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Growth and Morbidity in the First Three Months of Life Among Bangladeshi Infants Under Different Breastfeeding Regimens

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ABSTRACT

The study compared the growth and morbidity of infants who had received different feeding regimens throughout the first 3 months of their lives. Ninety-two healthy term infants were observed longitudinally in the Metropolitan area of Dhaka, Bangladesh. Postnatal growth was prospectively measured at monthly intervals from birth to 3 months. Weekly home surveillance was done to record feeding and illness symptoms. The infants were classified into 'predominantly breastfed' (DBF) and 'partially breastfed' (PBF) by their feeding mode. The mean birth weight of DBF infants was 2.83±0.48 kg and PBF infants was 2.93±0.56 kg. The mean group difference of weight increment between birth and the 3rd month was 2.42 kg (DBF) and 2.09 kg (PBF) respectively. DBF infants gained significantly more weight than the PBF infants ($P=0.013$). Morbidity from diarrhoea/ARI was lower among the DBF. Relative risk of exposure to infections was significantly higher among the PBF infants ($P<0.05$). The data showed higher rates of growth increments and less illness episodes among the predominantly breastfed infants than the partially breastfed infants in the early stage of extra-uterine life.

INTRODUCTION

Adequate nutrition, preferably by breastfeeding, is critical for growth and development in the early months of life. Early growth and development is essentially cumulative in nature and is susceptible to environmental influences such as nutrient inadequacy, infection or illnesses, caring pattern etc. Growth faltering is a major nutritional problem among the infants from developing countries (Waterlow, Ashworth & Griffith, 1980; Adair *et al.*, 1993). Though breastfeeding in these countries is universal, exclusive breastfeeding is rare (Mannan & Islam, 1995; UNICEF, 1998). Practices of non-exclusive breastfeeding, colostrum rejection, universal prelacteal feeding and improper weaning, further exacerbates the situation of growth faltering (Ahmed, 1986; Chowdhury *et al.*, 1997; Chowdhury & Mannan, 1998). Among these young children of developing countries, infection frequently coexists (Scrimshaw, Taylor & Gordon, 1968). Some studies indicated that the pattern of weight gain in infancy differs considerably by feeding regimen (Drewey *et al.*, 1992; WHO, 1994; Duncan *et al.*, 1984; Salmenpera, Perheentuba & Siimes, 1985; Krebs *et al.*, 1994; Dewey, 1998). In this context, this study examined

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the pattern of breastfeeding and morbidity on child growth among selected Bangladeshi urban infants from birth to 3 months of age.

MATERIAL AND METHODS

The study forms both prospective (from child visits) and retrospective (from maternal recall) study of infant growth, feeding and morbidity. The protocol was approved by the ethical review committee of the Bangladesh Medical Research Council to conduct the study.

Subjects

The sample was made up of 92 Bangladeshi infants born in the Dhaka Medical College Hospital. Informed written consent was obtained from the mothers before data collection. Infants were selected if they were singleton, full term and healthy. Mothers suffering from chronic diseases like diabetes, hypertension, tuberculosis or pre-eclampsia were not recruited due to probable adverse effects of the disease process on child growth both during intra-uterine life and after birth. The studied population was grouped at the end of the study period to avoid bias and also not to interfere with mother's perception of baby feeding for ethical reasons.

Study design

Mothers were interviewed on the day of delivery and before leaving the hospital, concerning socio-economic characteristics, as well as of past pregnancies. Once a mother who met selection criteria agreed to participate in the study, appointments were made for home visits. Infants were examined and mothers were interviewed every week. Three trained field investigators conducted examinations, interviews, weighing and data recording. During the planned weekly home visits a structured, pre-tested questionnaire was used to record information on infant feeding and illnesses in the preceding week. Infant morbidity was recorded by asking mothers about the symptoms and duration of illness episodes, which occurred during the previous week. Detection bias was minimised by frequent and regular surveillance.

Nutritional Status. Birth-weight of the newborn was taken within hours after delivery in a baby scale to the nearest 50 g (Baby scale – MISAKI, Japan). Subsequent weights were taken at the end of months 1, 2 and 3 during the follow-up visits at their home.

Mother's weight was determined to the nearest 0.1 kg with the use of a SECA-UNICEF electronic weighing scale. Height of mother was obtained by standard wooden height scale.

