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Growth and Breastfeeding among Low Birth Weight Infants Fed with or without Protein Enrichment of Human Milk

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ABSTRACT

The effect of protein enrichment of mother's milk on growth of low birthweight infants needs further exploration in order to optimize feeding strategies. The aim of this study was to describe feeding and growth of infants weighing <1,900 g at birth, up to a corrected age of 18 months, with or without protein-enriched breastmilk.

A retrospective, descriptive, non-experimental design was used to describe the growth of 52 low birthweight infants. Data on their growth and feeding were collected from medical records at hospitals and child health care clinics.

Despite more severe morbidity, the infants given protein-enriched milk showed similar growth as the other study infants. Standard deviation score for length at birth correlated positively with delta standard deviation score for length, from discharge to 12 and from discharge to 18 months corrected age. Duration of 'full' breastfeeding had a significant impact on subsequent improvement in SDS for weight. At discharge a smaller proportion of singletons fed with protein enriched milk were breastfed 'fully'. Infants who established breastfeeding at an early post-menstrual age were born with more optimal weight standard deviation score and had a better weight gain after discharge.

We conclude that protein-enriched breast milk enables low birthweight infants requiring especially intensive care to attain growth at discharge comparable to that of healthier infants not given enriched milk. Low standard deviation score for length at birth may predict poor growth after discharge. However duration of 'full' breastfeeding had a significant impact on subsequent improvement in SDS for weight. Therefore it is important that mothers of LBW infants are given sufficient support of lactation and breastfeeding.

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INTRODUCTION

The question 'how should infants with LBW be fed' is of major interest, as the nutriments given to these infants may predetermine subsequent health [1]. There is a general consensus that the milk from an infant's mother is the best possible. Nevertheless, due to preterm infants' greater protein requirement, it is generally agreed that human milk needs enrichment with protein- and also sodium, phosphate and calcium- to be the best choice for these infants [2, 3]. Two more facts support the latter conclusion: a) an association between protein intake and weight gain has been noted in preterm infants [4] and b) variability in protein concentration in mothers´ milk [5, 6]. The aims of feeding LBW with protein-enriched breastmilk are (a) to promote catch-up growth (including head growth) in order to reduce the risk of impaired psychomotor development, and (b) to reduce the risk of the metabolic syndrome [7].

Nevertheless, some other facts complicate this question; first of all, LBW infants do not constitute a homogeneous group. It includes SGA infants, AGA infants, preterm infants and infants with or without severe morbidity. One can assume that these differing categories constitute subgroups as regards nutritional requirements [8]. Second, even though protein enrichment affords short-term growth improvement, no long-term benefits have been demonstrated [8-10]. One Danish study suggested that unfortified human milk in daily amounts of around 200 ml/kg might be sufficient for preterm infants; in that study, infants given only their own mothers' unfortified milk were heavier at discharge but had length and head circumference measurements similar to infants fed with preterm formula [11]. Finally, in developing countries exclusively breastfed premature infants with VLBW have shown weight gain comparable to intra-uterine growth rates [12]. Early proactive enteral feeding has been associated with a reduction in mean days to reach full enteral feeding and days to regain birthweight [13]. Despite this, policies for the introduction and

List of abbreviations:

AGA	appropriate for gestational age
BF	breastfeeding
CPAP	continuous positive airway pressure
E-group	enrichment group
GA	gestational age
LBW	low birthweight
VLBW	very low birth weight
Md	median
non-E group	non-enrichment
PI	ponderal index
PMA	postmenstrual age
SDS	standard deviation score
Delta SDS	difference between two defined standard deviation scores
SGA	small for gestational age

advancement of enteral and oral feeding have been restrictive, and recommendations for maximum amounts around 150 ml/kg and day still appear to be common [14, 15].

In short, although extensive research has been conducted into the association between feeding of mother's milk and growth of LBW infants, gaps in our knowledge base persist and there is disagreement regarding strategies for optimization of these infants' growth.

The objective of this retrospective, non-experimental study is to describe breastfeeding and growth up to a corrected age of 18 months by infants weighing less than 1900 g at birth and fed breastmilk with or without protein enrichment.

METHODS

A retrospective, descriptive, non-experimental design was used to describe the growth of LBW infants born at the neonatal units of two Swedish university hospitals, University Hospital, Uppsala (A) and Norrland University Hospital, in Umeå (B). The design and procedures were approved by the research ethics committees of the Medical Faculties at Uppsala University and Umeå University. Relevant background data on mothers and information on infants' growth and feeding during their stay in hospital were extracted from the hospital medical records. Data on breastfeeding, complementary feeding and growth after discharge from hospital were obtained from child health care medical records and by a questionnaire to mothers.

