	1766
	160–169	23.5	2308
	≥170	23.4	271
Maternal education	Some	22.8	419 **
	None	23.9	4062
Maternal occupation	Some	22.7	403**
	None	23.8	4093
Maternal field work	Yes	23.8	4197**
	No	22.2	293

*$P < 0.01$; **$P < 0.0001$; *** P for trend < 0.0001.

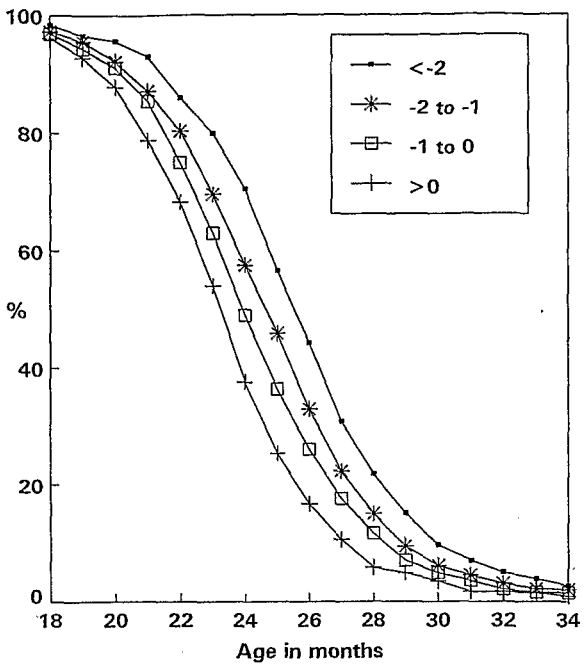

Figure 1 Probability of breastfeeding by age according to length-for-age (z-scores) at 9–10 months of age

being pregnant at weaning were weaned significantly earlier than the other children (median 22.7 versus 23.7 months, $P < 0.0001$).

The probability of breastfeeding by age of the child is given in Figure 1 for four groups of length-for-age at 9 months. A strong negative relationship was observed: children stunted during infancy were weaned later and children with a length-for-age higher than the median of the reference were weaned earlier than infants with length-for-age of –2 to 0 z-scores. At 24 months, the probability of still being breastfed was 70.7% for children who had a length-for-age of <–2 z-scores and 37.5% for those who had had a length-for-age >0 z-scores. Median age at weaning was 2.3 months higher for the children stunted during infancy than for those with normal length-for-age (Table 2, P for trend <0.0001). The association between age at weaning and length-for-age remained significant after adjustment for place of residence, season and rank of birth, field work of the father, and age, educational level and height of the mother ($P < 0.0001$).

The association with weight-for-length was somewhat weaker, though also very significant (Table 2, P for trend <0.0001), and it remained significant after adjustment for potential confounders; season and rank of birth of the child and age, educational level and occupation of the mother ($P < 0.0001$). Age at weaning was also associated with length-for-age and weight-for-length at 9 months among children weaned because of pregnancy (test for trend, $P < 0.05$).

When separating the 3557 children followed until cessation of breastfeeding into four groups of duration of breastfeeding, the prevalence of stunting at 9–10 months of age was four times greater among those breastfed more than 30 months compared to those breastfed less than 18 months (Table 3). The prevalence of wasting at 9–10 months of age was twice as high among those breastfed longer than 30 months compared to those breastfed for less than 18 months.

Table 2 Age at weaning according to nutritional status at the age of 9–10 months

Nutritional status	Length-for-age			Weight-for-length		
(z-scores)	N	Median	95% CI	N	Median	95% CI
<–2	620	25.0*	24.6–25.4	522	24.2*	24.0–24.6
–2 to –1.01	1513	24.1	23.9–24.4	1654	24.0	23.8–24.3
–1 to 0	1688	23.4	23.2–23.6	1680	23.5	23.3–23.7
>0	694	22.7	22.5–23.0	659	23.2	23.0–23.6

* P for trend < 0.0001.

