

Growth Pattern Of Exclusively Breastfed Infants In The First Six Months Of Life: A Study Of Babies Delivered at the University of Port Harcourt Teaching Hospital, Rivers State, Nigeria

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ABSTRACT

Background: Some authors demonstrate that exclusively breastfed infants have growth patterns comparable with the NCHS standards while others conclude that exclusively breastfed infants grow slower. These conflicting results informed the need for this study to aid the paediatricians and health workers to justify or condemn the recommendation of exclusive breastfeeding for six months. This was a prospective longitudinal study carried out to determine the growth pattern of exclusively breastfed infants in the first 6 months of life and compare them with the International, National Centre for Health Statistics (NCHS/WHO) reference and the Local, Janes' Elite Standards.

Methods: Using weight, length and occipito-frontal circumference as indices, 530 infants were recruited consecutively by convenience sampling over 17 months. Measurements were taken at birth, 2 weeks, 6 weeks, 2 months and subsequently monthly until the end of the 6th month.

Results: The exclusively breastfed infants doubled their birth weights at 3 months. The mean weight, OFC and length gains were maximal at 2 months, 2 weeks and 2 months respectively. The growth of exclusively breastfed infants compared favourably with the NCHS/WHO reference group and also compared favourably with the Janes' 'Elite' reference group.

Conclusion: It is concluded that the growth in weight, length and OFC of exclusively breastfed infants appears adequate for the first 6 months of life.

KEYWORDS: Growth; Pattern; Breastfed infants; Port Harcourt.

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INTRODUCTION

Breastfeeding, the art of nurturing a child with breast milk, is the natural way of feeding the infant in all traditions and has contributed to the healthy survival of children through the ages¹. Exclusive breastfeeding is defined by the World Health Organization (WHO) as exclusive intake of breast milk by an infant from its' mother or wet nurse or expressed breast milk with the addition of no other liquid or solids with the exception of drops or syrups consisting of vitamins, mineral supplements or medicine and nothing else².

Growth is measured by anthropometric assessment of the infants from birth. The anthropometric indicators of growth include weight (wt), length (lt), occipito-frontal circumference (OFC), proportionality indices (ponderal index), skin fold thickness, arm and chest circumference. Other anthropometric indices used are weight-for-height, height-for-age, weight-for-age, Standard deviation score (Z-score) and Body Mass Index (BMI), which are all important in the context of nutritional surveillance.

Two methods are commonly used to evaluate the extent to which exclusive breastfeeding meets an infant's energy and growth requirement³. These are, by comparing the growth patterns of exclusively breastfed infants with that of an accepted reference standard such as the National Centre for Health Statistics (NCHS) and by comparative calculations that relate infant energy requirement and the energy content of ingested human milk to growth performance.

In Nigeria various studies have been carried out on the growth patterns of children not based on feeding pattern⁴⁻⁸. Janes⁸, between 1962 and 1971 undertook a mixed longitudinal study on two groups ('Elite' and 'Oje') of Nigerian (Yoruba) children. It was concluded from this study that The Nigerian 'Elite' studied compared well with European and the NCHS standards. The study gave a guarded validity to the use of

the US data as a target standard for Africans. Though not validated or updated in the past 30 years, this is the only longitudinal study on the growth of Nigerian children, which has been proposed for clinical use in Nigeria⁸. For the purpose of this study, growth patterns of the exclusively breastfed infants were compared with the NCHS (WHO/CDC) standards and the Janes' 'Elite' reference, using weight, length and head circumference. To the best of our knowledge, no study has been carried out to date, which compares the growth of the exclusively breastfed infants with the 'Elite' group of the Janes' chart. It is hoped that this study will contribute to resolving the controversy of whether or not there is growth faltering in exclusively breastfed infants at 4 - 6 months and also to strengthen the WHO recommendation of exclusive breastfeeding for of the first 4-6 months.

SUBJECTS/METHODS

This study was carried out at the University of Port Harcourt Teaching Hospital (U.P.T.H.) in Rivers State. The Teaching Hospital is a referral centre for Rivers, Bayelsa and other adjoining States. It was designated "Baby Friendly" in 1993 and has a delivery rate of approximately 1,200 babies annually. At the U.P.T.H, information about exclusive breastfeeding is part of the daily health education talks given to all mothers attending antenatal and immunization clinics.

