GROWTH PARAMETERS OF EXCLUSIVELY BREASTFED VERSUS NON-EXCLUSIVELY FED INFANTS IN THE FIRST 5 MONTHS OF LIFE BEFORE INTRODUCTION OF SEMI-SOLID FOODS

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ABSTRACT

Introduction

Exclusive breast-feeding has many advantages over non-exclusive feeding; better growth and lower risks of infections being most important. The aim of this study was to find the hospital prevalence of exclusive breast-feeding, find any differences in growth and morbidity patterns in babies who were exclusively breast-fed as compared to those who were not.

Methodology

This was a hospital-based cross-sectional study over a period of one year which enrolled infants 1.5 months, 2.5 months, 3.5 months and 5 months of age who were on exclusive breast-feeding or non-exclusive feeding and who had not been started on semi-solid foods. Growth and morbidity patterns were recorded. Statistical analysis was done by SPSS ver 25. Continuous variables were reported as median [IQR] while categorical variables were reported as absolute number (%). Mann-Whitney U test and Chi-square test were used to find the level of significance respectively.

Results

The hospital prevalence of exclusive breast-feeding was found to be 62%. Weight for age was significantly higher in infants who were on exclusive breast-feeding (p=<.05) at 1.5, 2.5 and 3.5 months of age. Similarly length for age was higher in infants at 1.5 months (p=.034) of age but there after no difference was seen. Undernutrition was seen in 5.5% of non-exclusively fed infants as compared to 0.9% of exclusively breast-fed babies (p=<.001). Illnesses like pneumonia, diarrhea, ear infection and urinary tract infection were seen more in infants who were on non-exclusive feeding as opposed to infants who were exclusively breast-fed (p=<.05).

Conclusions

Exclusively breast-fed babies have better growth in terms of weight and lesser morbidities as compared to those babies who are non-exclusively fed.

KEYWORDS

Breast-feeding, growth, infant, morbidity

INTRODUCTION

Both World Health Organization (WHO) and UNICEF recommends initiating breast-feeding within an hour of birth, exclusive breast feeding to all infants until six months of age and continued breast-feeding up to the first two years of life or more with introduction of age-appropriate nutritionally acceptable semi-solid foods starting from the sixth month of age.[1] Optimal and appropriate feeding in the first two years of a child's life are critically important so that he achieves adequate growth and development. It also ensures lesser morbidities and lowers mortality.

Exclusive breast feeding (EBF) is defined as feeding infants with breast milk (including expressed milk) only till first six months of a child's life; occasional medications, oral rehydration saline being exempted from this definition.[2] The unique composition of breast milk allows it to meet the nutritional requirements of infants upto the first six months of life. Several benefits have been associated with EBF; namely better growth and development, decreased number of episodes of diarrhea and pneumonia (the two most common causes of morbidity and mortality in under-five children) as well as conferring positive health effects to the mother as well.[3-7] However, despite these positive effects, many mothers cannot, or choose not to, exclusively breastfeed. As a result, babies are supplemented with other sources of milk-animal or formula or maybe even other non-milk products. Giving an infant these alternate sources of feed will not provide them with the distinct advantages provided by breast milk.

Data of 2015-2020 shows that globally only 44% of infants 0-6 months of age are exclusively breastfed.[1] A large Demographic Health Survey conducted by United States Agency for International Development in 20 developing countries found the rate of EBF was 32% in infants 0-6 months of age.[8] While as per data of Nepal Demographic Health Survey (NDHS) 2016, 66% of babies under six months of age were found to be exclusively breastfed.[9] The remainder were found to be fed with other milk or non-milk foods.

The first six months of life is characterized by maximum growth velocity and any impediment on growth during this time either by nutritional inadequacy or ill-health can have an impact on future growth. Although under nutrition in the first six months of life is probably more prevalent than what is known, the true extent is really questionable because this group of infants are generally discriminated while doing nutritional surveys.[10] Most surveys focus on the anthropometric measurements of children 6-59 months of age when defining undernutrition. Some studies have found that undernutrition is indeed quite prevalent in this age group.[11,12] Added to that fact, if exclusive breastfeeding is terminated before that time, it can cause undernutrition as well as increase the chances of acquiring infectious diseases.[13-15] Hence the objectives of this study was to find the hospital prevalence of exclusive breastfeeding in infants ≤ five months of age before introduction of semisolid foods, study the growth parameters in children on EBF against those not on EBF and also to study the morbidity patterns of infants in the two groups.

