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GROWTH AND NUTRITIONAL STATUS OF THE FIRST SIX MONTHS OF LIFE AMONG SELECTED HOSPITALS- NAIROBI PROVINCE

A. S. LAKATI, A. O. MAKOKHA, C. W. BINNS and Y. KOMBE

ABSTRACT

***Background*: Exclusive breastfeeding for infants is recommended for the first six months for optimal health, development and growth. However, there is limited data on infant feeding practices and nutrition status of infants in Nairobi.**
***Objective*: To assess infant growth and nutritional status and compare with feeding practices in the first six months of life in selected hospitals, Nairobi Province.**
***Design*: Prospective cohort design**
***Setting*: Five major hospitals in Nairobi namely; The Aga Khan, Pumwani Maternity, Mater Misercordiae, St Mary's Langata and Jamaa Hospitals.**
***Subjects*: A sample of 692 mother-infant pairs were recruited at birth and followed up until six months.**
***Intervention*: There was no direct experimental intervention, but there was observation of infant feeding practices, weight and height measurement was recorded every four weeks and determination of nutrition status of the infants for a period of six months.**
***Main Outcome Measures*: Nutritional status and infant feeding practices in the first six months.**
***Results*: Slightly more than half (58.8%) of the mothers were formally employed and the rest were self employed. The mean age of the mothers was 28.3 ±4.9 years. The mean income was KES 26,360 ± 34,696. The mean birth weight of infants was 3.24 ±0.43kg and 53.3% of all infants were male. Above 80% of infants were within normal weight based on weight for age Z-scores (WAZ) at 6, 10, 14 and 23 weeks. The prevalence of overweight based on WAZ was 9.5%, 11.6%, 11.9% and 11% at 6, 14, 19 and 23 weeks, respectively. There were no significant (P>0.05) differences in WAZ between infants on different feeding methods.**
***Conclusions*: There was no significant difference in weight or length gain among children that were fully breastfed in comparison to those who were given infant formula or had mixed feeding. However, there was concern over the proportion of overweight infants, as the condition may lead to long term health problems.**

INTRODUCTION

The Global Strategy For Infant and Young Child feeding puts emphasis on the importance of monitoring the growth and development of infants and young children as a routine nutrition intervention (1). As per the WHO Global Public Health Recommendation, infants should be exclusively breastfed for the first six months to achieve optimal growth, development and health (2). Exclusive breastfeeding is promoted because of its health benefits (3). Human milk is uniquely superior for infant feeding and is species specific. All substitute-feeding options differ markedly from it (4).

Some observational studies have suggested that prolonged and exclusive and general breastfeeding is associated with lower infant weight and length by six to twelve months (5). A cluster-randomised trial in Belarus (5), of healthy full term breastfeed infants found that infants exclusively breastfeed gained more weight in the first three months and the difference disappeared by 12 months. There is considerable controversy whether there is a causal relationship between breastfeeding and poor growth performance in the developing world. Fawzi *et al* (6) observed an inverse association between breastfeeding, weight and height gain in their prospective cohort study of children under 36 months in Sudan. Breastfed children

in the same age range and from poorer households gained 449g less than weaned children. Breastfed children from poorer household were 10 mm shorter compared with 3 mm-difference in children from affluent households. This study did not assess dietary intake and reported marked differences in height and weight favoring weaned children <12 months of age. The differences were significantly greater in children from poorer households and from illiterate mothers. The authors were of the opinion that the higher risk of malnutrition seen among breastfed infants from illiterate parents and poor parents could be because this group is less likely to have adequate complementary feeding.

In the developed countries where infants are not at risk of retarded growth from malnutrition or other aspects related to sanitation, studies have indicated that breastfed infants tend to be smaller or weigh less than bottle fed infants. Yoneyama et al (7) used longitudinal data in Japan. They found that breastfed infants tended to be lighter in weight between six and 20 months than bottle or mixed fed infants. The differences in growth patterns in length were much smaller and negligible. The authors were of the opinion that differences in mean weight between breast, bottle and mixed fed infants which increased after six months, suggests the tendency of overfeeding of bottle fed infants and growth patterns in length suggests that breastfed infants are not necessarily inferior. Similarly, Dewey *et al.* (8) earlier cohort study compared breastfed (n = 46) and formula fed (n = 41) infants until ≥ 12 months. They found that weight for length was significantly greater for formula fed infants from 7 to 24 months. They also measured skinfold thickness (triceps, biceps, subscapular, flank, and quadriceps), and reported that at all sites except biceps, formula fed infants had larger skinfold thickness in later infancy (particularly 9-15 months) than did breastfed infants. The authors indicated that lower energy intake among breastfed infants explained the difference between the two groups. A previous study from the same authors (9) reported that although breastfed infants tend to be lighter with slower growth, the gain in head circumference is not compromised.

