

Original Article

Exclusive breastfeeding of low birth weight infants for the first six months: infant morbidity and maternal and infant anthropometry

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Background: to report anthropometry and morbidity among term low birth weight infants and anthropometry of their first time mothers during the first six months in relation to breastfeeding practice. **Methods:** we examined data from a randomized controlled trial in Manila, the Philippines. Of the 204 mothers randomized, 68 mothers received eight postpartum breastfeeding counseling sessions, the rest did not. Maternal and infant anthropometric data at birth, 2, 4 and 6 months were taken. During seven follow-up hospital visits, an independent interviewer recorded feeding data. **Results:** the 24 infants exclusively breastfed from birth to six months did not have diarrhea compared to 134 partially breastfed (mean 2.3 days) and 21 non-breastfed infants (mean 2.5 days). Partially breastfed and non-breastfed infants compared to exclusively breastfed infants had more frequent, as well as more severe episodes of respiratory infections. At six months, neither overall gain in infant weight, length and head circumferences nor mean maternal weight and body mass index differed significantly between the feeding groups. **Conclusions:** exclusive breastfeeding for 6 months can be recommended in term low birth weight infants, who were protected from diarrhea, had fewer respiratory infections, required no hospitalization and had catch up growth. Exclusively breastfeeding mothers did not differ from mothers who breastfed partially or those who did not breastfeed with regard to weight changes at six months.

Key Words: breastfeeding, counseling, diarrhea, anthropometry, growth

INTRODUCTION

The World Health Organization's recommendation for mothers to exclusively breastfeed infants for the first six months requires a broader appraisal of its effects on both infants and mothers.¹ This is particularly important for infants born with low birth weight (<2500 grams) and mothers with health risks.^{2,3} Low maternal BMI (<20) is associated with increased morbidity.⁴ Low birth weight (LBW) infants present unique problems in breastfeeding as newborns,⁵ and are at increased risk of serious health outcomes and long-term disabilities.^{6,7} LBW infants in the Philippines and elsewhere are breastfed to a smaller extent compared to infants with normal birth weights.^{8,9}

Exclusive breastfeeding leads to nutritional and immunological benefits as well as improved cognitive outcome.¹⁰ No growth deficiency was found in Honduran LBW infants exclusively breastfed from birth to six months.¹¹ Mothers who breastfeed exclusively are able to space childbirth and are less likely to have menstruation at six months or earlier,¹² which conserves nutrients such as iron.¹³ Breastfeeding helps mothers bond with their infants. Among low-income families, the financial cost savings derived from breastfeeding is huge.

We have recently reported results of a randomized controlled trial in which postpartum peer counseling among mothers of term and low birth weight infants have been shown to increase exclusive breastfeeding up to six months.¹⁴ Since the studied mothers and infants constitute a population at risk for poor health, the aim of this paper is to compare maternal and infant anthropometry and infant morbidity in relation to breastfeeding practice during the first six months.

MATERIALS AND METHODS

The randomized controlled trial was conducted in Metropolitan Manila. The methods of data collection have been described in an earlier article. In brief, the study was done at the Philippine General Hospital in Manila, from January

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2001 to August 2002. The study was approved by the ethics committees of the University of the Philippines, Manila and of the Medical Faculty of Uppsala University, Sweden. A total of 204 low-income, first-time mothers were recruited to the study. The mothers were eligible if they were 18 y or older, intended to breastfeed, and had vaginally delivered a LBW singleton with an Apgar score of 8 or higher at 5 min. The infant had to be born between 37 and 42 wk of gestation, as computed from the mother's last menstrual date and confirmed by Ballard scoring performed by a trained pediatrician. The following were excluded: mothers taking medications that may compromise breastfeeding, and those who were not staying, together with their infants, in the study area until the infant was 6 months old.

Sixty-eight mothers received breastfeeding counselling 67 mothers received general childcare counselling (without breastfeeding counselling) and 69 control mothers did not receive any counselling. The infants were discharged at 2-3 days of age. Those who received counselling were visited at home on eight occasions starting at infant age 3-5 days, then at 7-10 days, 21 days, 6 weeks and monthly thereafter till 22 weeks. The breastfeeding counsellors were trained and monitored by a breastfeeding coordinator.¹⁵ The mothers were asked to bring their infants to the hospital for seven health visits starting at two weeks, then at four weeks and monthly until six months. These visits took place within two weeks of a counselling session. One study physician, blinded to study group, attended to all scheduled and unscheduled infant visits, provided ferrous sulphate drops, and vaccinated all participating infants.

