

ORIGINAL ARTICLE

Effect of nutrition education on exclusive breastfeeding for nutritional outcome of low birth weight babies

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Background/Objectives: Low birth weight (LBW), defined as the body weight at birth of less than 2500 g, is a major public health problem in Bangladesh, where 37% of the babies are born with LBW. The objective of this study is to see the impact of nutrition education on growth of LBW babies with early initiation and exclusive breastfeeding compared to control group.

Subjects/Methods: A total of 184 LBW babies and their mothers who attended the Maternal Care and Health Training Institute and Dhaka Medical College Hospital were randomly allocated to either intervention or control group. Enrollment of the study population started in May 2008 and was completed in October 2008. Nutrition education was given to mothers twice weekly for 2 months, on initiation of breastfeeding within 1 h, exclusive breastfeeding and increasing their dietary intake. Nutritional status of LBW babies was assessed for length and weight every 2 weeks. Data were analyzed using SPSS/Window's version 12. Comparison of mean of data was done using standard Student's *t*-test.

Results: Mean initial body weight and length of LBW babies were similar in both groups (2261 ± 198 g vs 2241 ± 244 g, $P=0.535$ and 43.0 ± 1.3 cm vs 43.0 ± 1.7 cm, $P=0.77$). Body weight and length of the LBW babies after 2 months increased significantly (3620 ± 229 g vs 3315 ± 301 g, $P<0.001$ and 50.2 ± 1.3 cm vs 48.7 ± 1.6 cm, $P<0.001$). It was found that the intervention group suffered less from respiratory illness compared with the control group (39% vs 66%, $P<0.001$). The rate of early initiation of breastfeeding was also significantly higher with nutrition intervention (59.8% vs 37.2%, $P<0.001$). Exclusive breastfeeding rate was significantly higher in intervention group (59.8% vs 37%, $P=0.003$).

Conclusions: The present study showed that weight and length gain of LBW babies significantly increased by breastfeeding and nutrition education. Therefore, nutrition education on breastfeeding proves to be a strong tool to reduce the high risk of malnutrition and mortality of the LBW babies.

European Journal of Clinical Nutrition advance online publication, 16 November 2011; doi:10.1038/ejcn.2011.182

Keywords: nutrition education; LBW; weight and length gain; exclusive breastfeeding

Introduction

According to World Health Organization, low birth weight (LBW) is defined as weight at birth less than 2500 g (UNICEF and WHO, 2004). The two major causes of LBW are prematurity (born before 37 weeks of gestation) and intrauterine growth retardation (a condition in which fetal

growth has been constrained) (Kelley and Pojda, 2000; Nohr *et al.*, 2008).

Each year, over 20 million infants are born with LBW worldwide, resulting in a LBW rate of 15.5% (UNICEF and WHO, 2004).

The risk of neonatal death for infants who have LBW, weighing 2000–2499 g at birth is estimated to be four times higher than infants weighing 2500–2999 g, and ten times higher than for infants weighing 3000–3499 g (Ashworth, 1998).

In Bangladesh, the prevalence of LBW is among the highest in the world. The prevalence of LBW is higher in rural areas (37%) than in urban areas (29%) (Salam *et al.*, 2004). Eighty-four percent of LBW neonatal deaths occurred

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Received 10 February 2011; revised 13 September 2011; accepted 24 September 2011

in the first 7 days and half within 48 h of birth (Yasmin *et al.*, 2001).

The recent *Lancet* series on maternal and child under-nutrition revealed an eightfold increased risk of neonatal death for infants with birth weight 1500–1999 g, and a nearly threefold increased risk for infants with birth weight 2000–2499 g higher than infants with birth weight of ≥ 2500 g. It was also estimated that about 2.2 million deaths and 21% disability-adjusted life years for under-5 children were related to intrauterine growth restriction, stunting and severe wasting (Black *et al.*, 2008). There is also evidence from the *Lancet* series that LBW infants in developing countries have increased risk of future chronic health problems, for example, elevated blood glucose concentrations, high blood pressure, or harmful blood lipid profiles (Victora *et al.*, 2008).

The growth of LBW infant was related with nutrition education on early initiation (Nakao *et al.*, 2008) of breastfeeding, position of the baby and attachment to the breast (Goyal *et al.*, 2011), benefits of breastfeeding (immunological growth) (Agarwal *et al.*, 2011) and increased maternal dietary intake to improve ability for more breastfeeding. Breastfeeding is more appropriate for LBW babies, as it has an impact on the faster growth of the baby (Siva Subramanian *et al.*, 2011).

