Postdischarge formula consumption in infants born preterm

A Lucas, F King, N B Bishop

Abstract

In 31 infants born preterm and formula fed ad libitum, all milk intake was weighed from hospital discharge to nine months post-term. Mean daily milk intake was high, reaching 230 g/kg before four weeks post-term and was still over 150 g/kg beyond six months. Five of the 31 infants (16%) consumed 300–350 g/kg; 50% 'voluntarily' consumed more than upper recommended limits for energy intake and 35% did so for protein intake.

Despite considerable research on nutrition of preterm infants, there is little scientific information on their nutritional management after discharge from hospital. One practical question is how much milk should formula fed preterm babies consume during infancy? Their ad libitum milk intake might not be the same as in a full term baby. Preterm infants frequently show appreciable postnatal growth deceleration and often leave hospital with considerable catch up growth to achieve. Furthermore, enteral feeding is often given many weeks too soon in biological terms by an unphysiological route and in larger volumes (per kg) than those usually received by full term babies. We speculate these factors could influence the normal development of feeding behaviour. In 31 infants born preterm we weighed entire milk intake from hospital to nine months post-term and related milk intake to demographic factors.

MRC Dunn Nutrition Unit and University Department of Paediatrics, Cambridge
A Lucas
F King
N B Bishop

Correspondence to:
Dr A Lucas,
MRC Dunn Nutrition Unit,
Downham's Lane,
Milton Road,
Cambridge CB4 1XJ.

Accepted 20 January 1992

Subjects and methods

Preterm infants, whose mothers had chosen not to breast feed, were randomly assigned a standard adapted formula (Ostermilk, Farley Health Products Ltd) and a new, nutrient enriched 'postdischarge' formula (Premcare, Farley Health Products Ltd). The trial results will be published elsewhere; this paper concerns only weighed milk intake data. Milk intake on the two formulas was very similar and both formulas had a composition (energy 68 or 72 kcal/100 ml (285 or 301 kJ/100 ml); protein 1·5 or 1·8 g/100 ml) within the range recommended in Britain.[1] These formulas reflect the range of nutrient contents likely to be used in this population. Therefore we combined data from the two feed groups.

Mean (SE) birth weight was 1480 (200) g and gestation 31 (2) weeks (maxima: 1850 g and 35 weeks). Patients were recruited while in hospital (with informed consent and approval of the Cambridge Health Authority and Medical Research Council's local ethical committees) and studied after discharge home. At study entry mean (SE) postmenstrual age was 38 (3) weeks and mean (SE) body weight 2000 (190) g. Extensive clinical and demographic data had been collected during hospital stay.

In the home preweighed bottles of 'ready-to-feed' formula were supplied to the mother. Teats were attached to the bottles for feeding and at the end of the feed the teat was removed, the cap tightly replaced, and FK reweighed all bottles after each two week period up to nine months post-term. Regurgitations were not recorded as our objective was to measure intake rather than retention. Formula was consumed exclusively for a median of 11 weeks and then with weaning foods.

Results

Table 1 shows centile data for formula intake from discharge to term and for each four week period up to 40 weeks post-term.

To explore whether the babies who consumed the greatest milk volumes were the most immature or growth retarded, gestation and body weight SD score at discharge from hospital was correlated with milk intake/kg body weight for the first five postdischarge age periods studied (table 2).

Table 1 Weighed milk intake (g/kg/day): median and interquartile range (raw data), smoothed 97th centile (estimated from SD) and, for comparison, 97th centile for full term infants estimated from reference data (Fomon et al[5])

Weeks post-term	*Median*	*Interquartile range*	*Smoothed 97th centile*	*(97th centile for term infants)*
Discharge to term	212	189, 227	272	
1–4	230	195, 254	322*	(220)
5–8	206	170, 234	303	(204)
9–12	175	157, 203	286	(177)
13–16	177	143, 216	270	(166)
17–20	156	134, 187	255	
21–24	152	123, 183	240	
25–28	142	123, 182	227	
29–32	120	105, 145	215	
33–36	104	89, 138	203	
37–40	102	82, 129	191	

*Highest individual value 353 ml/kg/day.