MATERIALS

The sample comprised all infants born consecutively in hospital A from December 2000 and February 2002, and in hospital B between August 2000 and February 2002. Infants transferred to another hospital before discharge home were excluded. Criteria for inclusion in the study were birthweight below 1,900 g and admission to a neonatal unit. The infants should have been free from congenital abnormality or serious illness having a severe impact on feeding tolerance, such as necrotizing enterocolitis, severe cardiac illness, or chromosomal abnormality. Furthermore, their mothers were required to be Swedish speaking and intending to breastfeed.

Four infants at hospital A were excluded from the study for other reasons; a pair of twins because of metabolic disease in one twin, another infant because the mother was suffering from a serious illness and one infant because of intraventricular hemorrhage grade III. This generated a sample of 52 infants (35 from hospital A and 17 from hospital B). Gestational age at birth was based on ultrasound examination at 16-18 weeks' gestation. The infants were deemed to be SGA if they had a birthweight below -2 SDS according to Marsál [16]. Niklasson's adjusted Swedish reference standards for size at birth (unpublished) were used to evaluate growth up to 40 weeks PMA and Niklasson's Swedish reference standards to for growth after 40 weeks PMA [17]. PI index was calculated as weight (g) x 100/length^3 (cm) [14, 18].

Feeding regimens

At both hospitals, preterm infants received donor breastmilk which was gradually replaced by own mother's milk. In cases of insufficient maternal milk, preterm infants were given formula at around 36 postmenstrual weeks. Full-term infants received formula before milk production was established. At hospital A the infants were fed every 2 hours as long as they weighed less than 1,500 g and at hospital B until they weighed 1,200 g. Other infants were fed every 3 hours. At hospital A supplement was administered by tube or cup and at hospital B by tube or spoon. In order to minimize the interruption of growth already started in fetal life, hospital A followed a nutrition policy stipulating that all SGA infants were prescribed a total volume of 100 ml/kg and day on the day of birth, 150 ml/kg on day 1, and 200 ml/kg on day 2. The latter daily volume was maintained until the infant reached what was regarded by the attending neonatologist as adequate catch-up growth. For AGA infants the policy was to commence with 65 ml/kg and day on the day of birth, gradually increasing to 170 ml/kg and day on day 9. At hospital B, the nutrition policy for AGA infants in hospital A was applied to both AGA and SGA infants.

Most mothers lived-in and roomed-in at the neonatal unit and breastfed their infants for at least a couple of days before the infants' discharge. When breastfeeding was initiated and there were signs of suckling, infants at hospital A were test-weighed before and after feeding to determine the amount of milk the infant had ingested. At hospital B the daily amount was assessed by observing the infants' suckling behaviour. At both hospitals, bottle feeding was introduced only for exceptional reasons.

Regimens for enrichment

The attending neonatologist assessed infants' need of an enriched breastmilk. At both hospitals the product used was Enfamil Human Milk Fortifier. Altogether 22 infants were given this product in breast milk (17 at hospital A and 5 at hospital B) from an age between 8 and 35 days, at a median PMA of a 32.6 weeks. (The E-group received enriched milk and non-E group infants were not given enriched milk). The dose was gradually increased during 9 days. The enrichment was gradually set out when the infant started to breastfeed or when the breastmilk was replaced by formulafeed. Duration of treatment with enrichment in group E was 30.5 days (Md) ranging from 10 to 88 days.

Breastfeeding definitions

The breastfeeding definitions used were those currently applied at Swedish Child Health Care Centers:

Full breastfeeding: infants' predominant source of nutrition is breastmilk. Infants may be given vitamins, minerals and medicines. No other food-based fluids are allowed. From the age of 4-6 months, infants may ingest semi-solid foods, but no non-human milk.
Partial breastfeeding: infants take both breastmilk and non-human milk, with or without semi-solid foods.

Statistical analyses

The Statistical Package for Social Sciences (SPSS version 11.0) was used for the statistical analyses. The chi-square test and Fisher's exact test, and Mann-Whitney U-test were used for inter-group comparisons. Spearman's correlation analyses was used to analyse differences in the impact of certain factors on outcome variable. Linear regression analysis was used for the exploration of factors contributing to the explanation of infants' growth.