Among neonates, 11 and 12% post-neonatal deaths were associated with LBW (Bangladesh Govt., 2009). Most of these LBW babies are very premature, from 23 to 33 weeks of gestation (Moster *et al.*, 2008). In many instances, the cause(s) of prematurity remains unknown; however, maternal malnutrition, stress, high maternal blood pressures, acute infections, hard physical labor, multiple births, anxieties and other psychological factors are among likely factors (Kelley and Pojda, 2000). In developing countries, during pregnancy, maternal nutritional factor is associated with more than 50% of cases of LBW (Kramer, 1987; Ramakrishnan, 2004). In Bangladesh, poor maternal nutritional status throughout their life cycle is reflected in their low body mass index (BMI), lower weight gain during pregnancy and LBW of their babies (Bangladesh Govt., 2009). In Bangladesh, 30% of women are malnourished (BMI < 18.5) (Bangladesh Govt., 2009). About 20 and 33% of urban and rural women, respectively, have low BMI (< 18.5; Bangladesh Govt., 2009).

Previous evidence showed that maternal weight gain during pregnancy has a positive effect on birth weight of the neonate (Haughton *et al.*, 1992; Alexander and Korenbrot, 1995; Viswanathan *et al.*, 2008). In Bangladesh, National Nutrition Program Baseline Survey 2004 showed that only one-third women had gained more than 4 kg during the third trimester. The mean weight gain in the third trimester was 3.44 kg in Bangladesh (Ahmed *et al.*, 2005).

Exclusive breastfeeding for 6 months is strongly recommended for LBW infants in developing countries (Singh *et al.*, 2009; World Health Organization, 2009). Thirteen percent of all death of children aged less than 5 years (about

1.3 million lives per year) could be prevented by exclusive breast feeding (Jones *et al.*, 2003; Baker *et al.*, 2006). In the first 2 months of life, non-breastfed babies have almost sixfold greater risk of dying from infectious diseases than breastfed babies (WHO Collaborative Study Team on the Role of Breastfeeding on the Prevention of Infant Mortality, 2000; Baker *et al.*, 2006).

The outcome of exclusive breastfeeding is to reduce the rates of morbidity, and mortality in early infancy has been extensively reviewed (Lopez-Alarcon *et al.*, 1997; Zaman and Baqui, 1997; Perera *et al.*, 1999; Baker *et al.*, 2006; Black, 2008). Appropriate breastfeeding of newborns under 2 years of age has the greatest potential impact on child survival of all preventive interventions, with the potential to prevent 1.4 million deaths in the developing countries (Lauer *et al.*, 2007; UNICEF, 2008; LancetSeries, 2009). The increase of weight and head circumference of LBW babies is almost similar to the normal infants by exclusive breastfeeding (Singh *et al.*, 2009). The risk of neonatal death was fourfold higher in children given milk-based fluids even in addition to breast milk.

Globally, over one million newborn infants could be saved each year by initiating breastfeeding within the first hour of life (Lauer *et al.*, 2007). About 20% of neonatal deaths could be prevented by early initiation of breastfeeding (Thrive, 2010). In Bangladesh only, 43% of children are breastfed within 1 h of birth and only 43% of children are exclusively breastfed (Bangladesh Govt., 2009).

According to the WHO growth chart, the mean weight gain for all neonates during first 3 months of life is 1.1 kg and 0.8 kg for boys and girls, respectively (WHO, 2010). In this regard, we hypothesized that it would be possible to increase the rates of exclusive breastfeeding through nutrition education to the mothers and family, which in turn will significantly (at least 500 g) increase the body weight gain of LBW babies at the end of 2 months, compared with the controls.

Materials and methods

Study design

Newborns and their mothers giving birth in hospitals were randomly allocated to either control or intervention group to estimate the effect of the nutrition counseling. The study was conducted at the Maternal Care and Health Training Institute (Azimpur, Dhaka) and Dhaka Medical College Hospital (Dhaka). Enrollment of the study population started in April 2008 and was completed in October 2008. The Ethical Review Committee of ICDDR, B approved the study.