METHODOLOGY

This was a hospital based cross-sectional study conducted over a period of one year which enrolled babies attending the immunization clinic for their vaccination at 1.5 months, 2.5 months and 3.5 months of age. Infants who were five months of age but had not been weaned till that age were enrolled from pediatric outpatient department. Only those babies who were born at term were included in the study. Sample size was calculated using confidence level of 95%; power 80% and margin of error 5%. Prevalence was used from a previous study done in Nepal which found stunting prevalence of 12.6% in babies on inappropriate exclusive breastfeeding.[16] From this data, sample size was calculated as 163; we enrolled 180 babies in each groups of 1.5, 2.5, 3.5 and 5 months. Babies who were born preterm, who suffered from significant illness in neonatal period or thereafter, who had feeding difficulties which impaired normal feeding or those babies who had already been weaned with semi-solid foods were excluded. Informed consent was taken from the guardians prior to enrolling the babies in the study. Those babies whose guardians did not give consent for participation in the study were excluded. Ethical clearance was taken from the institutional review board (IRB) prior to enrolling the study subjects. Babies who were fed on breast milk only were taken as being exclusively breastfed (EBF). Those babies who were on partial breastfeeding (breast milk plus other sources of milk like formulas or bovine milk) or on only other sources of milk (formulas or bovine milk) were grouped as being non-exclusively fed (NEF). Demographic details about the mother and neonatal characteristics were collected. Type of feeding (EBF vs NEF), time of initiation of feeding after birth, whether colostrum fed or not and other such pertinent details were noted. Babies' weight was taken three times with minimal clothing on a weighing scale which had an accuracy of ± 50 gm (Docbel Braun). The average of three readings was taken as the actual weight. Length was measured keeping the legs extended and the top of the head and the sole of the foot touching the head board and foot board respectively using an acrylic infantometer with accuracy of ±0.1 cm. Weight for length was computed from the expected weight for that length. Head circumference was measured by using a standard measuring tape taking the supra-orbital ridge in front and occipital protruberance as landmarks. Chest circumference was measured using measuring tape at the level of nipples. In addition, details about any illnesses (diarrhea, pneumonia and others) which the infants might have suffered till then were noted on a pre-designed proforma.

Data was entered into an Excel spreadsheet and analyzed by SPSS ver 25. Normality of data was assessed by Shapiro-Wilk test. Categorical variables were presented as absolute number (%). Since data was found to be non-normally distributed, continuous variables were reported as median [IQR]. Z-score values were computed by SPSS. For weight, any value <-2SD for age was taken as under weight. Similarly, for length a z-score value <-2SD was taken as short for age (stunted). Wasting was defined as weight for length <-2SD. In case of head circumference, if <- 3SD was taken as

microcephaly and if > +2SD was taken as macrocephaly. To assess the level of significance for continuous variables, Mann-Whitney U test was used while for categorical variables Chi-square test was used. Level of significance was taken as p<.05.

RESULTS

Out of 720 babies enrolled into the study 446 (62%) babies were exclusively breastfed while 274 (38%) were non-exclusively fed. The ratio of males: females was 1.2:1.Of the babies who were on NEF, formula alone was used as the source of feeding in 224 (31%) while buffalo milk alone was found in 34 (4.7%). In other cases babies were fed predominantly with formula or buffalo milk but additionally other milk sources were also given in between (breastmilk, cow milk, etc). The most common reason for initiating NEF was mother's perception of inadequate breastmilk; this was seen in 245 (34%) cases. In 13 (1.8%) cases, NEF was given due to maternal illness. Five (0.7%) mothers were unable to exclusively breastfeed as they were job-holders and one mother (0.1%) chose not breastfeed her baby but opted for formula. Amongst the study participants, in 668 (92.7%) cases the mothers had more than primary education. In 242 (54.3%) cases of EBF group mothers had more than higher secondary level education as compared to 173 (63%) in the NEF group (p=0.019). EBF was seen in 90.6% of mothers who had ≤ 2 children as compared to 9.4% of those who had >2 children (p=.007). EBF was seen in 275 (70%) of babies delivered by vaginal delivery as compared to 171 (52.3%) of babies delivered by cesarean section (p<.001). Mothers who were housewives or working from home were more likely to exclusively breastfeed (64.8% vs 54.4%) as compared to those who were job-holders (p=.011). Colostrum was fed in 335 (75%) of babies who later received EBF while 111 (25%) of those babies who did not receive colostrum also had EBF (p=<.001). Feeding was initiated earlier in babies who had EBF as compared to the other group (p=<.001).Table 1 shows the demographic characteristics of the participants.