RESULTS

Characteristics of infants in the E and non-E groups. The infants who were assessed by the attending neonatologist as being in need of protein enrichment of breastmilk differed from infants who were not given enriched milk. They were of a younger gestational age and were both lighter and smaller. A greater proportion of these infants also needed more advanced neonatal care and treatment for apnea. The proportion of infants who were growth retarded from birth was the same in both groups (Table 1).

Table 1. Infant gestational age, weight, length, and head circumference at birth, SGA, twin, ventilator treatment, CPAP, oxygen, and theophyllamine

Variable	Unit	Enrichment (n=22)	No enrichment (n=30)	P-value
GA at birth	Md (range)	30.0 (25.0-33.0)	32.6 (26.7-39.9)	0.000
Birthweight, g	Md (range)	1.236 (713-1.868)	1.663 (947-1.886)	0.000
Birth length, cm	Md (range)	38.5 (32-43.5)	42 (35.5-46)	0.000
Birth head , cm	Md (range)	28 (23.5-31)	30 (25.5-32.3)	0.001
SGA	n	10	14	NS
Twin	n	3	10	NS
Ventilator	n	9	4	0.049
CPAP	n	20	16	0.006
Oxygen	n	15	10	0.024
Theophyllamine	n	17	7	0.000

Feeding and breastfeeding. The amounts of milk consumed by the E-group were smaller after one week, but not after two (Table 2). Most infants in both groups were breastfed. No significant inter-group was evident regarding breastfeeding out-

Table 2. Total amount of milk at age 7 and 14 days

Variable	Unit	Enrichment	No enrichment	P-value
ml/birthweight, kg	n	n=22	n=28*	0.007
day 7	Md (range)	131 (40-213)	162 (21-230)	
ml/birth weight, kg	n	n=22	n=22**	NS
day 14	Md (range)	183 (45-276)	191 (97-276)	

* Two infants had reached full breastfeeding
** Eight infants had reached full breastfeeding

come, with frequencies of 'partial' and 'full' breastfeeding of 86% and 59% in group E, and 93% and 80%, respectively, in the non-E group. However, when twins

Table 3. Breastfeeding in singletons at discharge

Variable	Unit	Enrichment (n=19)		No enrichment (n=20)		P-value
'Partial' breastfeeding	n (%)	16	(84)	19	(95)	NS
'Full' breastfeeding	n (%)	11	(58)	18	(90)	0.031
Weaned	n (%)	3	(16)	1	(5)	

were excluded from the sample, a larger proportion of infants in the non-E group were fully breastfed at discharge (Table 3). There were no significant differences between the groups regarding duration of full and partial breastfeeding (Table 4).

Table 4. Breastfeeding duration (in months) after discharge in singletons, duration in months

Variable	Unit	Enrichment (n=19)	Non enrichment (n=20)	P-value
'Full' breastfeeding	Md (range)	3 (0-10)	5 (0-12)	NS
'Partial' breastfeeding	Md (range)	6 (0-18)	7 (0-13)	NS

Growth. The E-group infants lost more weight and regained their birthweight later (Table 5). At the time of discharge they were significantly heavier and had larger head circumference than the non-E group infants (Table 6); there was no signifi-

Table 5. Lowest weight, weight loss percent, regain of birth weight and age in days when infants attained 'full' enteral feeding

Variable	Unit	Enrichment (n=22)	Non enrichment (n=30)	P-value
Lowest weight, days	Md (range)	4 (2-7)	4 (0-7)	NS
Weight loss, %	Md (range)	11.9 (2.2-21.3)	7.2 (0-18.3)	0.015
Days to regain birthweight	Md (range)	12.5 (3-31)	10 (0-16)	0.007
Days to full enteral feeding	Md (range)	7 (0-31)	3.5 (0-17)	0.011

cant difference in lenght. At this time there was no difference in PMA, even though infants given enriched breast milk had reached a higher postnatal age. However, at 40 weeks there were no differences between the groups in any of the anthropo-

Table 6. Age at discharge, weight, length, and head circumference at discharge and at 40 weeks

