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Relationship Between Feeding Practices and Patterns of Infant Growth: A Cross-Sectional Study

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Abstract: Breastfeeding is well known and widely practiced in South Africa. However, exclusive breastfeeding is uncommon. This study examines the relationship between feeding practices and patterns of infant growth in the Northern region of Limpopo Province of South Africa. Secondary analysis was done on feeding practices data and child anthropometric measurements (weight, length and head circumference) were taken at a regular interval of 1 month for 186 infants for 1 year. At birth, 6.5% of infants had a low birth weight, 11.3% were stunted, 8.1% underweight and 7.5% were wasted. Stunting became noticeable in the early months with 18.9% being stunted (<-2SD) by the third month and this percentage remained high for the 12 months period. Increased weight gain was observed during the first 3 months but then declined until the mean WAZ at 12 months was below zero SD. About 6% of infants were overweight (>2SD) by the 12th months. The infants in this study were breastfed for longer period with 78% still breast feeding by the 9th months. However, exclusive breastfeeding was uncommon because of early introduction of supplementary food with 39.5% of infants receiving some grains by the end of the 1st month. Only 0.6% of the infants were exclusively breastfed for more than 3 months. The infants were introduced to supplementary feeds at an early age and had a low birth weight were stunted, underweight and wasted. There was no significant relationship between feeding practice and infant growth. Wasting was associated with the average income of the households. Interventions are needed to promote appropriate feeding during pregnancy, early initiation of breastfeeding as well as correct complementary feeding as advocated by UNICEF.

Key words: Breastfeeding, feeding practice, growth, infants, stunting, underweight, wasting, rural setting

INTRODUCTION

Appropriate feeding practices during infancy are important for good health, growth and development of infants and children (Butte *et al*., 2000; Kumar *et al*., 2006). Studies conducted on infant and child feeding have shown the profound potential negative consequences of improper feeding practices on the growth, development and survival of infants and children, particularly in developing countries (Eckhardt *et al*., 2005; Bloss *et al*., 2004; Mamiro *et al*., 2005).

It has been established that breastmilk possesses nutritious value, reduces the risk of infection (WHO, 1998) provides psychosocial benefits to infants, improves physical growth and motor development and protects against obesity (Lpoez-Alarcon *et al*., 1997). However, the early introduction of supplementary feeds increases the risk of nutrient imbalances, infectious diseases and allergies and reduces the amount of breastmilk intake by infants (Savage *et al*., 1998). Consequently, the WHO (2001) recommends exclusive breastfeeding as the best practice for infant feeding for the first 6 months of life and continuation of breastfeeding up to 2 years. After 6 months, supplementary feeds are required to meet the additional nutrient needs of the child.

In Limpopo province, breastfeeding is commonly practiced. This may be due to the government reinforcement of breastfeeding. Hence, most mothers (85 %) breast-feed their children up to 9 months. However, exclusive breastfeeding as recommended by the WHO is uncommon due to early introduction of supplementary feeds (Mamabolo *et al*., 2004). Like most developing countries, growth retardation is common in Limpopo; it is therefore important to investigate the association between infant feeding practices and growth in the central region of Limpopo province. This study was part of a larger study in which these children were being followed from birth to 36 months.

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MATERIALS AND METHODS

Study area: The study was conducted in Dzimauli village, in the Northern region of Limpopo Province, South Africa. The village is predominately semi-rural with poor infrastructure, lack of electricity, proper sanitation, poor roads and poorly-equipped schools. The village relies mainly on subsistence farming.

Participants: Participants were infants recruited into the malnutrition and enteric infections; Consequences for child health and development (MAL-ED) project. This was a secondary data analysis of the MAL-ED project, a cohort study conducted from 2009-2014 which involved a random sample of 186 infants from the total of 314 infants recruited into the MAL-ED project. Only children who have spent 12 months in the MAL-ED project were included in this study.

Data collection: Data on demographic characteristics of head of household, mother and primary caregiver, socio-economic status and feeding practices were collected. Child anthropometric data on weight, height and head circumference were collected at 1 month interval up to 12 months.