A prospective cohort study that assessed growth among formula fed and exclusively breastfed Croatian infants found that breastfed infants had lower rates of weight gain than formula fed infants at six and twelve months. However, there was no significant difference in growth of head circumference at six, nine and twelve months and there were larger numbers (13.6% vs 9.1%) of overweight infants at twelve months among infants on formula feeding as compared to infants on exclusive breastfeeding. This study reported that although infants on exclusive breastfeeding had lower rates in weight gain, they were within normal range and further supported breastfeeding as adequate to promote growth in the first six months (10). In Nigeria early introduction of complementary feeding was found not to offer any advantage in terms of weight and length gain but was associated with frequent episodes of illness and growth faltering(11). In Kenya, previous studies on nutrition status were cross-sectional in design and with small sample sizes which do not allow examination of temporal relationships between actual effects of breastfeeding in growth and nutritional status. The main objective of this study was to assess the infant growth and nutritional status in the first six months of life in selected hospitals, Nairobi Province and compare growth rates among infants who were on exclusive (full) breastfeeding with those on mixed feeding, where complementary foods had been introduced before six months and / or those who were fed on infant formulae.

MATERIALS AND METHODS

A prospective cohort design was applied in the study, where the cohorts comprised mother-infant pairs who were recruited at birth of the infant and followed up until the infant was six months old. The study was based in five maternity hospitals that were purposively selected based on the relatively high number of deliveries per day and availability of maternal and child health (MCH) clinics that were used as points of monthly follow up. Epi Info (EPI INFO 3.3.2) statistical package was used to determine sample size for cohort studies. At a 95% confidence level, Power (1-ß) of 80% and expected different rates of breastfeeding at six months for mothers in formal employment (estimated at70%) and self employment (80%). The minimum required sample size determined was 626. This number was increased by 10% and a sample of 692 was recruited. Recruitment was carried out at the maternity wards of the hospitals after the birth of the infants before the mothers were discharged. The sample of working mothers (formal and informal) was recruited consecutively at each of the hospitals till the required sample size, in proportion to the number of daily deliveries, was attained (Table 1). Due to the small number of deliveries recorded per day in the private hospital all mothers who met the study criteria were requested to participate. Pumwani maternity hospital had a higher number of deliveries per day, however, fewer mothers met the inclusion criteria. The inclusion criteria was; mothers who are either in formal employment or self employment, those who reside in Nairobi, those with full term babies weighing 2 kg and above, and were medically fit as advised by the nurses. Data was collected using a structured questionnaire. The questionnaire collected information on socio demographic data, delivery variables, and hospital practices. A follow up questionnaire was used monthly to obtain information on infant feeding practices and to record weight and length of infants. The nutrition status of the infants was determined using anthropometric indices derived from weight, length and age. The main independent variables were infant feeding practices and mother's socio demographic characteristics, while the main dependent variable was the nutrition status of the children.

All data was coded, entered and analysed using the SPSS (Statistical Package for Social Sciences) Version 18.0 and Epi Info 3.3.2 2005. Epi Info was used to determine the Z-scores based on WHO reference points. Descriptive statistics involved measures of central tendency and dispersion for all continuous variables and frequencies and proportions for categorical variables. T-tests were used to compare the growth rates of infants on different feeding methods.

RESULTS

Out of the 692 mother-infant pairs, more than one third (38.6%) of the mothers were recruited from St Mary hospital, 23.7% were from Pumwani and few (2%) were recruited from Jamaa hospital (Table 1). St Mary hospital has a higher number of working mothers who meet the inclusion criteria compared to Pumwani hospital which recorded higher deliveries with majority not meeting the inclusion criteria. There were very few deliveries at Jamaa hospital and only 14 mothers could be recruited. Majority (87.1%) of the mothers in the study population were married, 10.6% single and the rest were either separated or divorced. Slightly above half (56.5%) of the mothers had college and university level of education. The average age was 28.3 ±4.9 years (95%CI 27.97-28.70). The youngest mother was 17 years and the oldest was 45 years. Most of the mothers (88%) were within the age range 21-35 years.