Table 3 Prevalence of stunting and wasting at 9–10 months of age with 95% confidence intervals (CI) according to age at weaning

Age at weaning (months)	N	Stunting		Wasting	
		%	95% CI	%	95% CI
<18	156	6.4**	2.4–10.3	7.7*	3.4–12.0
18–23.9	1816	9.5	8.1–10.8	9.2	7.8–10.6
24–30	1461	17.6	15.6–19.6	11.9	10.2–13.6
>30	124	26.6	18.7–34.5	14.5	8.2–20.8

Test for trend: * $P < 0.01$; ** $P < 0.0001$

Discussion

Since the aim of the analysis was to compare duration of breastfeeding according to previous nutritional status in order to elucidate whether a low nutritional status was a cause or a consequence of late weaning, eight children who had been weaned at the nutritional assessment at 9–10 months were excluded from the analysis. Their mean nutritional status at 9–10 months was not inferior to that of the other children, and their inclusion in the analysis did not change the results.

The median age at weaning was close to 24 months, which is the age prescribed by Islamic Canon. However, Catholics also weaned their children at 24 months on average. In addition to classical determinants of duration of breastfeeding such as education and occupation of the mother, the age and parity of the mother were closely and positively linked to duration of breastfeeding. Mothers aged over 35 weaned several months later than younger mothers, perhaps in an attempt to delay pregnancy or because their lower fecundity lead to lower rates of conception during breastfeeding. However, these hypotheses need validation, since reasons for weaning could not be investigated in this study which used routinely collected data. The negative association between maternal height and duration of breastfeeding was not explained by confounding by maternal age, since maternal age and height were unrelated ($r = -0.03$), but rather by a positive correlation between maternal height and height-for-age ($r = 0.28$).

A strong relationship was also found between the season of birth and age at weaning. Many demographic events exhibit strong seasonality in this area, with high rates during the rainy season: the mortality risk of infants and under-fives,[21] the prevalence of malnutrition among both mothers and infants[22] and birth rates.[18,22] The seasonal variations in the duration of breastfeeding could be explained both by earlier weaning during the period of intense maternal fieldwork from July to August and by later weaning at the end of the rainy season (from September to November) because of the low food availabily and the high mortality rate of young children during that season (hazard ratio: 1.99 between 12 and 23 months, 2.80 between 24 and 35 months).[21]

The main finding of this study was a highly significant trend of increasing age at weaning by decreasing length-for-age during late infancy. Infants who were stunted at 9 months of age were weaned significantly later, and this relationship resisted adjustment. This implies that mothers prolonged the duration of breastfeeding for stunted infants. They also reduced the duration of breastfeeding below the age of 24 months when the nutritional status of the child was good, as suggested by Caulfield *et al.*[8] As a result, the prevalence of stunting at 9–10 months of age was four times greater among the children who were weaned after 30 months than among those who were weaned before 18 months, and the prevalence of wasting was twice as high. These differences in nutritional status among groups are very likely to have persisted after infancy, explaining the height-for-age and weight-for-height superiority of weaned children compared to breastfed children between 18 and 30 months of age in this area.[19]

A central hypothesis of our study was that the nutritional status at the age of 9–10 months is predictive of nutritional status during the second and third year of life. This is clearly the case for length-for-age, since stunting is largely established at the end of infancy.[23–25] Though weight-for-length at 9 months has previously been shown to be predictive of weight-for-length at 18 months in Senegal,[26] weight-for-length is more sensitive to environmental factors such as seasonal stress.[27,28] This might explain why weight-for-length at 9 months was less strongly associated with age at weaning than length-for-age.

In order to understand how nutritional status can influence age at weaning, it is important to consider criteria used to decide weaning. In particular, it is not known whether mothers have a clear perception of their children's height status *per se*, or whether they use their children's behaviour as an indicator of their dependence on breastmilk. Unfortunately, these routinely collected data give no indications of mothers' perception. The most common reason given for weaning in peri-urban Mali was that 'it was time to wean', a wording which implies a criterion based on either age or general development.[29] Similarly, in Guinea-Bissau, the most prevalent reason for weaning was 'child healthy' or 'old enough' (68% of reasons, $N = 945$).[30] Some of those children probably 'wean themselves'. In West Africa, weaning is usually done on one single day, and a child who has not asked for the breast during a whole day, will normally not be allowed to suck again.[29] Since ill or malnourished children are likely to rely more on the breast than healthy, independent children, child-driven weaning may be very closely linked to the child's nutritional status. Mothers may also decide to postpone weaning in response to poor health status, as in urban Peru where low weight-for-age children with frequent episodes of diarrhoea were breastfed for longer durations.[17]