Ethics: Permission to conduct the study was obtained from MAL-ED project while ethical clearance was obtained from the University of Venda Health, Safety and Research Ethics Committee. Ethical approval and permission to undertake the study were obtained from the University of Venda Health, Safety and Research Ethics Committee.

Statistical analysis: Anthropometric data were first entered into WHO Anthro Version 2 and were expressed as z scores for each of the anthropometric indices of malnutrition against the new WHO child growth standards. The standardised data were then imported into SPSS 20.0 Software and merged with the feeding practices data for further analysis. Gender differences were analysed by student's t-test. Logistic regressions were computed to determine independent predictors of stunted growth, underweight and wasting. Statistical significance was set at a probability of 0.05.

RESULTS

Feeding practices: Table 1 and 2 show the type of milk intake of the infants at 1, 3, 6, 9 and 12 months and the feeding practices selected by their mothers. Exclusive breastfeeding (defined as breast milk given to the infant without additional liquids or solids) for periods longer than three months was uncommon.

Table 1: Type of milk intake consumed by infants at various periods from birth to 12 months

Age (months)	Breast milk n (%)	Formula n (%)	Breast milk and formula n (%)
1 (n = 186)	153 (82.3)	9 (4.8)	24 (12.9)
3 (n = 185)	137 (74.0)	14 (7.6)	34 (18.4)
6 (n = 183)	140 (76.5)	19 (10.4)	24 (13.1)
9 (n = 61)	50 (82.0)	6 (9.8)	5 (8.2)
12 (n = 43)	35 (81.4)	5 (11.6)	3 (7.0)

n = Number; % = Percentage

Table 2: Feeding practices selected by mothers

Practices	1 month (%)*	3 months (%)	6 months (%)	9 months (%)	12 months (%)
Exclusive breastfeeding	60.5	9.6	0.6	0.0	0.0
Breast milk and formula	17.1	8.4	0.6	0.0	0.0
Breast milk, formula and solids	1.6	12.7	12.7	8.2	7.3
Breast milk and solids	14.0	61.4	75.7	82.0	78.0
Formula	6.2	1.8	0.6	0.0	0.0
Formula and solids	0.8	6.0	9.9	9.8	14.6

*% = Percentage

Table 3: Primary supplementary foods introduced into infant's diets in addition to milk

Age (months)	Grains n (%)	None n (%)
1 (n = 186)	18 (9.7)	168 (90.3)
3 (n = 185)	135 (73.0)	50 (27.0)
6 (n = 183)	178 (97.3)	5 (2.7)
9 (n = 61)	60 (98.4)	1 (1.6)
12 (n = 41)	41 (100.0)	-
1 (n = 186)	18 (9.7)	168 (90.3)

n = Number; % = Percentage

By the end of the 1st month, 153 infants received breast milk and 60.5% were exclusively breastfed. About 6.2% infants were fed with formula milk and 12.9% with combination of breast milk and formula milk. The number of exclusively breastfed infants decreased dramatically to 9.6, 0.6% by the end of the 3rd and 6th months, respectively. Although, the study participants were from a semi-rural area relying on farming as a means of living, none of the mothers reported giving animal milk to their infants.

Supplementary foods: Early introduction of solid foods was a common practice in this study population and most mothers used to chose a variety of combinations as evident in Table 2. Mothers were inclined to feeding their infants combining breast milk, formula and solids; breast milk, formula and solids or breast milk or formula. At 3rd month, the most common practice was breast milk and solid.

As the infants grew, several supplementary foods were fed to infants (Table 3). The most common ones

Table 4: Mean anthropometric parameters of the study population at different intervals*

Variables	Birth (n = 186)	1 month (n = 186)	3 months (n = 186)	6 months (n = 186)	9 months (n = 184)	12 months (n = 186)
Weight (kg)	3.31±0.49	4.20±0.60	6.05±0.80	7.47±1.05	8.31±1.18	8.95±1.28
Height (cm)	49.68±2.12	52.65±2.40	58.50±2.55	64.50±2.56	68.83±2.57	72.11±2.63
Head circumference (cm)	35.62±1.62	37.29±1.42	40.28±1.51	42.84±3.49	44.78±1.50	45.81±1.52
HAZ**	-0.71±1.09	-0.83±1.18	-0.99±1.18	-0.99±1.11	-0.99±1.11	-1.2±1.060
WAZ***	-0.43±1.03	-0.32±1.04	-0.15±1.09	-0.26±1.20	-0.36±1.20	-0.46±1.18