Variable	Unit	Enrichment (n=22)		Non enrichment (n=30)		P-value
PMA at discharge, weeks	Md (range)	37.4	(35.9-42.7)	37.1	(33.6-40.7)	NS
Age at discharge, days	Md (range)	52	(25-107)	28	(6-89)	0.000
Weight at discharge, g	Md (range)	2.435	(1.810-.825)	2.232	(1.740-2.800)	0.025
Length at discharge, cm	Md (range)	46	(43-48)	45.75	(43.5-49)	NS
Head at discharge, cm	Md (range)	33.5	(31.5-35.5)	32.5	(30-35)	0.009
Weight at 40 weeks, g	Md (range)	2.938	(2.040-3.840)	3.010	(1.870-5.015)	NS
Length at 40 weeks, cm	Md (range)	48.75	(41-53)	49	(46-54)	NS
Head at 40 weeks, cm	Md (range)	35.8	(33-37.5)	35.2	(32-37.3)	NS

metric variables, nor of proportionality in terms of PI, with a median (range) PI for the E-group of 2.6 (2.2-3.1) and 2.6 (1.9-3.2) for non-E group. On the other hand, when PI values for AGA and SGA infants were compared, the latter continued to be thin, with consistently lower PI at 40 weeks than to the AGA infants (Md 2.4 vs 2.6, $p < 0.030$), 2 months (2.6 vs 2.8, $p < 0.045$), 12 months (2.2 vs 2.3, $p < 0.020$) and 18 months (1.9 vs 2.1, $p < 0.03$).

No differences were observed between infants given enriched milk and the 'control' infants, regarding SDS for weight, length, or head circumference at 2, 4, 6, 12 or 18 months corrected age (Table 7). But when the two groups were compared

Table 7. Median weight, length, head circumference SDS at birth, discharge, 40 week PMA and the corrected age of 2, 4, 6,12 and 18 months (head from 40 week PMA)

Variable	Birth		Discharge		40 weeks		2 months	
	E	Non-E	E	Non-E	E	Non-E	E	Non-E
SDS weight	-1,6	-1,7	-1,9	-2,0	-1,4	-0,9	-0,4	0,1
range	-3,3 to 1,1	-3,9 to 0,0	-3,4 to -0,4	-3,2 to -0.8	-3,2 to 1,5	-3,9 to 1,8	-2,6 to 1,3	-3,5 to 2,4
SDS length	-1,5	-1,1	-1,7	-1,4	-1,5	-0,8	-1,2	-0,6
range	-4,2 to 1,8	-4,3 to 1,4	-4,4 to 0,3	-3,3 to -0,1	-5,4 to 1,0	-2,7 to 0,6	-3,7 to 1,1	-3,3 to 0,5
SDS head					0,1	-0,2	-0,2	0,2
range					-1,3 to 2,3	-1,9 to 1,0	-1,4 to 1,7	-3,2 to 2,0
	4 months		6 months		12 months		18 months	
	E	Non-E	E	Non-E	E	Non-E	E	Non-E
SDS weight	-1,1	-0.2	-1,0	-0,7	-0,7	-0,9	-0,8	-0,6
range	-3,1 to 1,2	-3,2 to 2,1	-2,9 to 1,2	-3,1 to 1,6	-2,5 to 1,1	-2,6 to 1,9	-2,4 to 1,2	-2,3 to 1,8
SDS length	-0,9	-0,3	-0,5	-0,4	-0,4	-0,2	-0,5	-0,2
range	-3,5 to 0,8	-3,1 to 1,2	-3,7 to 1,3	-2,6 to 1,4	-3,3 to 1,8	-2,4 to 1,6	-3,72 to 1.9	-2,4 to 1,6
SDS head	-0,1	0,5	0,2	0,1	-0,1	-0,1	-0,4	-0,7
range	-1,5 to 2,9	-1,5 to 3,2	-1,6 to2,2	-1,9 to 1,9	-1,9 to 1,1	-2,0 to2,3	-2,1 to 1,7	-1,9 to 1,6

regarding changes in growth in terms of changes in SDS (delta SDS), several differences were identified. The non-E group infants showed greater improvement in weight gain and head growth from discharge to 2 and 4 months corrected age: no such differences in length were noted (Table 8).