Infant Feeding. Feeding history of the infants was recorded from day 1 postpartum till the end of the study period by interviewing the mothers every week during home visits. In every interview, the type of milk and food fed to the infant was recorded. 'Breastfeeding' was defined as the mode of feeding from birth until the final follow-up, even if other foods were offered. The breastfeeding group therefore included both infants who were 'predominantly breastfed' / DBF (when infant had received breast milk with / without complement of water) and 'partially breastfed' / PBF (when a breastfed infant received additional milk or milk based fluid).

Infant Morbidity. The identification of events and duration were based on the answers provided by the mother during questioning. The definition of illnesses used was adopted from those used by Mardya, Villalpando & Fajardo (1997). *Diarrhoea* was defined as the presence of three or more liquid or semi-liquid (whitish or greenish) stool per day accompanied or not by blood, mucous or fever. The total numbers had to exceed the usual

number of daily bowel movements. *ARI or Acute Respiratory Infection* was defined as the presence of runny nose or cough for at least two consecutive days or more of the following signs independent of duration – hoarse cry, respiratory distress (short breath, chest indrawing) or fever.

Individual episodes were defined as an event separated from another event by at least two days free of symptoms.

Data analysis

Statistical analysis was performed using the following computer packages – SPSS release 10.0 and EPINFO release 6. In bivariate analyses Student's *t*-tests were used when the data were normally distributed, otherwise non-parametric methods (Mann-Whitney-U test, chi-square tests) were used to compare groups. ANOVA was done to see the effect of feeding on final weight after controlling for birth weight.

RESULTS

The study infants were grouped into two groups, based on their feeding mode during the observation period. The 'predominantly breastfed' group (DBF, n=49) was given breast milk with or without non-milk fluids, and the 'partially breastfed' (PBF, n=43) group received breast milk and additional milk or milk based fluid.

General information of the mother

The characteristics of the mother recruited for the study are depicted in Table 1. Mean age of the mothers was 22 and 23 years respectively. About 40% of them were primipara. By occupation most of the mothers were housewives, only eight mothers in DBF group were found to be engaged in outside employment. The family income level of about half of the subjects was below Tk-5,000/- per month, but a substantial number (more than 40%) of families were between Tk-5,000/- to Tk-10,000/- income scale. Nutritional status as measured by BMI score shows 70-72% of the mothers were well nourished. Maternal characteristics did not differ significantly between the groups, thus allowing the groups to be socially comparable.

Infant feeding

All the infants were breastfed. The mean time of putting the infants on breast was less than 2 hours (1.88 ± 1.28) in Group-1 (DBF) and it was 17 hours (16.7 ± 1.77) for Group-2 (PBF) – data not shown. None were found to have discarded colostrums. Prelacteal feeding was common in general. Plain water or sugar-sweetened water was introduced shortly after birth in both the groups and fed intermittently. Therefore, none of the infants were exclusively breastfed. Other supplements, usually powdered milk, were given to the infants in PBF group.

Infant growth

Mean weight of the studied infants at birth, m-1, m-2 and m-3 are shown in Table 2. No significant difference between the groups could be detected at any point of the study period. The gain in weight was more pronounced in DBF than in PBF group, though the mean birth weight of the infants of PBF group was higher than that of DBF group. The mean velocity of monthly weight gain of the studied population is shown in Table 3. Greater mean weight gain was observed in the 2nd month in both the groups, which was significantly higher in the DBF group ($P<0.05$). The velocity of weight gain varied from 24 to 32 g per day (in DBF) and 22 to 26 g per day (in PBF). The DBF infant's per day weight increment was higher than the earlier study of Talukder (1986), which

Table 1. Maternal characteristics of study population

	Group-1/ DBF (n = 49)	*Group- 2 / PBF(n = 43)*	*P-value*
Age (in years)	*22 ± 4.09*	*23 ± 4.55*	*N.S.*
Parity			
Primi	21 (43)	18 (42)	N.S.
Multi	28 (57)	25 (48)	
Occupation			
Housewife	41 (84)	41 (95)	N.S.
Service	8 (16)	2 (5)	
Family income in Tk*. (monthly)			
# 5,000	24 (49)	20 (46)	
5,001 – 10,000	22 (45)	18 (42)	N.S.
$10,001	3 (6)	5 (12)	
Mean income (Tk)	5546 ± 4718	6443 ± 5153	
BMI Score			
< 18.5	6 (12)	7 (16)	
18.5 – 25.0	35 (72)	30 (70)	N.S.
> 25.0	8 (16)	6 (14)	
Mean BMI	21.83 ± 3.41	22.58 ± 3.46	