*Data are presented as mean±standard deviation; **HAZ = Height/Age z score; ***WAZ = Weight/Age z score; ****WHZ = Weight/Height z score

Table 5: Percentage of infants falling withing the WHO growth reference categories

	HAZ*			WAZ***			WHZ****				
Age (months)	%<-3SD**	Normal	%<-2SD	%<-3SD	Normal	%<-2SD	%<-3SD	%<-2SD	Normal	%<+2SD	%<+3SD
0 (n = 186)	1.1	87.6	11.3	1.6	90.9	7.5	1.6	8.1	85.4	4.9	0.0
1 (n = 186)	3.4	83.2	13.4	0.5	92.5	7.0	1.1	4.3	82.2	11.9	0.5
3 (n = 186)	3.2	77.9	18.9	0.5	95.2	4.3	0.5	1.6	71.8	20.7	5.4
6 (n = 186)	2.7	76.3	21.0	1.1	91.9	7.0	1.6	2.2	82.7	10.8	2.7
9 (n = 184)	2.2	74.4	23.4	0.5	90.8	8.7	0.0	1.6	90.3	5.9	2.2
12 (n = 186)	3.8	72.0	24.2	1.6	87.1	11.3	1.6	3.2	87.7	5.9	1.6

*HAZ = Height-for-age z score; **SD = Standard Deviation; ***WAZ = Weight-for-Age z score; ****WHZ = Weight-for-Height z score

were: rice, porridge, bread, noodles and other food made from grains. The infants were usually given a combination of these supplements in some cases as early as the 1st month. Commercial infant cereals were given to 6.7% and 11.2% of the infants at 3rd and 6th months, respectively.

Growth: Table 4 shows the mean±Standard Deviation (SD) values of infant anthropometric measurement and their z scores. Figure 1 shows the changes in mean z scores for the Height for Age (HAZ), Weight for Height (WHZ) and Weight for Age (WAZ) over a period of 12 months. Table 5 shows the point prevalence of infants who were above or below ±2SD for the WHO reference curves. Table 5 shown as the prevalence of stunting (HAZ<-2 SD) increased from 11.3% at birth to 24.2% at 12 months. The infants gained weight rapidly, especially during the 1st and 3rd months.

Low birth weight (birth weight <2.5 kg) was found in 6.5% of the infants with mean values of 3.172±0.4599 at birth, 11.3% of the infants were stunted, 8.1% were underweight and 7.5% were wasted as described by HAZ, WAZ and WHZ scores, respectively.

There was a progressively lower mean HAZ score with advancing age until the 12 months. The greatest decline occurred in the 1st month. In contrast, the mean WAZ were all below zero. At birth, low WHZ scores were seen in about 8% of the infant, normalised by the 3rd month and then steadily declined at 12th month. The prevalence of stunting (-2 SD) remained between 13% and 24% from the 1st-12th months.

The growth (in terms of length) of individual infants was then tracked over the 12 months period. Their HAZ scores revealed that in general, infant born with extremely low z-scores (-2SD) and remain with low z scores for the first 12 months of life. Among infants in this group, only

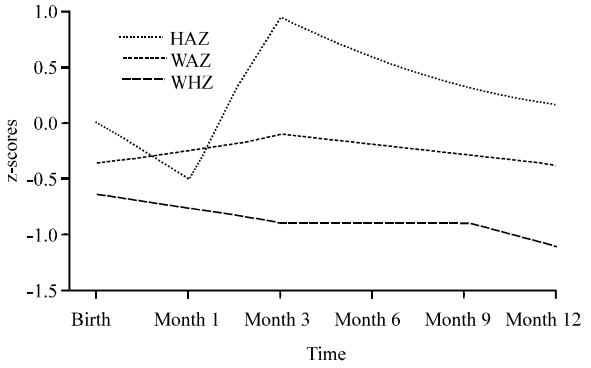

Fig. 1: Tracking of mean HAZ, WAZ and WHZ scores of infants from birth to 12 months: HAZ = z-score for Height for Age; WAZ = z-score for Weight for Age; WHZ = z-score for Weight for Height

7% showed catch-up growth (moving from <-2SD to within±2 SD) by first month and 8.1% by 12th months. By 12 months, there was significant difference between the mean HAZ scores of the group stunted at birth and the non-stunted at birth (Fig. 1).