The 530 study subjects were healthy mother-infant pairs recruited within the first 24 hours of delivery who were breastfeeding exclusively on discharge from hospital. All the mothers had the intention to exclusively breastfeed their infants for the first 6 months of life and gave informed consent to participate in the study. Low Birth Weight (<2.5kg), preterm infants, infants with oral anatomical abnormalities e.g. micrognathia, obvious congenital abnormalities e.g. Down's syndrome, multiple births, infants with birth asphyxia, pathological jaundice, cardiac abnormality, neonatal sepsis, serious illnesses e.g. respiratory infections, diarrhoea, HIV/AIDS, fever requiring admission between

birth and the 6th month of life, infants whose mothers died and those who defaulted at follow-up for two consecutive visits were excluded from the study. Infants who were given water or complementary feeds before the age of six months or whose mothers had chronic illness and were taking any medication on a regular basis were also excluded.

By convenience sampling, between September 1999 and February 2001, the first 530 mother-infant pairs who met the inclusion criteria were consecutively recruited into the study within the first 24 hours of delivery. The weight, length and OFC of infants were taken on the same day. Mothers recruited were ensured to have initiated and established breastfeeding before discharge from the hospital. They were counselled and encouraged to maintain exclusive breastfeeding. One of the investigators visited the homes of all of the mothers within the first two weeks of discharge from hospital to ensure that exclusive breastfeeding was continuing appropriately. Some mothers willingly agreed to come to the hospital for follow-up measurement. On discharge from hospital, infants were seen at two weeks, six weeks and then monthly. Mothers (at each visit at home or in the hospital) were encouraged to exclusively breastfeed, day and night on demand and were counselled to use their breast as the only source of nutrient up to the 6th month of life. Informal talks were given by one of the investigators to as many family members as possible (including mothers, fathers, husbands, in-laws, other children and neighbours) on the advantages of breastfeeding and the need to support and encourage the exclusive breastfeeding mother to continue for at least six months.

The investigator measured each child's weight, length and occipito-frontal circumference (OFC). Also random unannounced visits were carried out to ensure that no formula or water/other liquids were being given. Though not part of the study, mothers were taught to commence appropriate feeds after the six months of exclusive breastfeeding.

All measurements were made using

standard procedures⁹. The weight was measured with the child nude using a Stadler infant weighing scale, which was checked daily for zero adjustment. Three measurements were obtained and the mean recorded to the nearest 0.05kg. The length was measured on a locally constructed infantometer. The child was placed supine on the board of the infantometer with a fixed head piece at one end at right angles to it. The child's parent held the infant's head to the headboard until the measurement was complete. From this headpiece a meter rule ran down one side of the length of the board. The foot piece was a moveable right-angled piece of wood. The child's head touched the headboard, with his eyes and external auditory meatus in a straight line perpendicular to the board. The investigator held the child's knee with one hand completely straightening the infant's hip and knees. The soles of the feet were both firmly pressed against the heel with the toes pointing upwards and the foot piece made to touch the heel of the child. The child was then gently "Stretched" to get the maximum length, which was read off the meter rule and recorded to the nearest 0.1cm. Three measurements were carried out and the average taken.

The occipito-frontal circumference was measured using a 2cm wide non-elastic flexible tape measure. It was placed on the lower forehead, over the glabella just above the supra orbital ridges, passed around the head at the same level on each side and over the occiput posteriorly where it was moved slightly up and down to find the maximum reading. The tape was pulled very firmly to compress the hair. Three consecutive measurements were obtained to the nearest 0.1cm and the mean recorded.

Routine immunization during the first 6 months consisting of BCG, OPV0, DPT, OPV1, DPT2, OPV2, DPT3, OPV3 and Vitamin A were verified. On recruitment, each proforma was tagged and measurements transferred into a master sheet and into the computer at the earliest possible time. Ethical clearance from Ethics committee of U.P.T.H was obtained.

Data was analyzed using SPSS (Statistical Package for Social Survey) package for

Windows. Version 7.5. 1 (Dec 20 1996).