Infants were regarded as exclusively breastfed if they received only breast milk (with or without iron drops) up to six months. Partial breastfeeding is here defined as any breastfeeding in complement with water, formula and/or solids. Of the 204 mothers, 25 (12%) were not able to complete the trial. These 25 mothers relocated or had given up their infants for adoption during the trial period. Twenty-one mothers, 10% (21/204), breastfed for 2 weeks or less and gave formula throughout six months.

The women in this study were originally recruited for a randomised controlled trial but the data concerning infant morbidity and maternal and infant anthropometry are now reported as a cohort study.

The groups studied in this paper are the 24 mothers, 12% (24/204), who breastfed exclusively, the 134 mothers, 66% (134/204) who breastfed partially and the 21 mothers who initiated breastfeeding but did not persist and gave formula only.

Infant anthropometry

Weight, length and head circumference measurements of the infants were taken within 30 minutes after birth by a pediatrician on duty. The study physician, blinded to group, made all subsequent measurements. At infant ages 2, 4, and 6 months, undressed infants were weighed using an electronic weighing scale (Nakamura[®], Japan). Body weight was measured to the nearest gram. The average of three weight measurements was recorded as infant weight. The weighing scale was calibrated daily using standard weights. The study physician and an assistant took infant

length by use of an infantometer (Nakamura[®], Japan), recorded as the average of two readings to the nearest cm. The infant's head (occipito-frontal) circumference was measured to the nearest 0.1 cm using a non-elastic measure tape. An average of two readings was recorded.

Maternal anthropometry

A trained research assistant measured the mid-upper arm circumference (MUAC) and took the weights of all mothers before discharge at 12 to 72 hours postpartum and then at infant ages two, four, and six months. The MUAC was measured using a non-elastic tape, calibrated to the nearest 0.1 cm, at the midpoint of the upper arm between the acromion process and the tip of the olecranon process. In addition a height measurement was performed at infant age 2 weeks. A beam balance weighing scale (Detecto[®], USA) calibrated to 100 grams was used to weigh the mothers. To compute for body mass index (BMI), the weight (kg) is divided by squared height in meter. A BMI of ≥ 20 is regarded as normal, 18.5-20 is low and < 18.5 represents chronic energy deficiency (CED).¹⁶

Infant morbidity

The mothers brought their infants to the study physician when they observed cough, colds or stool changes in the infants. Diarrhea was diagnosed when the infants had stools that were looser, more watery and more frequent than usual. All infant health consultations made by the mother outside the study clinic were verified and recorded by the study physician. All infant illnesses in the study were diagnosed and managed by the study physician.

Statistical analysis

Data were analyzed using the STATA 7.0 statistical software. Descriptive analysis included frequencies and contingency tables. Weight-for-age, length-for-age, and head circumference-for-age z scores were calculated by using EPI INFO 2000 (CDC, Atlanta).¹⁷ Weight at birth and head circumference at birth analysis were compared using ANOVA. Changes in infant anthropometry and maternal weight, BMI and MUAC over time and interaction between time and groups were tested using repeated measures ANOVA. Morbidity outcomes were analyzed by chi-square test and Fischer's exact tests where appropriate. Mean duration of morbidity were compared using ANOVA.

RESULTS

Infants

All 179 infants were born at term (39 ± 0.5 weeks). There were more female than male infants in all groups: 54% of the exclusively breast fed, 60% of the partially breastfed and 57% of the formula fed. The infants had no asphyxia or other medical conditions warranting further stay at the hospital and were discharged within 48 hours postpartum.