Note : Figures in parentheses are percentages * 1 US$=Tk.50

Table 2. Weight in kg (mean ± s.d.) of the infants at different time interval

Age (months)	*Feeding group*[a]	*Mean (SD) weight (kg)*	*P-value*
At birth	DBF	2.83 (0.48)	.917
	PBF	2.93 (0.56)	
m-1	DBF	3.51 (0.61)	.384
	PBF	3.56 (0.67)	
m-2	DBF	4.41 (0.59)	.785
	PBF	4.30 (0.74)	
m-3	DBF	5.25 (0.68)	.138
	PBF	5.02 (0.88)	

[a] DBF (n=49), PBF (n=43)

Table 3. Velocity of growth over 3 months

Interval (months)	*Mean weight gain (kg)*		*Z - score*	
	DBF	*PBF*	*DBF*	*PBF*
At birth	2.83 ± 0.48	2.93 ± 0.56	- 1.5	-1.5
m – 1	0.68 ± 0.31	0.63 ± 0.41	- 1.0	-1.0
m – 2	0.90 ± 0.30	0.74 ± 0.35	0.5	0.0
m – 3	0.84 ± 0.26	0.72 ± 0.33	1.0	0.5

Table 4. Mean weight gain (in kg) of the infants by feeding group

Feeding Groups	*Birth weight*	*Weight on 3rd month*	*Mean diff. : wt. 3rd m – birth wt.*	*F and P value*
DBF	2.83 ± 0.48	5.25 ± 0.68	2.42 ± 0.46	F=6.44
PBF	2.93 ± 0.56	5.02 ± 0.88	2.09 ± 0.74	(1,89) P=0.013

showed a daily increment of 23.97 g per day. The mean difference of weight increment between the birth weight and weights at 3rd month was 2.42 kg and 2.09 kg respectively (Table 4). The mean difference of the initial and final weight between the groups was statistically significant when the data was analysed using analysis of co-variance where the final weight was used as the dependent variable and the initial weight as a co-variate, while feeding groups as a factor. The main effect on the breastfed group was significant (F=6.44, d.f. = [1,89] and the exact P=0.013), suggesting that those who were predominantly breastfed gained more weight than those who were on partial breastfeeding.

Infant morbidity at follow-up

The number of illness episodes and mean duration of illness per episode of the infants are shown in Table 5. To get an idea of the infant morbidity at different time intervals, we grouped the observation period into three: m-1, m-2 and m-3. Number of infants who were ill and disease episodes was more in DBF group than in PBF, but the difference was not statistically significant. More infants were found sick with ARI than with diarrhoea in both the groups. A similar finding was reported by Rahmanifar *et al.*, (1996). It was found that the infants suffered more during the 2nd month of their life. Number of illness episodes and mean days of illness per episode was not statistically different between the groups (P>0.05).

Effect of feeding on morbidity

Risk of exposure to infection over the weeks as expressed by RR (Relative Risk) factor was calculated and is shown in Table 6. Mean RR was 1.22±0.46 for DBF and 2.14±1.02 for PBF during the observed period. The values differ significantly between the groups (P<0.05). Thus, risk of infection among the partially breastfed infants is higher than the predominantly breastfed infants.

Table 5. Illness of the infants expressed as number of infants ill, number of episodes, duration of episodes during months 1, 2 and 3