Table 1
Background characteristics of the study population

Variable	Number	Percentage
Hospital of recruitment		
• St Mary's	267	38.6%
• Pumwani	164	23.7%
• Aga Khan	138	19.9%
• The Mater	109	15.8%
• Jamaa	14	2.0%
Marital Status		
• Married	603	87.1%
• Single	71	10.3%
• Others (Living with partner or Separated)	18	2.6%
Highest level of Education		
• Primary	77	11.1%
• Secondary	224	32.4%
• College Certificate &Diploma	286	41.3%
• University	105	15.2%
Age group		
• ≤20	31	4.5
• 21-25	184	26.6
• 26-30	269	38.9
• 31-35	157	22.7
• 36-40	44	6.4
• >40 years	6	0.9
Average age 28.3 ±4.9 years		
Attendance of ANC		
• Yes	691	99.9
• No	1	0.1
Birth order		
1st	303	43.8
2nd	274	39.6
3rd	81	11.7
4+	34	4.9

Nearly all (99.1%) of the mothers reported to have attended ANC services during pregnancy. Only one mother from Pumwani hospital was found not to have attended ANC services. Most of the mothers (83.4%) were having their first or second babies babies and very few (4.9%) were having the fourth baby and above. Table 1 presents the distribution of the background characteristics of the study population.

Infant growth and nutritional status: The weight gain of infants was found to follow the growth pattern as used in the Road to Health card (Figure 1). There were no significant (P<0.05) differences in weight gain between infants on full breastfeeding and infants on mixed and or formula feeding throughout the follow up period. Table 2 shows the weight gain of infant's full breastfeeding and infants on mixed and or formula feeding. The mean weight in kilograms among infants on full breastfeeding was 4.92 kg (±0.64) vs. 4.87 kg (±0.74) for infants on mixed and or formula feeding at six weeks. This difference was not significant (P>0.05). At 10 weeks, the mean weight was the same, 5.93 kg, for the two groups., At 14 weeks infants on full breastfeeding had a mean weight of 6.75kg (±0.82) while infants on mixed feeding had a mean weight of 6.67 kg (±0.92). There was no significant difference in the mean weight between the two groups.

Figure 1
Box plot illustrating pattern of weight gain in first six months

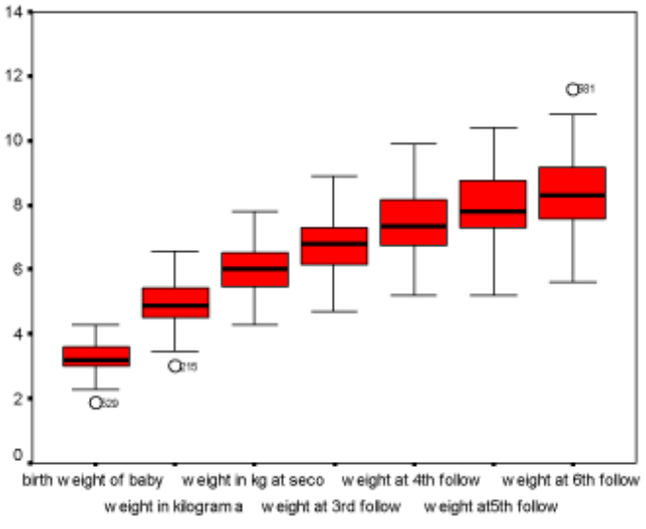

Table 2
Weight gain of infants in the first six months of life

Time of follow up and feeding method (N)	Mean Weight Kg (SD±)	T-Value	P-Value
6 weeks			
Full breastfeeding (n = 334)	4.92 (0.64)	0.550	0.583 (P>0.05
Mixed feeding /formula (n = 62)	4.87 (0.74)		
10 weeks			
Full breastfeeding (n = 169)	5.93 (0.74)	0.020	0.984 (P>0.05)
Mixed feeding/formula (n = 70)	5.93 (0.84)		
14 weeks			
Full breastfeeding (n = 110)	6.75(0.82)	0.717	0.474 (P>0.05)
Mixed feeding/formula (n = 116)	6.67 (0.92)		
19 weeks			
Full breastfeeding (n = 51)	7.43(0.86)	0.297	0.767 (P>0.05)
Mixed feeding/formula (n = 140)	7.39(1.00)		