Infant morbidity

None of the 24 exclusively breastfed infants had diarrhoea during the study period (Table 1). Comparably, 44/134 (32.8%) partially breastfed infants and 15/21 (71.4%) non-breastfed infants had a mean of 2.3 days and 2.5 days of diarrhoea, respectively. Ten of twenty-one non-breastfed infants had 2 episodes of diarrhoea during the

Table 1. Infant morbidity

	Exclusively breastfed infants (n=24)	Partially breastfed infants (n=134)	Infants on formula (n=21)
Diarrhea	0	44 (32.8%)*	15 (71.4%)*,****
Duration (days)	0	2.3***	2.5**
Respir. tract inf. antibiotics	2 (8.3%)	35 (26.1%)*	12 (57.1%)*
Hospitalization	0	12 (8.9%)**	8 (38%)**
Intensive care	0	2/12 (16.6%)**	2/8 (25.0%)**

* $p < 0.001$ vs. exclusively breastfed, ** $p < 0.01$ vs exclusively breastfed

*** $p < 0.05$ vs. exclusively breastfed

**** $p < 0.001$ vs partially breastfed.

Table 2. Infant anthropometry by age and feeding mode from birth to six months

	Exclusively breastfed infants (n=24)	Partially breastfed infants (n=134)	Infants on formula (n=21)
Mean weight, g (SD)			
Birth weight	2311 (180)	2370 (137)	2375 (130)
2 months	4232 (443)	4242 (469)	4247 (480)
4 months	5625 (653)	5603 (543)	5630 (550)
6 months	6316 (780)	6436 (622)	6435 (613)
Mean body length, cm (SD)			
Birth	46.7 (2.0)	47.2 (1.7)	46.7 (2.0)
6 months	63.0 (2.5)	63.3 (2.5)	63.3 (2.5)
Mean head circumference, cm (SD)			
Birth	31.8 (0.9)	31.8(1.2)	31.8(1.2)
6 months	41.3 (1.5)	41.3(1.1)	41.3(1.5)

Table 3. Gains in weight, length and head circumference by infant age and feeding mode

Gains	Exclusively breastfed infants (n=24)	Partially breastfed infants (n=134)	Infants on formula (n=21)
Mean weight gain, g (SD)			
0-2 months	1879 (386)	1878 (435)	1880 (438)
2-4 months	1363 (407)	1367 (384)	1375 (380)
4-6 months*	683 (335)	834 (325)	834 (320)
0-6 months	3926 (785)	4080 (602)	4075 (618)
Mean length gain, cm (SD)			
0- 6 months	16 (3)	16 (3)	16 (3)
Mean gain of head circumference, cm (SD)			
0-6 months	9.5 (2)	9.5 (2)	9.5 (2)

* $p < 0.05$

study period; two of them required intravenous fluids. Twelve of one hundred thirty-four (8.9%) partially breastfed infants had 2 or 3 episodes of respiratory tract infections during the study period. There were significantly more partially breastfed infants 35/134 (26.1%) and non-breastfed infants 12/21 (57.1%) compared to exclusively breastfed infants 2/24 (8.3%) who received antibiotics for respiratory infections. None of the exclusively breastfed infants were hospitalized for respiratory infections compared to 12/134 (8.9%) of the partially breastfed infants and 8/21 (38%) of the non-breastfed infants. Two of the twelve (16.6%) partially breastfed infants and two of the eight (25%) non-breastfed infants hospitalized for bronchopneumonia required intensive care (Table 1). No infant in the study died.

Infant anthropometry

Table 2 shows infant mean weight at birth, 2, 4 and 6 months. Body length and head circumference at birth and at 6 months is also shown. The exclusively breastfed in-

fants did not differ from those partially breastfed and the non-breastfed infants in any of these parameters. Table 3 shows gains in weight, body length and head circumference in the groups from birth to six months. Weight gains were largest between birth and two months and lowest between four and six months. During the latter period the weight gain of the partially breastfed and non-breastfed infants were significantly higher than that of those who were exclusively breastfed ($p < 0.05$). However, overall weight gain from birth to six months did not differ between the groups. Neither did the gains of length or head circumference from birth to six months differ. Figure 1 shows the development of mean weight-for-age z score (WAZ) during 6 months. Neither WAZ (Figure 1) nor mean length-for-age z score (LAZ) or mean head circumference- z score for age at birth, 2, 4, and 6 months differed between the groups. When tested by ANOVA there were no significant differences between the groups over time. There was no difference in any of the groups with