Gender differences: There were few gender differences in the infant's growth patterns. There were significant differences observed in the 1st, 3rd and 9th months. Female infants had higher mean z-scores for HAZ in the 3rd and 9th months than their male counterpart but lower mean z-score in the 1st month.

Association between feeding practices and anthropometric measurements: The results of bivariate analysis between feeding practice and infant growth (stunting), underweight (weight for age z-score) and wasting (weight for height z-score) are shown in Table 6. More than half of the infants were not

stunted, underweight and wasted. There is no relationship between feeding practice used by mothers and infant growth: stunting ($\chi^2(2) = 0.827$, $p>0.05$); underweight ($\chi^2(2) = 0.733$, $p>0.05$) and wasting ($\chi^2(2) = 0.733$, $p>0.05$).

Socio-demographic factors: Several dichotomized household level independent predictors were entered into a binary logistic model. The dependent variables were height for age, weight for height and weight for height z scores, respectively. Table 7 shows the result of the multivariate analysis concerning the association between socio-demographic factors and infants anthropometric measurements at 12 months.

Table 8 shows the result for the independent predictor of low height for age (stunting) and low

Table 6: Bivariate association of Height for Age (HAZ), Weight for Age (WAZ) and weight for weight z scores with feeding practices

	Height for age		
Feeding practices	Not stunted n (%)	Stunted n (%)	p-values
Exclusive breastfeeding	1(100.0)	-	0.827
Formula feeding	5(83.3)	1(16.7)	
Complementary feeding	134(77.9)	38(22.1)	
Weight for age			
	Not underweight	Underweight	0.733
Exclusive breastfeeding	1(100.0)	-	
Formula feeding	6(100.0)	-	
Complementary feeding	157(91.8)	14(8.2)	
Weight for height			
	Not wasted	Wasted	0.520
Exclusive breastfeeding	-	1(100.0)	
Formula feeding	3(50.0)	3(50.0)	
Complementary feeding	94(55.6)	75(44.4)	

*Significant at $p<0.05$

Table 7: Association between socio-demographic factors and infants anthropometric measurements at 12 months

Variables	HAZ*	OR** (95% CI***)	WAZ****	OR (95% CI)	WHZ****	OR (95% CI)
Food security category						
Food insecure	73	0.427(0.244-1.818)	73	5.760(0.816-40.667)	71	1.213(0.552-2.667)
Food secure	59	-	58	-	59	-
Ownership of radio or transistor						
No	26	0.337(0.092-1.241)	25	1.044(0.149-7.293)	24	1.172(0.408-3.365)
Yes	106	-	106	-	106	-
Ownership of television						
No	22	1.690(0.276-10.357)	22	0.741(0.058-9.466)	22	0.682(0.167-2.788)
Yes	110	-	109	-	108	-
Ownership of refrigerator						
No	32	0.472(0.112-1.993)	31	0.462(0.054-3.942)	32	0.916(0.280-3.002)
Yes	100	-	100	-	98	-
Ownership of agricultural land						
No	70	4.761(1.620-13.990)	68	3.163(0.469-21.332)	69	0.558(0.252-1.237)
Yes	62	-	63	-	61	-
Ownership of chicken or ducks						
No	86	1.781(0.641-4.948)	86	2.127(0.398-11.378)	86	1.312(0.582-2.958)
Yes	46	-	45	-	44	-
Separate kitchen						
No	26	1.150(0.333-3.973)	26	0.526(0.060-4.637)	26	1.374(0.480-3.931)
Yes	106	-	105	-	104	-
Household head age (years)						
<29	7	0.152(0.017-1.356)	7	0.032(0.001-0.796)	7	0.427(0.077-2.384)
≥29	125	-	124	-	123	-
Household head education						
Primary	33	2.485(0.742-8.323)	33	0.313(0.046-2.131)	32	0.544(0.217-1.368)
Secondary/Tertiary	99	-	98	-	98	-
Maternal education						
Primary	11	0.287(0.049-1.666)	13	0.090(0.010-0.796)	13	0.366(0.097-1.385)
Secondary/Tertiary	121	-	118	-	117	-
Mother's age						
<19	11	2.410(0.436-13.319)	11	1.252(0.062-25.271)	11	1.011(0.232-4.403)
≥19	121	-	120	-	119	-
Main source of drinking water						
Not piped	50	0.914(0.332-2.514)	48	0.514(0.099-2.673)	49	1.022(0.455-2.298)
Piped	82	-	83	-	81	-
Mother's marital status						
Single	45	0.480(0.165-1.393)	46	0.432(0.080-2.320)	45	1.236(0.520-2.939)
Married	87	-	85	-	85	-
Marital status of household head						
Single	30	0.245(0.077-0.779)	30	0.708(0.098-5.108)	30	0.677(0.261-1.759)
Married	102	-	101	-	100	-
Sex (child)						
Male	68	0.356(0.126-1.008)	70	4.162(0.761-22.771)	70	1.224(0.565-2.652)
Female	64	-	61	-	60	-