23 Weeks			
Full breastfeeding (n = 27)	8.16(0.85)	1.457	0.147(P>0.147)
Mixed feeding/formula (n = 126)	7.83(1.12)		
25Weeks			
Full breastfeeding (n = 8)	8.11(0.64)	-0.617	0.539(P>0.05)
Mixed feeding/formula (n = 105)	8.37 (1.15)		

Weight for age: Weight for age Z-scores were classified based on WHO classification of nutritional status for underweight. Based on this classification, majority (over 80%) of the infants were within the normal range at the various points of assessments (Table 3). However, at six and 23 weeks, 11 % of the babies were above +2SD, and were classified as overweight. A small proportion, less than 5% of all infants, were either mild or moderate underweight. Figure 2 presents the proportion of infants classified as moderate underweight, mild underweight and overweight at different times of follow up.

Table 3
Weight for age Z-scores (WAZ)

Time of follow up	Mean Z-score (SD)	Minimum Z-score	Maximum Z-score	Statistical Tests
6 Weeks				
Full breastfeeding (n = 334)	0.665 (0.95)	-2.18	3.16	T=1.405; P>0.05 [0.161]
Mixed feeding /formula (n=62)	0.478 (1.01)	-1.78	3.01	
10 weeks				
Full breastfeeding (n=169)	0.850(0.93)	-1.55	3.17	T=0.405; P>0.05 [0.686]
Mixed feeding /formula (n=70)	0.795(0.97)	-1.60	3.10	
14 weeks				
Full breastfeeding (n=110)	0.9082 (0.98)	-2.12	3.35	T=1.338; P>0.05 [0.182]
Mixed feeding /formula (n = 116)	0.734(0.97)	-1.65	3.75	
23weeks				
Full breastfeeding (n=27)	1.08(0.82)	-0.21	2.95	T=2.498; P<0.05 [0.014]
Mixed feeding /formula (n = 126)	0.4918 (1.15)	-3.23	4.30	
25weeks				Not tested
Full breastfeeding (n=8)	-3.37 (0.71)	-4.98	-2.72	
Mixed feeding /formula (n = 104)	-3.49(0.92)	-5.68	-1.17	

Table 4
Length for age Z-scores in the first six months of life

Point of follow up and feeding method	Mean Z-Score (±)	Median	Mann Whitney U-Test Z-Value and P Value
6 weeks			
Full breastfeeding (n = 198)	-0.0402(1.33)	0.050	Z = -0.537; P>0.05 (0.591)
Mixed feeding /formula (n = 43)	-0714 (1.05)	-0.080	
10 weeks			
Full breastfeeding (n = 113)	0.378(1.02)	0.370	Z = -1.073; P>0.05 (0.283)
Mixed feeding /formula (n = 52)	.546(1.04)	0.595	
14 weeks			
Full breastfeeding (n = 73)	0.497(0.99)	0.510	Z = -1.175; P>0.05 (0.240)
Mixed feeding /formula (n = 87)	0.3155(0.88)	0.350	
23 weeks			
Full breastfeeding (n = 73)	0.506(0.80)	0.55	Z=-1.610; P>0.05 (0.107)
Mixed feeding /formula (n = 87)	0.177(0.89)	0.15	

Length for age Z-scores: Length for age Z-scores were calculated using the Epi Info software which is based on the WHO growth references. The calculated Z-scores were transferred to the SPSS software where Mann Whitney U-test was used to determine significant differences in Z-scores for age at different points of follow up. Mann Whitney test was used because the Length Z-scores did not have a normal distribution and transformation of the variable was not successful. Table 4 presents the length for age Z-scores at various points of follow up. There were no significant (P>0.05) differences in length Z-scores between infants on full breastfeeding and those on mixed or formula feeding at all the points of follow up. These findings indicate that the introduction of complementary feeding did not offer advantage in growth in length, as perceived by some mothers in this study.