Study participants

A total of 184 LBW babies (92 in intervention and 92 in comparison group) were selected for this study. When an LBW baby was identified, the attending relatives were explained of the purpose of the study, and consent was

obtained by the investigators. Exclusion criteria considered were women having cesarian section, retained placenta, multiple births, babies who were born at night after 2100 h, and physically (disabled, wounded) and mentally (shocked, disturbed, etc. as stated by attending family members) handicapped.

Randomization

After meeting the criteria for selection, the subjects were recruited in the study when the birth weight of the babies was below 2500 g. Random table was used to allocate the mother-baby pairs to the intervention and control groups. Birth weight was measured by the hospital nurses using scales with precision of 100 g and supervised by the investigators.

Intervention

The mothers of the intervention group were given nutrition education as soon as the baby was recruited on exclusive breastfeeding twice a month for 2 months after delivery. Nutrition education was emphasized for avoiding the pre-lactal feeds, start early initiation (within 1 h after birth) of breastfeeding, attachment to the breast by the baby, position of baby during breastfeeding, exclusive breastfeeding for 6 months, increasing the frequency and quality of food intake of the mother during lactation, food hygiene, personal hygiene and necessary assistance from the family for breastfeeding.

Anthropometric measurements

After delivery when mother was physically able to stand, body weight and height were taken using weighing scale and height scale following the WHO guidelines. Body weights were measured to the nearest 100 g using an electronic digital scale (Seca, Hamburg, Germany, model 770) standardized with 10 kg standard weights. Standing height of lactating women was measured using locally constructed height scale with precision of 1 mm. For accuracy in body weight, three measurements were obtained, and the average of the nearest two was taken as the correct measurement. Birth weight and length of the newborn was taken within half an hour of birth, with minimum clothing. Weight of the infant at birth was obtained using Salter Scale (Salter, Tonbridge, UK) with an accuracy of 100 g. LBW was defined as less than 2.5 kg.

Quality-control measures

The data collection instruments were field-tested and adjusted to a maximum accurate response from the subjects. Skills of interviewing, anthropometric measurements and record-keeping were supervised at intervals. Spot-checking was done by the senior author (SKR) who re-interviewed

cases and rechecked 5% of the anthropometric measurement for assessing validity of the data.

Statistical analysis

All statistical analyses were done using standard statistical software (SPSS/Window's version 12, Chicago, IL, USA). Chi-squared test was used to test the difference between proportions. Student's *t*-test was used to test difference between the two means, when distribution was normal. Statistical significance was accepted at a probability level of 5%. Student's *t*-test was applied to compare the quantitative growth data between intervention and comparison group.

Results

The baseline nutritional and socioeconomic status of the intervention and comparison group was comparable (Table 1). Age of the mothers of the intervention group was similar compared with the control group (22.18 ± 4.60 year vs 22.53 ± 4.47 year, $P=0.604$). Monthly income of the groups was comparable between the groups (9258 ± 2459 vs 10090 ± 2784 Tk (Taka, currency of Bangladesh), $P=0.393$). Maternal weight and height were similar in both groups (50.30 ± 4.11 vs 49.22 ± 4.82 kg, $P=0.105$ and 151.65 ± 2.72 vs 151.61 ± 2.34 cm, $P=0.908$) BMI of the intervention group and the control group was not different (21.38 ± 2.19 vs 21.01 ± 1.99 , $P=0.226$). Gestational age of the intervention group was similar compared with the control group (33.97 ± 3.0 vs 33.48 ± 3.12 weeks, $P=0.278$). The proportion of iron tablet intake was also similar in both groups (19.6% vs 21.7%, $P=0.856$). Proportion of male and female babies was comparable between the groups.

Mean birth weight of LBW babies was similar in both groups (2.26 ± 0.19 vs 2.24 ± 0.14 kg, $P=0.535$). Body weight of the LBW babies after 2 months increased significantly in the intervention group compared with the control group (3.62 ± 0.22 vs 3.32 ± 0.30 kg, $P<0.001$; Table 2). There was about 26% more weight gain in education group (1.4 vs 1.1 kg). The length of the LBW babies at birth was similar in both groups (43.0 ± 1.3 vs 43.0 ± 1.7 cm, $P=0.77$). At the end of 2 months, the length of the LBW babies increased significantly in the intervention group compared with the control group (50.2 ± 1.3 vs 48.7 ± 1.6 cm, $P<0.001$) leading to 26% more length gain (Table 3).