Table 1: Characteristics of study participants

Parameters	Exclusively breast-fed group[EBF] (n= 446)	Non-exclusively fed group [NEF] (n= 274)
Male gender[#]	246 (55.2)	158 (57.7)
Maternal age[*]	27[7]	27[6]
Parity[#]		
≤2	404 (90.6)	263 (96)
>2	42 (9.4)	11 (4)
Maternal educational status[#]		
No formal education	11 (2.5)	6(2.2)
Primary education	21 (4.7)	14 (5.1)
Lower secondary education	172 (38.6)	81 (29.6)
Higher secondary education	111 (24.9)	74 (27)
Higher education	131 (29.4)	99 (36.1)
Gestation in weeks[*]	39[2]	39[2]
Vaginal delivery[#]	275 (61.7)	118 (43.1)
Birth weight[*]	3000 [650]	2930 [800]
Colostrum fed[#]	335 (75.1)	149 (54.4)
Feeding initiation after birth (in hours)[*]	2[23]	24[47]
Demand feeding[#]	381 (85.4)	209 (76.3)
Working mother[#]	106 (23.8)	89 (32.5)
Number of study participants[#]		
1.5 months	103 (57.2)	77 (42.8)
2.5 months	124 (69)	56 (31)
3.5 months	109 (60.6)	71 (39.4)
5 months	110 (61)	70 (39)

[*]median [IQR]; [#]number (%)

Table 2 shows the anthropometric data of children in the two groups. We found that weight was significantly higher in the group who had EBF as compared to NEF at 1.5 months (p=<.001), 2.5 months (p=.002) and 3.5 months (p=<.001). However at 5 months of age, there was no difference in weight between the two groups. Similarly, length was higher in the group with EBF at 1.5 months of age (p=.034) there after there was no difference between the two groups. There was also no statistically significant difference in head circumference and chest circumference between the two groups at any age.

Table 2: Anthropometric parameters of babies exclusively breast-fed (EBF) versus non-exclusively fed(NEF) according to age

Parameter	EBF	NEF	p-value
Weight for age*			
1.5 months	5[1]	4.5[1.2]	<.001
2.5 months	6[1]	5.5[1]	.002
3.5 months	6.7[1.2]	6.2[1]	<.001
5 months	7[1.4]	7[2]	.380
Length for age*			
1.5 months	57.7[4]	56[5]	.034
2.5 months	60[6]	59[5]	.202
3.5 months	62[4]	61[4.5]	.182
5 months	65[5]	63[4.8]	.276
Head circumference for age*	38[2]	37[3]	.293
1.5 months	39[2]	38.5[2]	.554
2.5 months	41[3]	40[2]	.144
3.5 months	41[2]	41[2]	.620
5 months			
Chest circumference for age*	37[4]	36[3]	.101
1.5 months	37.5[3.8]	37[4]	.973
2.5 months	39[3]	39[3]	.872
3.5 months	40[2]	40[2.6]	.553
5 months			

[*]Median [IQR]

Underweight (weight for age <-2 SD) was seen in 4 (0.9%) of babies in EBF group as compared to 15 (5.5%) in NEF group while weight >+2 SD for age was seen in 8 (1.8%) and 1 (0.4%) in EBF and NEF group respectively (p<.001). Length for age z-score <-2SD (stunting) was seen in 2.5% of EBF infants as compared to 3.7% of NEF infants while length >+2SD was

seen in more babies in EBF group; however these findings were statistically not significant. There was also no difference in the z-scores of weight for length and head circumference for age in the two groups (Table 3).