Comparison of the means and comparisons of weight, length and OFC with maternal factors were done using a One-way analysis of variance (ANOVA). Paired samples were analysed by the Student t-test and independent samples analyzed using Levene's Test for equality of variance. Z-score was calculated using ANTHRO software for calculating Paediatric anthropometry, Version 1.01. 10 Dec. 1990. Growth was compared with the NCHS and Janes' 'Elite' standards by evaluating shifts in the 50th percentile at various months. The values for the study group at 1 month were interpolated from the graphs showing the growth curves. Mean rate of gain in weight, length, OFC was calculated using the difference between weight, length and OFC at different times divided by the number of interval days. A probability (p) value of less than 0.05 was considered statistically significant.

RESULTS

Five hundred and thirty mother-infant pairs were recruited into this study from September 1999 to February 2001. There were 269(50.8%) male and 261 (49.2%) females giving a male: female ratio of 1.01:1.

Table I shows the number of infants who were exclusively breastfeeding from birth (530 newborns) to 6 months (309 infants).

Overall, the exclusive breastfeeding (EBF) rate declined from 100% at birth to 58.3 at 6 months. The EBF rate of males and females showed the greatest difference at 6 months being 62.8% and 53.6% respectively.

The cumulative gain in weight, length and OFC from birth to 6 months was 5.12kg, 16.4cm and 10.1cm respectively.

While Table IIa contains the data for all the infants who had not dropped out of the study at the respective ages, Table IIb shows the data for only the 309 who were exclusively breastfed and remained in the study from recruitment to completion at 6 months. There is however no significant difference in the two sets of data. Subsequent analysis is based on data from the 309 recruited infants who were EBF from birth to six months.

The mean birth weight doubled at 3 months. The maximum mean daily weight gain of 52gm/day was noted in the second month of exclusive breastfeeding as shown in Figure 2a. The daily rate of weight gain reduced to 21gm/day by the 6th month. The slowest gain in weight was between the 5th and 6th month. The maximum mean daily gain in length of 0.15cm/day was noted in the second month of exclusive breastfeeding.

The maximum gain for OFC was at the 2nd week of life at 0.11cm/day and decreased progressively to 0.03cm/day at the 6 months. The slowest gain was however between the 4th and 5th month for length and at the 6th month for OFC.

Table I. Exclusive Breastfeeding (EBF) Status of the recruited infants from birth to 6 months

Age of infants	Total no (%) of infants on EBF	Male no (%)	Female no (%)
Birth	530 (100)	269 (50.8)	261 (49.2)
2weeks	502 (94.7)	252 (50.2)	250 (49.8)
6weeks	481 (90.8)	242 (50.3)	239 (49.7)
2months	469 (88.5)	236 (50.3)	239 (49.7)
3months	432 (81.5)	214 (49.5)	218 (50.5)
4months	415 (78.3)	214 (51.6)	201 (48.4)
5months	344 (64.9)	184 (53.5)	160 (46.5)
6months	309 (58.3)	169 (54.7)	140 (45.3)

Table IIa. The distribution of the means of weights, lengths and OFC of the recruited exclusively breastfeeding infants from birth to 6months.

Age	No	Mean weight ± (SD)	Mean length ± (SD)	Mean OFC ± (SD)
Birth	530	3.23±(0.48)	50.18±(0.89)	34.57±(1.94)
2 weeks	502	3.77±(0.57)	52.26±(0.80)	36.25±(1.94)
6 weeks	481	4.52±(0.62)	55.04±(0.93)	38.69±(2.15)
2 months	469	5.45±(0.71)	58.24±(1.24)	39.97±(2.17)
3 months	432	6.20±(0.76)	60.71±(1.37)	41.46±(2.14)
4 months	415	7.02±(0.76)	62.62±(1.42)	42.84±(1.05)
5 months	344	7.69±(0.79)	64.41±(1.82)	44.00±(1.99)
6 months	309	8.35±(0.73)	66.55±(1.07)	44.83±(1.76)

Table IIb. The distribution of the means of weights, lengths and OFC of the 309 infants who exclusively breastfed for 6 months

Age	No	Mean weight ± (SD)	Mean length ± (SD)	Mean OFC ± (SD)
Birth	309	3.22±(0.48)	50.16±(0.94)	34.74±(1.92)
2 weeks	309	3.76±(0.57)	52.29±(0.79)	36.48±(1.91)
6 weeks	309	4.52±(0.62)	55.17±(0.86)	39.05±(2.05)
2 months	309	5.40±(0.70)	58.35±(1.18)	40.31±(2.11)
3 months	309	6.20±(0.75)	60.75±(1.33)	41.66±(2.17)
4 months	309	7.00±(0.77)	62.63±(1.55)	42.97±(2.03)
5 months	309	7.70±(0.76)	64.29±(1.72)	44.08±(1.93)
6 months	309	8.40±(0.73)	66.55±(1.07)	44.83±(1.83)

Table III. Distribution of the Z-score of study group.