Factors explaining growth. In regression analyses (controlling for the following

Table 8. Median changes in weight, length, and head circumference in SDS from discharge to 2, 4, 6, 12, and 18 month (head from 40 week PMA)

Variable	2 months		4 months		6 months		12 months		18 months	
	E	Non-E	E	Non-E	E	Non-E	E	Non-E	E	Non-E
Delta SDS weight	1,5	2,2[1]	0,9	1,6[2]	0,9	1.4	0,9	1,3	0,8	1,5
Delta SDS length	0,6	0,9	0,9	1,0	0,9	0,8	1,2	1,0	0,8	1,2
Delta SDS head	-0,1	0,5[3]	-0,1	0,8[4]	0,2	0,1	-0,2	0,1	-0,6	-0,4

[1] P < 0.036 [2] P < 0.038 [3] P < 0.012 [4] P < 0.011

independent factors: head circumference at birth, weight at birth, GA at birth, PMA at discharge, oxygen treatment in days, teofyllamin treatment, and enrichment in breastmilk) enrichment in breastmilk no longer came out as a significant factor for head circumference or weight at discharge. Significant factors explaining weight at discharge were GA at birth ($p < 0.000$), weight at birth ($p < 0.000$) and PMA at discharge ($p < 0.000$). Head circumference at discharge was explained by GA at birth (p < 0.000), head circumference at birth ($p < 0.02$) and PMA at discharge ($p < 0.000$).

Furthermore, the following variables also emerged as significant for study infants' growth. Length SDS at birth correlated positively with d SDS for length from discharge to 12 months ($p < 0.023$) and 18 months ($p < 0.022$); head circumference at 40 weeks correlated positively with d head circumference from discharge to 12 months ($p < 0.037$) and 18 months ($p < 0.016$). GA at birth correlated positively with length SDS at birth, but did not correlate with d SDS for length later on. Duration of 'full' breastfeeding correlated positively with d SDS for weight at discharge to 6 months ($p < 0.025$) and discharge to12 months ($p < 0.045$), and duration of 'partial' breastfeeding months correlated positively with d SDS for weight at discharge to 6 months ($p < 0.042$) and discharge to18 month ($p < 0.048$).

The factor 'months of 'full' breastfeeding' also emerged as significant for the explanation of delta SDS for weight in a regression analysis. Independent factors included in this analysis were: SDS for weight at birth, GA at birth, oxygen treatment in days, teofyllamin treatment, gender, twin, months of 'full' breastfeeding, and enrichment in breastmilk. Months of 'full' breastfeeding explained d weigth SDS from discharge to 6 months ($p < 0.005$), to 12 months ($p < 0.007$) and to 18 months ($p < 0.033$).

Infants with early 'full' breastfeeding. During the process of data analysis, infants with early attainment of full breastfeeding (at a PMA of less than 36 weeks) were explored separately. This group consisted of 14 infants, 4 of whom had a birthweight below 1.500 g. (table 9). Compared with the other study infants, these infants had a higher median weight SDS at birth (-0.9 vs –2.3, $p < 0.020$). However, at time of discharge, no difference were seen in median weight SDS (-1.8 vs – 2.0). At PMA 40 weeks the early breastfed infants were significantly heavier (Md 3.215 vs 2.887, $p < 0.017$), higher median weight SDS (-0.5 vs -1.4, $p < 0.008$). The 'early full breastfed' infants continued to show superior weight gain up to 2 months corrected age, at which they had achieved a higher weight gain (Md 5.223g vs

Table 9. Infants exclusively breastfeed <36 weeks PMA

Variable	Unit	n<14
GA at birth	Md (range)	31.2 (28.6-34.0)
Birthweight, g	Md (range)	1.640 (1.125-1.868)
Birth length, cm	Md (range)	42 (38-43.5)
Birth head, cm	Md (range)	29.3 (26-31.5)
SGA	n	3
Twin	n	3
Ventilator	n	3
CPAP	n	11
Oxygen	n	7
Theophyllamine	n	6
Enrichment	n	3
PMA 'Full' BF, weeks	Md (range	35.1 (32.6-35.9)
PMA at discharge, weeks	Md (range)	36.1 (33.6-37.0)
Weight at discharge, g	Md (range)	2.119 (1.740-2.590)
Length at discharge, cm	Md (range)	45.5 (43-47.5)
Head at discharge	Md (range)	32.5 (30-33.5)

4.655g, $p < 0.012$), and a greater increase in SDS (Md 0.5 vs -0.5, $p < 0.030$). When the groups were compared regarding growth in terms of changes in SDS from discharge to 2 months corrected age, the infants with 'early full' breastfeeding had a higher d weight SDS (2.3 vs 1.6, $p < 0.047$). Furthermore, these infants were fully breastfed for a significantly longer period than the other study infants (Md 5.5 months vs 3 months, $p < 0.041$).