Table 3: Characteristics of infants according to z-score values in exclusively breastfed (EBF) and non-exclusively fed (NEF) group

Parameters	EBF	NEF	p-value
Weight for age z-score*			
<-2 SD	4(0.9%)	15 (5.5%)	
-2.1 to 2 SD	433 (97.3%	257 (94.1%)	<.001
>+2 SD	8 (1.8%)	1 (0.4%)	
Length for age z-score*			
<-2 SD	11 (2.5%)	10 (3.7%)	
-2.1 to 2 SD	427 (96%)	263 (96.3%)	.077
>+2 SD	7 (1.6%)	0 (0%)	
Weight for length z-score*			
<-2 SD	0 (0%)	0 (0%)	
-2.1 to 2 SD	418 (93.7%)	264 (96.4%)	.126
>+2 SD	28 (6.3%)	10 (3.6%)	
Head circumference for age z-scores*			
<-3 SD	0 (0%)	1 (0.4%)	
-3.1 to 2 SD	440 (98.7%)	271 (98.9%)	.332
>+2 SD	6 (1.3%)	2 (0.7%)	

*number (%)

On analyzing the difference in morbidity patterns in between EBF and NEF groups, no difference was found in incidence of pneumonia between the two groups. However, in those babies who developed pneumonia, episode of pneumonia >1 time was seen more in those babies who were on NEF (p=.022). Diarrhea, on the other hand was seen more in those babies who were on NEF (p=.001). In those babies who had at least one episode of diarrhea, more than one episode of diarrhea was seen more in the babies who were on NEF (p<.001). Ear infection and urinary tract infection was also seen more in babies who were on NEF (p=.035 and p=.008 respectively). Table 4 elaborates the morbidity profile of infants in the two groups.

Table 4: Morbidities of babies exclusively breastfed (EBF) versus non-exclusively fed (NEF)

Morbidities	EBF (n=446)	NEF (n=274)	p-value
At least one episode of	114(25.6)	77(28.1)	.453
Pneumonia#	9(2)	14(5.1)	.022
Pneumonia >1 time#			
At least one episode of	43(9.6)	51(18.6)	.001
Diarrhea#	2(0.4)	16(5.8)	<.001
Diarrhea > 1 time#			
Other illnesses#			
Ear infection	2(0.4)	7(2.6)	.035
UTI	3(0.7)	9(3.3)	.008
Meningitis	1(0.2)	3(1.1)	.127
Septic arthritis	0(0)	2(0.7)	.071
IDA	0(0)	1(0.4)	.202

DISCUSSION

This study found the hospital prevalence of exclusive breast feeding to be 62%. This was comparable to the finding of NDHS 2016 where 66% of infants less than six months of age were found to be exclusively breastfed.[9] Similar finding was noted in anotherstudy conducted in Nepal where exclusive breastfeeding was found in 61.3% of infants under six months of age.[17] However disparities were found in some studies conducted in various regions of Nepal. In a study conducted in Kaski district, it was found that although 98% of mothers breastfed their infants for first six months of life, the rates of exclusive breastfeeding declined rapidly from 90.9% at birth to 29.7% at 22 weeks of age.[18] Similarly, a study conducted in Mid-Western and Eastern part of Nepal found EBF in 23.3% infants under six months of age.[19] So rates of EBF is seen to vary within regions in the same country as it can between countries. Studies have found that EBF is higher in developing nations but lower in the more developed countries.[20-24] Reasons for these disparities within the same geographic regions and in between nations could be the different subsets of population sampled with differing mentalities, their educational and socioeconomic conditions, easy accessibility to formula and non-human milk products, working group of mothers, etc. From the individual aspect, reasons why the prevalence of non-exclusive breast feeding is increasing are problems with latching and effective lactation so that mothers feel that her breast milk is inadequate for the baby, concerns about infant's weight gain, ill-health in mothers, unsupportive work policies, lack of family support, etc.[18,19,21] The Global Breastfeeding Collective, a partnership of non-governmental organizations, academic institutions and donors, led by WHO and UNICEF set a global target to increase the rates of EBF to at least 60% by 2030.[24] And even though our hospital prevalence of 62% has surpassed the global target, there is still a long way to go before this target is achieved globally.