In Senegal, a new pregnancy for the mother usually leads to weaning, and pregnancy was a risk factor for early weaning in this study, as has been described in other settings.[30] Since the duration of post-partum sexual abstinence is only 2 months in this area,[18] and since modern contraceptives are not used, women rely exclusively on lactational amenorrhoea to avoid pregnancy, and an estimated 30% of women become pregnant during lactation.[18] The prevalence of occurrence of pregnancy during breastfeeding is usually lower when self-reported (here 16%), probably because women are reluctant to report early pregnancy.[30] Continued breastfeeding after the onset of pregnancy is traditionally taboo in this society, but a few women continue to breastfeed (10% while 4 months pregnant and 2% while 9 months pregnant).[18] Women report that when a child is very young or weak, breastfeeding may continue during pregnancy because the mother fears that her child will not survive weaning.

In conclusion, in the society studied here, the decision to wean is not made at random, but rather, includes an analysis of

the health status of the child, since the mother and, on a wider scale, the community, is aware of the high mortality risk of weaned children. Consequently, mothers prolong breastfeeding of malnourished children and reduce the duration among well-nourished children. Although these results do not preclude that a few children may catch up in growth after weaning,[12,29] the lower nutritional status which is often described for breastfed children compared to weaned children is probably not due to any negative impact of prolonged breastfeeding on growth, but rather to pre-existing differences. Longitudinal growth studies up to age 3 years are needed to confirm this hypothesis.

From a public health point of view, the 'weaning strategy' adopted in this community is an example of adaptation to the environment, since it optimizes child survival and should therefore be re-enforced, i.e. mothers should be strongly discouraged from weaning their undernourished children prematurely without any medical control; rather, they should be encouraged to continue their usual custom of prolonged breastfeeding of such children.

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References

[1] Victora CG, Vaughan JP, Martines JC, Barcelos LB. Is prolonged breast-feeding associated with malnutrition? *Am J Clin Nutr* 1984;**39:** 307–14.

[2] Martorell R, Leslie J, Moock PR. Characteristics and determinants of child nutritional status in Nepal. *Am J Clin Nutr* 1984;**39:**74–86.

[3] Michaelsen KF. Value of prolonged breastfeeding. *Lancet* 1988;**ii:** 788–89.

[4] Briend A, Bari A. Breastfeeding improves survival, but not nutritional status, of 12–35 months old children in rural Bangladesh. *Eur J Clin Nutr* 1989;**43:**603–08.

[5] Cornu A, Simondon F, Olivola D *et al.* Allaitement maternel prolongé et malnutrition. In: Lemonnier D, Ingenbleek Y, Hennart P (eds). *Alimentation et Nutrition dans les Pays en Développement.* Paris: Karthala-ACCT-AUPELF, 1991.

[6] Mølbak K, Gottschau A, Aaby P, Højlyng N, Ingholt L, da Silva APJ. Prolonged breast feeding, diarrhoeal disease, and survival of children in Guinea-Bissau. *Br Med J* 1994;**308:**1403–06.

[7] Nubé M, Asenso-Okyere WK. Large differences in nutritional status between fully weaned and partially breast fed children beyond the age of 12 months. *Eur J Clin Nutr* 1996;**50:**171–77.

[8] Caulfield LE, Bentley ME, Ahmed S. Is prolonged breastfeeding associated with malnutrition? Evidence from nineteen demographic and health surveys. *Int J Epidemiol* 1996;**25:**693–703.

[9] Taren D, Chen J. A positive association between extended breast-feeding and nutritional status in rural Hubei Province, People's Republic of China. *Am J Clin Nutr* 1993;**58:**862–67.

[10] Briend A, Wojtyniak B, Rowland MGM. Breastfeeding, nutritional state, and child survival in rural Bangladesh. *Br Med J* 1988;**296:**879–82.