DISCUSSION

This study examined the impact on growth of infants with a birthweight below 1,900 g who were given (or not given) protein enriched breastmilk. Those infants prescribed enrichment differed from the others at birth by lower GA, lower weight, length, and head circumference; they required more intensive care, lost more weight, and the increase in enteral feeding was slower than in the non-E group. Despite more severe morbidity, the infants given protein-enriched milk showed similar growth as the other study infants. Even regarding PI there was no difference between the groups. During the follow-up period up to 18 months corrected age, there were no inter-group differences in weight, length, head circumference or PI. On the other hand, when AGA and SGA infants were compared, the latter had lower PI values. According to Lubchencko's curves, a PI of less than about 2.45 at 40 weeks is below the 25th percentile, and 2.60 at the 50th percentile [14, 18]. The PI levels measured in this study demonstrated that the SGA infants were thinner than the AGA infants at 40 weeks and subsequently.

The reason why the infants in the non-E group showed greater improvement in weight gain and head growth from discharge to 2 and 4 months corrected age may be attributed to the effect of enrichment treatment on the E group; the latter infants gained weight during a longer period of hospital stay, the non-E group with a shorter duration of stay had their catch-up growth after discharge from hospital. LBW infants with controlled nutrition in hospital using enriched breastmilk may gain weight slower after discharge, when on demand feeding has been established.

When twins were excluded, a smaller proportion of E-group infants were fully breastfed on discharge, compared with the non-E group. It is conceivable that this could be attributed to their lower GA and greater morbidity, necessitating a longer stay in hospital, thus contributing to maternal stress with possible consequent impairment of lactation. Another explanation could be the non-verbalized message to the mothers, imparted by adding enrichment to their milk, implying its inadequacy. One further hinder to the establishment of breastfeeding in the E group could be programming for malnutrition in LBW infants, leading to flagging interest in and slower progress with oral feeding, in combination with infant satiety, because of the slower gastrointestinal passage of protein-enriched milk.

The subgroup of 14 infants who reached 'full' breastfeeding at a low PMA had higher SDS for weight at birth than the other infants; at discharge this difference had disappeared. One possible explanation for why they took to breastfeeding so early may be that, unlike the infants with lower weight SDS at birth, they were not programmed for low energy intake and were therefore more interested in oral feeding. Although there is a selection bias, the authors consider the discovery of this fact worth presenting.

The finding that a smaller proportion of infants who received enriched milk breastfed 'fully' is worrisome, as breastmilk feeding is especially important for VLBW infants because of its impact on cognitive development [19]. Breastmilk feeding may also be important for infants at risk of developing the metabolic syndrome, as duration of breastfeeding is evidently associated with reduced risk of high blood pressure [20] and obesity in adult life [21]. One factor that emerged as significant for explaining infant length at 12 and 18 months corrected age was SDS for length at birth. This finding agrees with the common observation that a certain proportion of premature infants with LBW and with poor growth already started in fetal life will continue to show poor growth after discharge from hospital, regardless of type of nutrition given during their stay in hospital. However duration of 'full' breastfeeding also had significant impact on subsequent improvement in SDS for weight. It is therefore essential that appropriate policies and practices for the establishment and maintenance of lactation and breastfeeding in these infants are applied, and that mothers-infants at risk of breastfeeding failure are given sufficient support by adequately trained professionals, in hospital and after discharge. When breastfed infants fail to grow satisfactorily, enrichment can be given as a complement to breastfeeding, intraorally via a syringe or by cup feeding, in order to not jeopardize breastfeeding by introduction of bottle feeding, whether in hospital or after discharge.

An optimal design would have been to randomize infants weighing less than 1,900 g to treatment/non-treatment with enriched milk, but for ethical reasons such a study was inconceivable. In this study, data on infants without and with protein enrichment could be obtained in a quasi-experimental situation, using retrospective data. This made it possible to describe adequate growth in LBW infants not given protein enriched breastmilk.

Conclusion

Protein enrichment of breastmilk enables LBW infants needing more intensive care to attain growth at discharge, comparable to growth observed in infants with lower degree of morbidity who did not receive protein enrichment. It appears that infants with low SDS for length at birth will continue to show poor growth after discharge from hospital regardless of the type of nutrition given during their hospital stay. However duration of 'full' breastfeeding had a significant impact on subsequent improvement in SDS for weight. Therefore it is important that mothers of LBW infants are given sufficient support of lactation and breastfeeding.

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