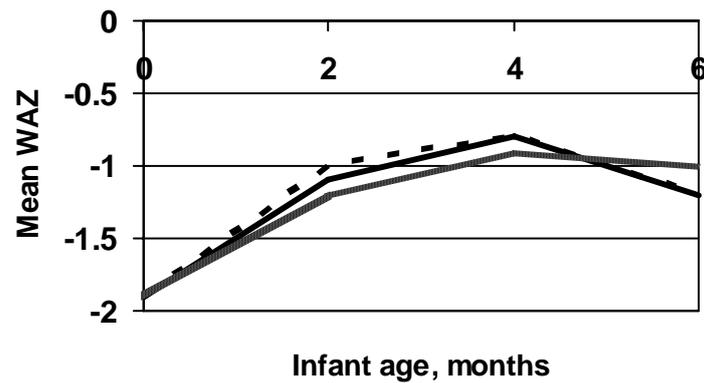


Figure 1. Mean weight for age z-score (WAZ) at birth, 2, 4 and 6 months. Mean weight for age z-score (WAZ) at birth, 2, 4 and 6 months (--- Exclusively breastfed infants, ___ Partially breastfed infants, ooooooo Non-breastfed infants).

regard to mean weight gain between infants of mothers with normal or low BMI and CED.

Mothers

With respect to: age, number of prenatal visits, education, income or employment outside the home; mothers who breastfed exclusively did not differ from those who breastfed partially.

Maternal anthropometry

Table 4 shows maternal anthropometry. Mean height did not differ between the groups. Mean weight, BMI and

MUAC were not statistically different between the groups at 24-48 hour postpartum, or at 2, 4 and 6 months. Neither did the mean weight loss, decrease in BMI or MUAC during the six months differ. ANOVA-analysis showed that there were no significant changes in MUAC over time. However, there were significant changes in weight as well as in BMI but the changes did not differ among the groups for weight or for BMI. The proportions of mothers with low BMI and CED (Table 5) increased as compared to the situation at baseline. However, there were no significant differences among groups at any time point.

Table 4. Maternal mean weight, BMI, height and MUAC

Measurement	Mothers who breastfed exclusively (n=24)	Mothers who breastfed partially (n=134)	Mothers who did not breastfeed (n=21)
Mean weight, kg (SD)			
Baseline	52.3 (8.0)	53.3 (6.9)	52.9 (8.1)
2 months	47.4 (7.3)	47.4 (5.8)	47.4 (5.9)
4 months	45.8 (7.8)	47.0 (6.1)	47.0 (6.1)
6 months	45.3 (8.0)	46.8 (6.2)	46.0 (6.5)
Mean BMI, kg/m ² (SD)			
Baseline	22.5 (2.7)	23.0 (3.0)	23.0 (2.7)
2 months	20.7 (2.7)	20.5 (2.5)	20.5 (3.0)
4 months	20.1(2.8)	20.3 (2.6)	20.5 (2.5)
6 months	19.9 (2.6)	20.2 (2.6)	20.0 (2.8)
Height (cm)	150 (10)	150 (10)	150 (10)
Mean MUAC, cm (SD)			
Baseline	24.3 (2.5)	24.7 (2.2)	24.5 (2.6)
2 months	23.9 (3.3)	24.5 (2.2)	23.9 (3.2)
4 months	23.6 (3.0)	24.6 (2.5)	24.6 (2.5)
6 months	23.4 (3.0)	24.8 (2.7)	24.6 (2.5)

Table 5. Percentage of mothers who are chronic energy deficient (CED) or with low body mass index (BMI) during the first six months

Infant age (mo)	Mothers who breastfed exclusively (n=24)		Mothers who breastfed partially (n=134)		Mothers who did not breastfeed (n=21)	
	Chronic energy deficient†	Low BMI‡	Chronic energy deficient†	Low BMI‡	Chronic energy deficient†	Low BMI‡
Birth	4	13	12	4	10	10
2	17	42	20	25	33	38
4	29	38	23	27	28	33
6	29	38	25	22	28	33

†BMI<18.5 ‡18.5≤BMI<20

DISCUSSION

The infants who were exclusively breastfed from birth to six months were protected from diarrhea as well as severe respiratory infections and had catch up growth. The mean weight loss and decrease in BMI and MUAC through six months did not differ among these first time mothers who breastfed infants exclusively or partially or gave formula. This is reassuring for mothers of low birth weight infants, who commonly have nutritional problems.