A study was conducted in Brazil to see the effects of exclusive breastfeeding on growth of infants upto six months of age; it was found that although growth was rapid in the first four months of life, there was a slowing of growth to almost 50% after the fourth month with similar finding observed in terms of length.[25] Another study conducted in Sweden, however shows that while there was no significant differences in weight gain in between the EBF and NEF group at 0-4 months, there was a slowing in growth in both the groups at 4-6 months, more so in the EBF group.[5] In our study although weight was significantly higher in the group with EBF as compared to NEF in infants <5 months of age but there was no difference at 5 months of age. We however did not find any difference in length between the two groups except at 1.5 months of age. There are some studies which have shown that formula feeding is associated with greater weight gain when compared to exclusive breastfeeding.[14,26] The higher protein content and addition of other nutritional elements like iron, calcium, phosphorus, vitamins, lipids etc

in the formula might contribute to greater weight gain in formula fed than in those babies on EBF.[27] Because the nutritional requirement gradually increases as baby grows, it could be that starting at around 4-6 months of age, only EBF might not be sufficient for growth. Among the babies who were on NEF, 31% were fed exclusively on formula. As the formula-fed babies are already receiving added nutritional supplements, it might have seemed that there was lesser growth in those babies fed EBF and this could be the reason that at 5 months of age, we did not find any difference in weight at that age.

More babies on NEF were underweight as compared to EBF group while more babies with EBF had weight >+2SD as compared to NEBF group. Weight can be influenced by the feeding status whether EBF or NEBF even over a short period of time while length reflects the nutritional status over a longer time duration. The study sample consisted of infants < 6 months of age; the time frame could have been too short to have an effect on the length of the infant. If these infants had been followed over time maybe we could have studied the effect of feeding type on the length of the child. There was also no difference in wasting or stunting between the two groups. This finding is supported by a study conducted in Bangladesh where it was found that early interruption of EBF before 4-6 months had a significant increase in underweight but there was no effect on wasting and stunting.[13]Similar finding is reported by another study conducted in Kenya where there was no difference in the status of underweight, wasting or stunting in babies who were EBF against those who were on NEF.[28] One study compared the growth pattern of exclusively breastfed babies against the standard NCHS 1977 and WHO 2006 growth charts and found that the weight of these babies were higher than the NCHS references at 2,3,4 and 6 months of age. When compared to WHO charts the weight were higher for males at 3 and 4 months; while for females at 2,3 and 6 months. While there was no difference in length for males except at birth and for females the length was higher than the NCHS and WHO standards at 2 and 6 months.[29]

A large study conducted in 20 developing countries found that the weight and length was significantly higher in the babies who were on EBF as compared to those who were not on any breastfeeding or not on EBF. They also had higher weight and height z-scores and lower probabilities of wasting and stunting when compared to non-breastfeeding and NEF group. The probability of diarrhea was also lower in the EBF group.[8] Similar finding was also noted by other studies.[14-16] There was no difference in the rates of pneumonia in between the groups of EBF and NEF, but when infants who had pneumonia more than one episode were analyzed, it was seen to be more in those babies who were on NEF. Similarly diarrhea, ear infection and urinary tract infection was seen to occur more in NEF group. Infants who had diarrhea more than once were seen to occur more in group with NEF as compared to EBF. Like in this study, early interruption of EBF before 4-6 months was found to increase the odds of having fever, diarrhea and acute respiratory infections significantly.[13] This finding reaffirms the distinct advantages EBF has over NEF; not only in terms of growth but also in terms of decreased morbidity. This study lends support to the need to encourage more mothers to continue EBF until their infant is at least six months of age so that the mother-baby pair can enjoy the advantages that comes with exclusive breastfeeding .

Strength of this study is that there was a relatively good sample of infants who were studied. This study was conducted in a tertiary level academic institution of Western Nepal which is frequented by low to middle class population. This gives us an idea about the breastfeeding practices of the lower to middle class population of this area and how it has influenced the growth and morbidity of infants in this region.

CONCLUSION

Exclusively breastfed infants have better weight than those babies who are not exclusively breastfed and they suffer from fewer illnesses in the first six months of life. The hospital prevalence of EBF in this part of Western Nepal has surpassed the global target but we should continue to promote breastfeeding advocacy programs so that increasingly more numbers of mothers understand the benefits and continue to practice exclusive breastfeeding until their infant is at least six months of age.

RECOMMENDATIONS

There is a need to conduct a larger scale longitudinal study which can follow-up exclusively breastfed infants over time to study its effect on growth and morbidities and compare it to babies who are not exclusively fed.

LIMITATIONS OF THE STUDY

Limitations of this study was the cross-sectional design of this study. It would have been better if a longitudinal study had been conducted analyzing the effect of growth and morbidities in children with EBF against NEBF over a period of time; maybe we would have been able to truly interpret the effect of type of feeding on these outcomes.

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CONFLICTS OF INTEREST

None

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