WHZ = z score for Weight-for-Height; **OR = Odds Ratio; ***CI = Confidence Interval; ****HAZ = z scores for Height-for-Age

Table 8: Independent predictors of low height for age (stunting) and low weight for age (underweight) in multivariable modelling

Stunted (Low HAZ)	B	SE	Wald	df	Sig.	Exp(B)	95% CI
Ownership of agricultural land: no versus Yes	1.560	0.550	8.050	1	0.005*	4.761	1.620, 13.99
Marital Status of household head: single versus married	-1.407	0.591	5.674	1	0.017*	0.245	0.077, 0.779
Constant	2.208	1.721	1.646	1	0.199	9.099	
Underweight (Low WAZ)							
Household head age: <29 versus more than 29 years	-3.447	1.642	4.406	1	0.036*	0.032	0.001, 0.796
Maternal education: primary versus secondary/tertiary education	-2.413	1.114	4.688	1	0.030*	0.090	0.010, 0.796
Constant	2.844	2.608	1.190	1	0.275	17.185	-

*Significant at p<0.05

weight for age (underweight). Ownership of agricultural land and marital status of household head were the only factors that predicted whether a child was stunted. The chance of a child being stunted at 12 months old when the household does not own agricultural land is 5 times more likely than when the household does own agricultural land. It is also somewhat likely for a child to be stunted when the household head is married than when household head is single. Similarly, household head age and maternal education both predicted whether a child was underweight. Coming from household where the household head is <29 years and mothers attained primary education were both protective of a child being underweight. None of the factors predicted whether a child was wasted.

DISCUSSION

This study revealed that the number of infants who continued to be breast-fed until 12 months was high (85.3%); consisitent with Mamabolo *et al.* (2005) study in the central region of Limpopo province where 85% of infants were breast-fed up to 9 months. This finding is in congruence of other studies reporting 87-91% infants receiving breast milk for at least 1 year (Marriott *et al.*, 2012; Husk and Keim, 2016).

Exclusive breastfeeding was uncommon in this present study. In South Africa, the South African Demographic and Health Survey (SADHS) showed that 20.1% of children were never breastfed and only 11.9% of infants zero to 4 months were exclusively breastfed (Hendricks *et al.*, 2006). In South Africa, exclusive breastfeeding is not widely practised (Kleynhans *et al.*, 2006), a situation which is generally low in Africa with less than one-third of infants younger than 6 months receiving exclusive breastfeeding. Over the period of 10-15 years, exclusive breastfeeding increased in Africa from 33.0% in 1995 to 38.0% in 2008 (UNICEF, 2009). In a study involving Malawian infants, followed from birth to 12 months, only 13.3% of mothers exclusively breastfed their children (Kalanda *et al.*, 2006). Appropriate breastfeeding practices and duration of exclusive breastfeeding is based on the information the mother received on the importance of breastfeeding. The WHO recommends exclusive breastfeeding for 6 months (WHO, 2001). Mothers without formal education usually exclusively breastfed for a median of 1.1 months, whereas mothers with a higher education usually exclusively breastfed for only 0.4 month. Better education is usually linked to better socio-economic status which could possibly explain why better-educated mothers would refrain from breastfeeding (Sowden *et al.*, 2009).