Table 2 Correlations of gestation and body weight SD score at discharge with postdischarge formula volume intakes

Age post-term	*Correlation coefficient (r) for relation between milk intake and:*			
	Gestation		*Discharge weight SD score*	
	r	*p Value*	*r*	*p Value*
Discharge to term	0·24	0·23	−0·30	0·13
1–4	0·31	0·09	−0·23	0·22
5–8	0·10	0·60	−0·19	0·33
9–12	0·02	0·92	−0·09	0·64
13–16	−0·07	0·69	−0·00	1·00

Discussion

We have not identified other studies in which all formula consumed was measured over such a prolonged period in preterm infants after discharge from hospital. We observed surprisingly high volume intakes on a body weight basis. In our previous studies on exclusively formula fed full term infants from the same catchment area, milk intakes at 4–6 weeks and 10–12 weeks were 170 and 155 g/kg/day.[2] Preterm infants maintained an average intake well above this, reaching 230 g/kg in the first month post-term. Butte *et al* found that by four months milk intake in predominantly formula fed term infants had fallen to 118 g/kg/day compared with 184 g/kg in our preterm infants.[3] Intakes remained above 150 g/kg beyond six months when our (unpublished) observations show babies born at term consume under 60 g/kg/day.

Our previous work on full term infants showed mean values for weighed formula intake minus weighed regurgitations and spills were within 98–99% of the values not accounting for regurgitation.[4] We accept that preterm infants might have regurgitated more than term infants in the very early weeks, though this would be less likely to explain persistently high intakes after a few months. Carelessness was an unlikely source of significant error as our previous studies on similarly well motivated and supervised mothers showed mean weighed milk intake matched closely with intake derived by deuterium kinetic studies in the infant.[4]

Some preterm infants had particularly high intakes: 5/31 had at some time an intake over 300 g/kg. Formula intakes in full term infants have also been reported to be highly variable,[5] though the 97th centiles for intake/kg (estimated from published reference data[5]) are still substantially below those for preterm infants in the first four months (table 1). Table 2 does show some evidence for a trend (not significant) towards more immature babies and those more growth retarded at discharge having the highest intakes, but only in the early weeks. A larger sample would be needed to investigate reasons for the high intakes observed.

Regardless of mechanism, our findings have important implications for the nutrition of infants born preterm. About 50% of infants studied 'voluntarily' consumed more than the generous upper limit for energy intake for premature infants set down by the European Society for Paediatric Gastroenterology and Nutrition (ESPGAN)[6] in 1983 of 165 kcal (690 kJ)/kg (most authorities recommend 120–130 kcal (502–544 kJ)/kg/day[7]). Perhaps more important, 35% of these preterm infants consumed more than the upper limit (ESPGAN) for protein intake of 4 g/kg/day.[6] Are these babies trying to tell us something about their dietary needs?

We thank Farley Health Products Ltd for financial support and supply of diets and Evelyn Smith for preparation of the manuscript.

1 Department of Health and Social Security. *Report on health and social subjects No 32. Present day practice in infant feeding*. London: HMSO, 1988:21.
2 Lucas A, Davies PSW. Physiological energy content of human milk. In: Atkinson SA, Hanson LA, Chandra RK, eds. *Breastfeeding, nutrition, infection and infant growth in developed and emerging countries*. Newfoundland: ARTS Biomedical, 1990:337–57.
3 Butte NF, Wong WW, Ferlic L, O'Brian Smith E, Klein PD, Garza C. Energy expenditure and deposition of breast-fed and formula-fed infants during early infancy. *Pediatr Res* 1990;**28**:631–40.
4 Lucas A, Ewing G, Roberts SB, Coward WA. Measurement of milk intake by deuterium dilution. *Arch Dis Child* 1987;**62**:796–800.
5 Fomon SJ, Ziegler EE, Nelson SE, Edwards BB. Requirement for sulfur-containing amino acids in infancy. *J Nutr* 1986;**116**:1405–22.
6 Committee on Nutrition of the Preterm Infant, European Society for Paediatric Gastroenterology and Nutrition. Nutrition and feeding of preterm infants. *Acta Paediatr Scand* 1987;**ii**:(Suppl 336):1–14.
7 Lucas A. Feeding the preterm infant. *Clinical nutrition of the young child*. Vevey/New York: Nestec Ltd/Raven Press, 1991:317–36.