Age		Male	Females
0.5	HAZ	-0.14	0.22
	WAZ	0.01	0.33
	WHZ	0.12	0.02
1.5	HAZ	-0.54	0.62
	WAZ	-0.33	0.72
	WHZ	0.25	0.19
2	HAZ	0.06	0.62
	WAZ	0.58	0.72
	WHZ	0.71	0.19
3	HAZ	-0.15	0.42
	WAZ	0.51	0.72
	WHZ	0.81	0.36
4	HAZ	-0.37	0.21
	WAZ	0.57	0.89
	WHZ	1.03	0.78
5	HAZ	-0.56	0.08
	WAZ	0.60	0.95
	WHZ	1.23	1.01
6	HAZ	-0.34	0.06
	WAZ	0.67	0.97
	WHZ	1.04	1.09
Normal Z-score range		HAZ (Height for age) 0±6	WAZ (Weight for age) 0±6
		WHZ (Weight for height) -4±6	

The Z-scores of the males and females shows that they were neither stunted nor wasted-Table III.

The growth curves of the weight, length and OFC of both sexes of the study group compare favourably with the NCHS group as shown in Figures 1a-c.

The median weight (50th centile) for males was consistently above the 50th centile of NCHS males from birth until the 6th month being 102%, 107% and 108% of NCHS values at birth, 3 months and 6 months respectively. For the females, the median weight was 99.1% of the NCHS 50th centile for females at birth and was above the 50th centile until the 6th month being 110% and 114% at the 3rd and 6th months

respectively. The corresponding lengths for males were consistently lower and declined from 99.6% at birth to 99.2% and 98.4% at 3 months and 6 months respectively though the differences were of no statistical significance. However for the females the median lengths were consistently above the 50th centile from birth to the 6th month (100.6%, 102% and 107% at birth, 3 months and 6 months respectively). The 50th centile OFCs of the males were same at birth and increased to 102% and 103% of the 50th centile NCHS males at the 3rd and 6th months respectively. For the females the OFC at birth was 99.1% of the 50th centile of NCHS for females and remained above it, being 104%

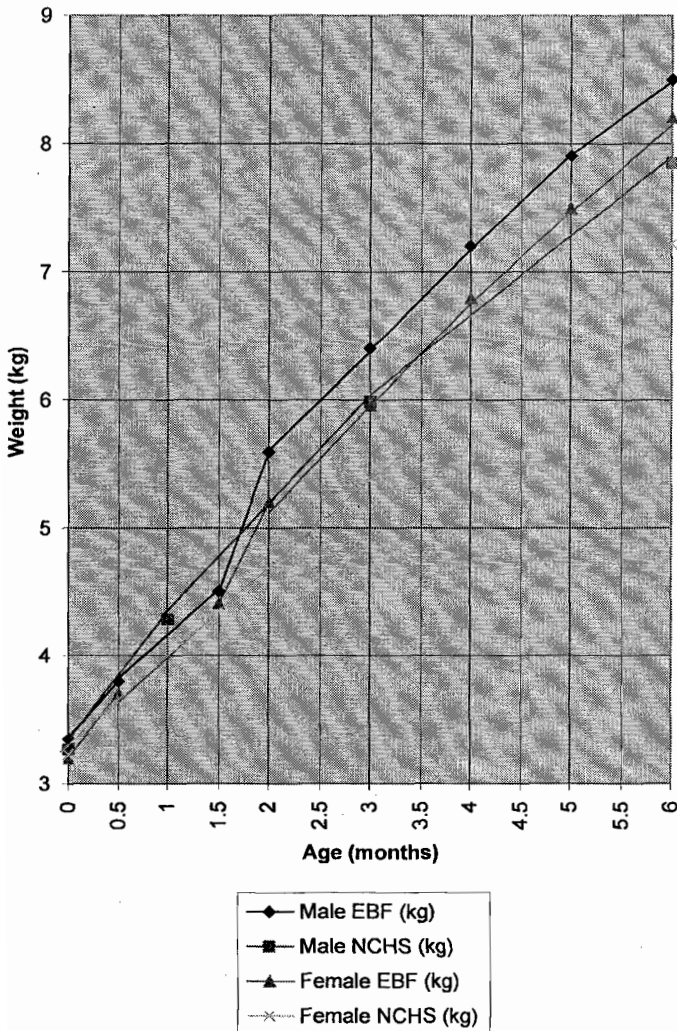


Figure 1a. Growth curve of the 50th centile weights of the male and female study group compared to the 50th centile NCHS