Saha *et al.* (2008) study reported 92% of infants being breastfed at 12 months of age but only 10.7% were exclusively breastfed at 6 months. Similarly, 3.3% of vietnamese infants were breastfed exclusively at the age of 4 months (Mamiro *et al.*, 2005). Contrastingly, a study on breast feeding and complementary feeding practices among farming communities of Southern Ethiopia indicates that 56% of the women practiced exclusive breastfeeding while more than 86% consistently continued breastfeeding until age 2 years (Regassa, 2004). Again, Sapra *et al.* (2015) study reported 47.8% of mothers exclusively breastfed their children for up to 6 months of age.

Infants in this study were introduced to supplementary feeds early in life. This finding is well documented in South Africa in both rural and urban areas (Mamabolo *et al.*, 2004; Ransoma *et al.*, 1988; Delport *et al.*, 1997; Ladzani *et al.*, 1998). Other studies on breastfeeding attitudes and practices elsewhere have shown early introduction of supplementary food to infants (Lundberg and Thu, 2012; Meechan and Roulette, 2013). These results, however, contradicts the findings of other studies which reported the late start of complementary feeding for children aged 6-8 months (Regassa, 2014) and delay supplementary feeding of infants until 7 months (Sapra *et al.*, 2015). The practice of early introduction of solid food is not only peculiar to South Africa, other studies have described same patterns elsewhere (Savage *et al.*, 1998; Marques *et al.*, 2001). This practice has been attributed to several factors. Mothers perceive the quantity and quality of their breast milk insufficient for their infants; some mothers are separated from their infants due to work or schooling; inadequate information about the importance of breastfeeding and breast-related problems (Savage *et al.*, 1998; Hau *et al.*, 1992).

Studies have shown that infant growth and early introduction of food supplements is associated with prelacteral feeds such as teas and sugared water with stunting and wasting in children (Marques *et al*., 2001; Cohen *et al*., 1994). Further, exclusively breast-fed infants have been found to grow more rapidly in length than formula-fed infants during the first 6 months, especially in environment that are socio-economically disadvantaged. This has been attributed to the protective effects of breast milk against infections, known to retard growth (Villalpando and Lopez-Alarcon, 2000).

In a study among Malawian infants up to 12 months old, 83.5% of breastfed infants were fed porridge while 33.1% received other food at three months (Kalanda *et al*., 2006). Similarly, a study conducted in Bangladesh to determine malnutrition among children 6- 60 months old found children 6-12 months old started solid food at mean age of 8 months (Iqbal *et al*., 1999). Globally, 60% of children aged 6-9 months old received solid, semi-solid or soft food while being breastfed (UNICEF, 2009). An earlier study conducted in Limpopo among children 12-24 months old reports 36.2% of infants are fed with solid foods at <1 month while 63.8% of children older than 1 month received solids (Kleynhans *et al*., 2006). In this current study, solid foods were mostly introduced between 1-6 months. However, no significant association was found between feeding practice and growth of infants.

One in four children are malnourished in tribal or rural areas in South Africa (Kleynhans *et al*., 2006), stunted and more threatened. However, in this study, due to large number of infants introduced to food supplements at an early age, we did not consider the differences that might have been present between infants breast-fed for longer period and those who were introduced to supplements early in life.