Breastfeeding has been reported to lower incidence and percentage of infant ill days, and to result in shorter episodes of diarrhea and acute respiratory infection.¹⁸ We obtained no differences among groups with regard to the number of respiratory infections, even though the partially breastfed infants had more severe infections. Our data are consistent with results from studies from the Philippines as well as with data from other developing countries demonstrating that breastfeeding confers protection against diarrhea. Exclusive breastfeeding protects against diarrhea by eliminating exposure to water- and food borne pathogens.¹⁹⁻²¹ It also provides protection through several factors such as SIgA, antibodies, lactoferrin and lysozyme.²²

Gains in weight, length and head circumference during the six months study period did not differ among the study infants. Further, similar average gains in weight, length and head circumferences were observed even among infants of mothers with low BMI or CED. The mean weight, length and head circumference of the infants of all groups through six months were well within the normal range for LBW Filipino infants.²³ The average gains in infant weight, length and head circumference over the six-month period were similar to those observed in other low-income country studies.²⁴ Despite the smaller weight gain achieved by infants of all groups between 4 and 6 months, growth faltering is difficult to evaluate during the short observation period and by using the NCHS growth chart, which is based on a sample of predominantly formula-fed infants, born appropriate for age. The LBW infants in this study who were breastfed exclusively for their first 6 months had catch up growth implying that breast milk alone is sufficient to support growth. Considering the benefits of exclusive breastfeeding from birth the need to collect this kind of information should be kept in mind and that the use of 24 hours recall of infant feeding might have limitations as to accuracy.

Studies involving mothers from developed countries have not shown any relationship between postpartum maternal weight loss and breastfeeding.^{25,26} Our findings confirm results showing that the duration and exclusivity of breastfeeding was not associated with increased postpartum maternal weight loss at six months.^{27,28} Therefore, exclusive breastfeeding from birth to six months, as recommended by the WHO, is not disadvantageous with respect to maternal physical status.

There are some limitations in our study. First, there were a small number of exclusively breastfed infants. Secondly, our data was derived from a randomized trial, of which the primary objective was to test the efficacy of peer counselling on the exclusivity and duration of breastfeeding through six months. Even though breastfeeding

was self-reported the recall period was short and hence more reliable.²⁹

The strength of the study is attributable to the fact that data was derived from a randomised controlled trial. Only one study physician verified infant illnesses and made all body measurements. Furthermore, one and the same researcher made all maternal measurements during the entire study period. The high quality of the data is strengthened by careful, longitudinal and repeated measurements over time.

CONCLUSION

In conclusion, exclusive breastfeeding from birth to six months was associated with catch up growth and protected LBW infants from diarrhea and more severe respiratory tract infections. It is reassuring that exclusively breastfeeding mothers did not lose more weight than those partially breastfeeding or the mothers who did not breastfeed. Exclusive breastfeeding of term low birth weight infant is thus beneficial for both mother and infant.

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AUTHOR DISCLOSURES

The authors declare that they have no competing interests.

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Original Article

Exclusive breastfeeding of low birth weight infants for the first six months: infant morbidity and maternal and infant anthropometry

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六個月內完全哺餵母乳對低出生體重嬰兒之罹病率及母親和嬰兒體位的影響

前言：探討足月的低出生體重嬰兒之體位與罹病率，以及分析他們的母親在分娩後六個月內，哺餵母乳情形及體位改變狀況。材料與方法：分析資料來自菲律賓馬尼拉一項隨機對照試驗。將 204 位母親隨機分派，其中 68 位接受 8 次產後母乳哺餵諮詢課程。紀錄產後母親與嬰兒在六個月內的體位變化共四次，分別在分娩完、兩個月、四個月與第六個月。並安排七次醫院回診，由面訪者記錄哺餵情形。結果：24 位六個月內完全母乳哺餵之嬰兒都未發生腹瀉，而 134 位部份哺餵母乳與 21 位完全沒有哺餵母乳之嬰兒平均腹瀉持續日數分別為 2.3 天與 2.5 天。部份哺餵母乳與未哺餵母乳之嬰兒，比起完全母乳哺餵之嬰兒，呼吸道感染的發生率比較高，也較嚴重。在第六個月時，嬰兒之體重、身長、頭圍及母親之體重及身體質量指數之改變，在各組皆無顯著差異。結論：建議給予足月的低出生體重嬰兒完全母乳哺餵持續六個月，可預防腹瀉與降低呼吸道感染，免除住院需求，同時維持正常成長。而且六個月內完全哺餵母乳之母親與部份哺餵或是完全不哺餵母乳者，體重變化沒有差異。

關鍵字：哺餵母乳、諮詢、腹瀉、體位、成長