DISCUSSION

A number studies (12, 13) have been done in Kenya on infant feeding and nutritional status. However, nearly all of these studies are cross-sectional in design with small sample sizes that do not allow examination of various variables on the effect on child nutritional status. A major strength of this study is its prospective design that reduces the recall bias on exact feeding practices. This study included a sample of mothers in formal and self employment in Nairobi, which compares favorably with proportion of mothers in formal or informal employment (14). In this study the term full breastfeeding has been used by other studies (15) to refer to infants receiving breastmilk and fluids such as water or other ritualistic drinking that may have been given infrequently, but no solid word or other milk. This is because mothers in this study very few mothers adhered to exclusive breastfeeding as defined by WHO (2).

The results of this study show that there was no significant differences in weight and length gain between infants on full breastfeeding and those on mixed feeding or infant in formula. Throughout the follow up period except at 25 weeks, infants on full breastfeeding had slightly higher mean weight than the infants on mixed or formula feeding. This differences were however, not significantly (P<0.05) different. These findings clearly indicate that early introduction of complementary feeding in Nairobi may not provide an advantage in weight gain as perceived by mothers. The results further support WHO recommendations that exclusive breastfeeding is adequate to promote growth for the first six months of the infant. These results are in contrast to those of an earlier study in Sudan (6) that showed an inverse relationship between breastfeeding and weight gain. But results of that study were greatly confounded as children from poor or illiterate mothers had lower weight and length gain. The authors recognized that their findings may be explained by poorer complementary feeding practices among children from poor and illiterate mothers.

The length gain and length for age Z-score was compared between infant on full breastfeeding and infants on mixed and or formula feeding. These scores were very skewed and transformation could not achieve normality. Comparison using non-parametric test (Mann Whitney) showed no significant ($P>0.05$) differences in length gain in the two groups. These further shows that in the settings of this study, early introduction of complementary feeding did not offer any advantage in growth. Other studies have reported that delayed initiation of breastfeeding, deprivation from colostrums and improper weaning were found to be significant ($P<0.05$) risk factors for under nutrition among under fives (16).

Kramer *et al* (5)argues that all existing evidence supporting formula feeding is based on observation studies with considerable potential for bias, including confounding, reverse causality and selection bias. In their cluster randomized trial in Belarus modeled on the WHO/UNICEF Baby-Friendly initiative, they found that prolonged and exclusive breastfeeding may actually accelerate weight and length gain in the first few months with no detectable deficit by 12 months.

Similar findings were reported in a cohort study in Nigeria (11), where 352 infants were followed up. Growth and illness was compared. Infants (both male and female) who were exclusively breastfed for six months were found to have median weights above the 50th percentile of the WHO/NCHS reference that is currently used on our national 'Road to Health' (growth monitoring) cards.

Contrary to the study findings, a study in Croatia (10) that compared 44 breastfeed and 44 formula feed infants, found that breastfed infants had significantly lower rates of weight gain than formula fed at 6 ad 12 months. This study, however, found that a large number of infants in the formula group were found to be overweight in comparison with both the WHO and NCHS (National Centre for Health Statistics) growth references. Despite these findings the authors concluded that breastfeeding provided the nutrients necessary for infants to keep with the WHO standard of regular growth in children. This study also observed overweight infants based on WHO growth reference. These infants were few (11%), making it difficult to compare with a feeding method. However it cannot be ignored that in the study settings, the prevalence of overweight could be on the rise. This is of concern as overweight and obesity are associated with increased morbidity and mortality later in life as was suggested by a study of 9357 Germany children (17), that recommend that, breastfeeding may help decrease the prevalence of obesity in childhood and eventual reduction in adulthood.

These findings are in line with other studies that have shown that, early introduction of complementary feeding does not offer an advantage in growth (5, 11), a perception held by many mothers in our study. Mothers should therefore be supported to breastfeed exclusively for six months and educated that complementary feeding does not offer advantage in growth, but instead may expose infants to diseases like diarrhea especially in our settings.

CONCLUSION AND RECOMMENDATION

The evidence from this prospective cohort study have found no significant difference in the rates of weight or length gain among infants who had full breastfeeding in comparison to those who were introduced to complementary feeding early before six months, or those who were fed on infant formula. Early introduction of complementary feeding did not offer any advantage in weight gain, weight for age Z-scores and length for age Z-score. More emphasis should be put into improving mother's confidence that breastmilk is adequate and breastfeeding infants do not require water. Early introduction to complementary feeding should be discouraged as it offers no advantage in growth but exposes infants to illness.

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