Table 4 showed that the rate of early initiation of breastfeeding was 62% higher in the intervention group compared with the control group (59.8% vs 37.2%, $P<0.001$), 62% mothers gave colostrums to the LBW baby in the intervention group compared with 51.1% in control group ($P<0.01$). After 2 months of intervention, exclusive breastfeeding rate was about 60% higher in the intervention group compared with the control group (59.8% vs 37%, $P=0.003$). After 2 months, it was found that infant in the intervention group had 41% less suffering from respiratory

Table 1 Baseline characteristics of study groups

Characteristics	Intervention group N = 92 (mean \pm s.d.)	Comparison group N = 92 (mean \pm s.d.)	P-value ^a
Present age of the mother (years)	22.18 \pm 4.60	22.53 \pm 4.47	0.604
Age of marriage (years)	18.46 \pm 2.25	18.97 \pm 2.60	0.171
Mother's education	4.40 \pm 1.62	4.40 \pm 1.68	1.000
Monthly income	9258.70 \pm 2459.53	10 090.22 \pm 2784.85	0.393
Maternal weight (kg)	50.30 \pm 4.11	49.22 \pm 4.83	0.105
Maternal height (cm)	151.65 \pm 2.72	151.61 \pm 2.34	0.908
Body mass index (BMI)	21.38 \pm 2.19	21.01 \pm 1.99	0.226
Gestational age (months)	33.97 \pm 2.99	33.48 \pm 3.12	0.278
	% (n)	% (n)	
Iron tablet intake during pregnancy	19.6 (18)	21.7 (20)	0.856
Vitamin A during pregnancy	42.9 (39)	34.8 (32)	0.290
Sex			
Male	46.7 (43)	48.9 (45)	0.883
Female	53.3 (49)	51.1 (47)	

^aStudent's *t*-test.**Table 2** Weight gain of LBW babies from 1st day to 60 days

Weight gain (g)	Intervention group N = 92 (mean \pm s.d.)	Comparison group N = 92 (mean \pm s.d.)	P-value ^a
1st day	2261 \pm 198	2241 \pm 148	0.535
15th day	2496 \pm 229	2440 \pm 251	0.117
30th day	2775 \pm 230	2559 \pm 254	0.001
45th day	3107 \pm 260	2944 \pm 286	0.001
60th day	3620 \pm 229	3315 \pm 300	0.001

Abbreviation: LBW, low birth weight.

^aStudent's *t*-test.**Table 3** Length gain of LBW babies from 1st day to 60 days

Height gain (cm)	Intervention group N = 92 (mean \pm s.d.)	Comparison group N = 92 (mean \pm s.d.)	P-value ^a
1st day	43.0 \pm 1.3	43.0 \pm 1.70	0.772
15th day	45.0 \pm 1.3	44.4 \pm 1.6	0.054
30th day	46.4 \pm 1.3	45.7 \pm 1.6	0.001
45th day	48.3 \pm 1.2	47.2 \pm 1.6	0.001
60th day	50.2 \pm 1.3	48.7 \pm 1.6	0.001

Abbreviation: LBW, low birth weight.

^aStudent's *t*-test.

illness (39.1% vs 66.3%, $P < 0.001$) and 37.2% less from diarrhea (40.2% vs 64.1%, $P < 0.002$) compared with the control group (Table 4).

Discussion

Our study has demonstrated the enhanced growth effects of exclusive breastfeeding on LBW babies in regard to weight and length gain. The study showed the effect of nutrition counseling to mothers on breastfeeding the LBW babies,

Table 4 Effect of antenatal nutrition education on breastfeeding practice

Indicator	Intervention group N = 92 (%)	Comparison group N = 92 (%)	P-value ^a
Early initiation of breastfeeding	59.8	37.0	0.001
Given colostrum	62.0	51.1	0.001
Exclusive breastfeeding (after 2 months)	59.8	37	0.003
Respiratory illness (after 2 months)	39.1	66.3	0.001
Diarrhea (after 2 months)	40.2	64.1	0.002

^aChi-square.

leading to significant improvement in nutritional status within 2 months.