[11] Cousens S, Nacro B, Curtis V *et al.* Prolonged breastfeeding: no association with increased risk of clinical malnutrition in young children in Burkina Faso. *Bull World Health Organ* 1993;**71:**713–22.

[12] Brakohiapa LA, Yartey J, Bille A *et al.* Does prolonged breastfeeding adversely affect a child's nutritional status? *Lancet* 1988;**ii:**416–18.

[13] Prentice A. Breastfeeding and the older infant. *Acta Paediatr Scand* 1991;**374(Suppl.):**78–88.

[14] Grummer-Strawn LM. Does prolonged breastfeeding impair child growth? A critical review. *Pediatrics* 1993;**91:**766–71.

[15] Morley D, Bicknell J, Woodland M. Factors influencing the growth and nutritional status of infants and young children in a Nigerian village. *Trans R Soc Trop Med Hyg* 1968;**62:**164–95.

[16] Mata LJ, Kronmal RA, Garcia B, Butler W, Urrutia JJ, Murillo S. Breast-feeding, weaning and the diarrhoeal syndrome in a Guatemalan Indian village. In: Elliot C, Knight J (eds). *Acute Diarrhea in Childhood.* Amsterdam: Elsevier, 1976.

[17] Marquis GS, Habicht J-P, Lanata CF, Black RE, Rasmussen KM. Association of breastfeeding and stunting in Peruvian toddlers: an example of reverse causality. *Int J Epidemiol* 1997;**26:**349–56.

[18] Cantrelle P, Léridon H. Breast feeding, mortality in childhood and fertility in a rural zone of Senegal. *Popul Stud* 1971;**25:**505–33.

[19] Garenne M, Maire B, Fontaine O, Dieng K, Briend A. *Risques de Décès Associés à Différents États Nutritionnels chez l'Enfant d'âge Préscolaire.* Dakar, Senegal: ORSTOM, 1987.

[20] Simondon KB, Gartner A, Berger J *et al.* Effect of early, short-term supplementation on weight and linear growth of 4–7-mo-old infants in developing countries: a four-country randomized trial. *Am J Clin Nutr* 1996;**64:**537–45.

[21] Ronsmans C. Birth spacing and child survival in rural Senegal. *Int J Epidemiol* 1996;**25:**989–97.

[22] Simondon KB, Bénéfice E, Simondon F, Delaunay V, Chahnazarian A. Seasonal variation in nutritional status in rural Senegal. In: Ulijaszek SJ, Strickland SS (eds). *Seasonality and Human Ecology.* Cambridge: Cambridge University Press, 1993.

[23] Waterlow JC. Observations on the natural history of stunting. In: Waterlow JC (ed.). *Linear Growth Retardation in Less Developed Countries.* New York: Raven Press, 1988.

[24] Scholl TO, Johnston FE, Cravioto J, Delicardie ER. The utility of cross-sectional measurements of weight and length for age in screening for growth failure (chronic malnutrition) and clinically severe protein-energy malnutrition. *Acta Paediatr Scand* 1983;**72:**867–72.

[25] Simondon KB, Simondon F, Cornu A, Delpeuch F. The utility of infancy weight curves for the prediction of growth retardation in preschool children. *Acta Paediatr Scand* 1991;**80:**1–6.

[26] Simondon KB. *Prédiction des Malnutritions Protéino-Énergétiques par la Croissance Infantile au Congo et à Pikine, Sénégal.* Paris: Editions de l'Orstom, 1992.

[27] Brown KH, Black RE, Becker S. Seasonal changes in nutritional status and the prevalence of malnutrition in a longitudinal study of young children in rural Bangladesh. *Am J Clin Nutr* 1982;**36:**303–13.

[28] Bairagi R. A comparison of five anthropometric indices for identifying factors of malnutrition. *Am J Epidemiol* 1987;**126:**258–67.

[29] Dettwyler KA. Breastfeeding and weaning in Mali: cultural context and hard data. *Soc Sci Med* 1987;**24:**633–44.

[30] Jakobsen MS, Sodemann M, Mølbak K, Aaby P. Reason for termination of breastfeeding and the length of breastfeeding. *Int J Epidemiol* 1996;**25:**115–21.

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