Birth-weight is a predictor of malnutrition (Kleynhans *et al*., 2006) and there is a direct connection between maternal and child nutrition (Negash *et al*., 2015; Kimani-Murage *et al*., 2011). In the present study, low birth weight was found in 6.5% of the infants. In a longitudinal study conducted in Limpopo, South Africa in which children were followed from birth up to 3 years; greater height at 12 months was protective of stunting (Mamabolo *et al*., 2005). In this present study, at birth, a smaller proportion of infants were stunted, underweight and wasted. This finding could have resulted from several factors affecting utero growth including maternal diet, maternal age, parity, pre-pregnancy weight and maternal weight gain during pregnancy (Strauss and Dietz, 1999; Fraser *et al*., 1995). The infants showed a progressive decline in HAZ scores with time with the lowest z-scores recorded around 12 months. The high frequency of stunting between 6 and 12 months (approximately 24.0%) is comparable to the South African Vitamin A Consultative Group study which reported 23.4% of 12-23-months old infants were stunted (height for age <-2SD) and 6.8% were severely stunted (height for age <-3SD) (Labadarios *et al*., 1995). Similarly, Mamabolo *et al*. (2004) found 35% of infants between 6 and 12 months stunted.

Regarding individual growth of the infants in this study, the stunted infant's remain stunted with little catch-up growth (8.1%) and stunting was evident in the infants by the 1st month. This result is consistent with an earlier finding which reported 7% of infants with catch-up growth by 12 months (Mamabolo *et al*., 2004). The most likely explanation for the large growth deficit in the 1st month and onwards is feeding practices introduced from birth onward, particularly the early introduction of supplementary feeding during the early months in many infants.

In this study, the mean WAZ scores showed a different picture as they were all below zero from birth to 12 months period. This implies that there is an increase in adiposity and/or oedema in these infants due to consumption of carbohydrate-rich foods that replaced breast milk. This theory is also supported by the WHZ scores which remained above zero from the 3rd months up to the 12th months. The presumption of growth deficit as an outcome of early introduction of solids is also reflected in the percentage of infants who had length and weight deficits (<-2SD). An cursory look the WHZ scores reveal that the number of infants with scores above 2 SD increased dramatically from 4.9-20.7% and then declined steadily thereafter, reaching 5.9% by 12 months. This is an indication of a high prevalence of overweight and stunted children.

A low prevalence of underweight was observed among infants in our sample at 1 year, accompanied by a higher prevalence of stunting. Such phenomenon has been previously described (Mamabolo *et al*., 2004; Cesar *et al*., 1996; Post and Victora, 2001; Walsh *et al*., 2002) and has been attributed to body proportionality. Wasted children tended to have large abdominal, head, and chest circumferences which have been speculated to account for the increased weight gain (Post and Victora, 2001).

In this present study, a high percentage of infants were overweight (WHZ>2SD) between 1 and 9 months. This might be attributed to early introduction of solid foods, competing with milk as a primary source of nutrition and source of energy. Several researchers have found positive association between infant feeding practice and infant growth (Butte *et al*., 2000; kumar *et al*., 2006; Saha *et al*., 2008).

CONCLUSION

The infants were introduced to supplementary feeds at an early age. The infants had a low birth weight were stunted, underweight and wasted. There was no significant relationship between feeding practice and infant growth. Postnatally, the growth pattern changed during the first 12 months with infants gradually becoming more stunted and more overweight because exclusive breastfeeding was uncommon. Post-natal factors that appeared to be associated with stunting were those related to socio-economic status, namely marital status of household heads and ownership of agricultural land, and child factor, namely child sex.

LIMITATIONS

Several limitations of the study are worth nothing. Due to longitudinal design of the study, only associations could be established; causal relationships could not be described. As the study was questionnaire-based, questions that required a good memory were vulnerable to recall bias. In addition, some questions that might be sensitive were susceptible to socially desirable answers. Also, several field workers were involved in measuring length, weight and head circumference of infants. As a result, measurement errors might have been introduced. Although, the interviewers were trained, the instruments were validated while there was routine supervision of measurement techniques and procedures by direct observation, they are tools by which errors could be minimised they do not guarantee objectivity.

RECOMMENDATIONS

Interventions are needed to promote appropriate feeding during pregnancy, early initiation of breastfeeding as well as correct complementary feeding as advocated by UNICEF. Also, staple vegetable foods must be promoted in a culturally acceptable manner as complementary food since, they are cheaper and always available. Growth monitoring and promotional activities should be included in all health care programmes and promoted as a community-based intervention.

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