The study was undertaken with a missed opportunity of applying the exclusive breastfeeding techniques and skills to explore the beneficial effects on LBW babies who are generally at high risk of mortality and morbidity. The study has underscored important positive outcomes by offering education on breastfeeding to mothers of LBW babies such as early initiation of breastfeeding, skills for attachment to the breast, positioning of the baby and mother, leading to higher early initiation rate, exclusive breastfeeding rate, reduced morbidity, higher weight and length gain.

In Bangladesh, maternal malnutrition and poverty are major determinants of LBW (Nahar *et al.*, 1998; Haseen, 2005). In our study, one of the main objectives was to ensure the exclusive breastfeeding, and at the end of the intervention, it was found that higher proportion of exclusive breastfeeding has increased effect on weight and length gain of LBW babies. Some previous observational studies showed that the growth of LBW infants is strongly associated with

exclusive breastfeeding (Kalies *et al.*, 2005; Gupta, 2008; Gunnarsdottir *et al.*, 2009). Another observational study found that exclusive breastfeeding was enough for LBW babies to gain normal weight and length and no supplementary feeding was necessary for them, and this study found that after 2 months, the weight gain of LBW babies was 1480 g (Sur *et al.*, 2001; World Health Organization, 2008). One previous prospective, longitudinal study found that after 2 months period, the weight and length gain of LBW babies were 1304 g and 7.8 cm, respectively (Singh *et al.*, 2009). Our study showed the effectiveness of nutrition education given at twice weekly intervals, which was a less intensive method than the above instances.

Exclusive breastfeeding is the only practice that is not only naturally available, but also sufficient to overcome the growth, morbidity and mortality of LBW babies (American Academy of Pediatrics, 2005; World Health Organization, 2008). LBW babies in the control group have been affected repeatedly by infections, because of the under-developed immune system and external bacterial contamination of other feeds, but infants in the intervention group was much protected from such infection. Several research results provide strong evidence that breastfeeding increases growth of infants and decreases the severity and frequency of infectious diseases, including bacterial meningitis, bacteremia, diarrhea, respiratory tract infection (American Academy of Pediatrics, 2005). The WHO Multicentre Growth Reference Study (MGRS; WHO, 2006) was based on predominantly breastfed infants and children, and they were taller in comparison with the infants who participated in earlier National Centre for Health Statistics standard, who were predominantly bottle-fed. Better linear growth in our infants with more exclusive breastfeeding in the intervention group was provided by breast milk in required amount of essential and limited amino acids such methionine and lysine.

We have demonstrated that exclusive breastfeeding in LBW babies led to reduced respiratory and diarrheal illness and infections. The enhanced growth effect in the intervention group could be in two ways; first, the ingredients of breast milk were the best suitable nutrients for growth of LBW babies when exclusive breastfeeding is ensured. The second mechanism is to have less disease burden due to infections, which reduces food intake and increases energy expenditure through fever and loss of nutrients through stools. Some of these effects have been confirmed in earlier studies in other settings (Lopez-Alarcon *et al.*, 1997; Zaman and Baqui, 1997; Perera *et al.*, 1999; Baker *et al.*, 2006; Gunnarsdottir *et al.*, 2009; Singh *et al.*, 2009).

We found that significantly much more mothers in the intervention group compared with one-third of the control group gave breast milk to her baby within 1 h (Early initiation of breastfeeding). This has high relevance to reduce the neonatal mortality. Early initiation is a strong tool to prevent mortality of newborn (Adair and Popkin, 1996; Mullany *et al.*, 2008). A previous study showed that late initiation (after day 1) was associated with a 2.4-fold

increase in risk of mortality (Edmond *et al.*, 2006). Another study found that more than 22 and 16% of all newborn deaths could be prevented by breastfeeding within 1 and 24 h of birth, respectively (Mullany *et al.*, 2008).

Our study found that infants who were not exclusively breastfed suffered 40% more from respiratory and diarrheal illness, compared with those infants who were exclusively breastfed. In our study, mean birth weight tends to be slightly higher among the boys than in girls which explains higher prevalence of LBW in girls using the 2.5 kg cutoff point.

Conclusion

Our study demonstrated that early initiation and exclusive breastfeeding have a prospective outcome to reduce growth faltering and morbidity, even when a baby has born as LBW. This has a major implication for Bangladesh, where 37% newborn are LBW babies who contributes to high burden of childhood malnutrition and mortality, challenging the hope of meeting the goals of Millennium development goals, 4.

Conflict of interest

The authors declare no conflict of interest.

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