Illness	*Age of infants*		
	m-1	*m-2*	*m-3*
DBF (n = 49)			
Diarrhoea			
No. of infants ill	2	3	4
No. of episodes	2	3	4
Duration of episodes (days)			
mean ± SD	4.5 ± 2.1	3.0 ± 1.7	4.0 ± 1.4
Episodes > 7 days	0	0	0
ARI			
No. of infants ill	12	11	9
No. of episodes	18	14	11
Duration of episodes (days)			
mean ± SD	4.0 ± 2.4	4.6 ± 3.0	3.4 ± 2.1
Episodes > 7 days	1	1	1
All illnesses[a]			
No. of infants ill (% of all infants)	26 (53)[b]	30 (61)	31 (63)
Episodes	32	34	38
PBF (n = 43)			
Diarrhoea			
No. of infants ill	4	3	5
No. of episodes	6	4	6
Duration of episodes (days)			
mean ± SD	4.0 ± 2.9	3.7 ± 3.1	4.2 ± 1.8
Episodes > 7 days	0	0	0
ARI			
No. of infants ill	16	17	13
No. of episodes	22	27	16
Duration of episodes (days)			
mean ± SD	3.9 ± 1.8	4.3 ± 2.1	3.5 ± 2.2
Episodes > 7 days	0	1	1
All illnesses[a]			
No. of infants ill (% of all infants)	32 (74)	38 (91)	28 (65)
Episodes	55	66	46

[a]Including diarrhoea, respiratory, fever, dysentery, skin, eye, ear and mouth infections
[b]Figures in parentheses are percentages

Table 6. Risk of exposure to infection by feeding group

Feeding mode	*No. of child ill*	*No. of days ill*	*Episodes*	*RR (m ± sd)*	*P*
DBF	87	320	104	1.11 ± 0.46	
PBF	98	501	167	2.14 ± 1.02	<0.05

DISCUSSION

The child's rate of postnatal growth appears to be a resultant variable, which is influenced by feeding type and incidence of illness. Our findings highlight different growth and morbidity patterns between predominantly breastfed and partially breastfed infants during the first 3 months of extrauterine life. No differences in maternal characteristics (age, BMI, gravida, family income, working status) were found between those who had started feeding predominantly with breast milk and those with breast milk plus other milk or milk products. The mean birth weight by feeding regimen was not different among groups, allowing us to assume that the nutritional status was comparable at base line (Table 4). Though the DBF infants were lighter at birth, they gained weight more and grew more quickly in weight and became heavier at every follow-up measurement compared to their counterpart. The body weight nearly doubled by the 3rd month of age. These results are consistent with recent studies (Gokcay *et al.*, 2003; Hop *et al.*, 2000). Per day weight increments for the groups (DBF vs PBF) during m-1 (24.29 g vs 22.5 g respectively), m-2 (32.14 g vs 26.42 g respectively, $P<0.05$) and m-3 (30.0 g vs 25.7 g respectively, $P<0.05$) show a linear upward trend for the first two months in both the groups and then declines. The results confirm the WHO views on infant growth that the postnatal weight gain of the infants maximises during the 2nd month of life (WHO, 1994). The rate of growth between the groups was different and more pronounced at 2nd month ($P<0.05$). This difference in weight increment signifies the importance of predominant breastfeeding. At birth, the mean z-score values of both the groups were at –1.5, but with the advancement of time, the catch-up growth for the DBF infants was more than the PBF infants, and at the end of 3rd month, the z-score value reached to the height of +1.0 against +0.5 (Table 4). The catch-up growth was more pronounced among the DBF infants than the PBF infants at any point of the observation throughout the study period.

The DBF infants were observed to have a lower incidence of ARI/diarrhoea, and a lower percentage of sick days of shorter duration than the PBF infants. These findings are consistent with other researchers (Beaudry, Dufour & Marcoux, 1995; Brown *et al.*, 1989; Wright *et al.*, 1989 Pisacane *et al.*, 1994), claiming a protective effect of breastfeeding against infection. Infants were more often sick with ARI than with diarrhoea in both the groups, as also shown by Rahmanifar *et al.* (1996). The number of episodes of illnesses from diarrhoea / ARI was seen more among the partially breastfed infants during the 2nd month, which might have compromised their growth by reducing weight increment in the 3rd month. The study findings indicated that the reduction in morbidity is associated with the mode of breastfeeding practised.

Since the major aim of the study was to compare growth and morbidity between two defined breastfeeding groups, it is concluded that predominant breastfeeding allows the infants to achieve their optimum growth. This study thus reinforces the benefits of breastfeeding for the health of infants in our society. In developing countries like Bangladesh, where breastfeeding is virtually universal and homogeneously prolonged (Mannan & Islam, 1995), motivation of the mothers to abandon pre-lacteal feeding and practice of predominant breastfeeding, if not exclusive, is therefore called for to ameliorate early malnutrition in childhood.

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