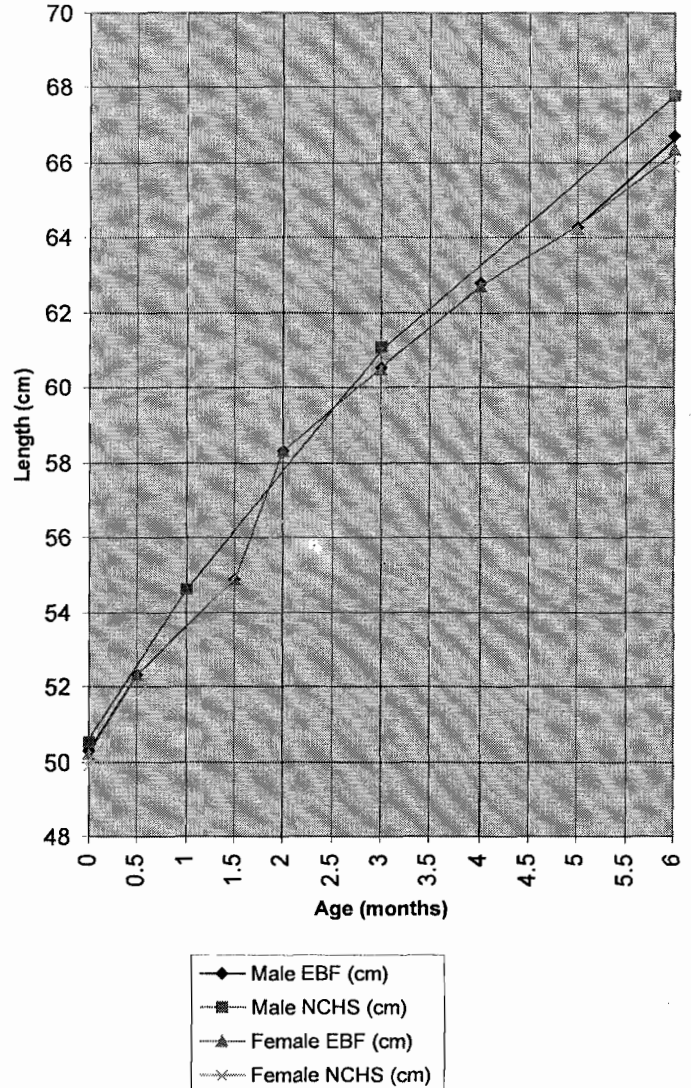


Figure 1b. Growth curve of the 50th centile lengths of the male and female study group compared to the 50th centile NCHS.

and 106% at the 3rd and the 6th months.

There were however no significant differences between the corresponding sexes of the two groups ($p > 0.05$). In all, the exclusively breastfed males were heavier and with bigger OFCs than the NCHS males but were shorter by 1.16cm at the 6th month while the females were heavier, taller and had bigger head circumferences than the females of the NCHS.

The curves of the mean weight, length and OFC of both sexes of the study group compares favourably with the 'Elite' group as shown in Figures 2a-c.

The median weights for the exclusively breastfed males were above the 50th centile of

'Elite' group from the 1st month of life until the 6th month (113%, 116% and 123% at 1 month, 3 months and 6 months respectively). The head circumference was also consistently above the 50th centile 'Elite' (100%, 100.4% and 102% at 1, 3 and 6 months) however, the lengths were consistently below the 50th centile (98.3%, 97.1% and 97% at 1, 3, and 6 months) and the study males were shorter by 2.4cm at the 6th month.

The females of the exclusively breastfed group showed superiority in weight (101%, 103%, 110%), and head circumference (100%, 104%, 105%) at the 1st, 3rd and 6th month when compared with the females of the 'Elite' group. The same pattern was noted for length

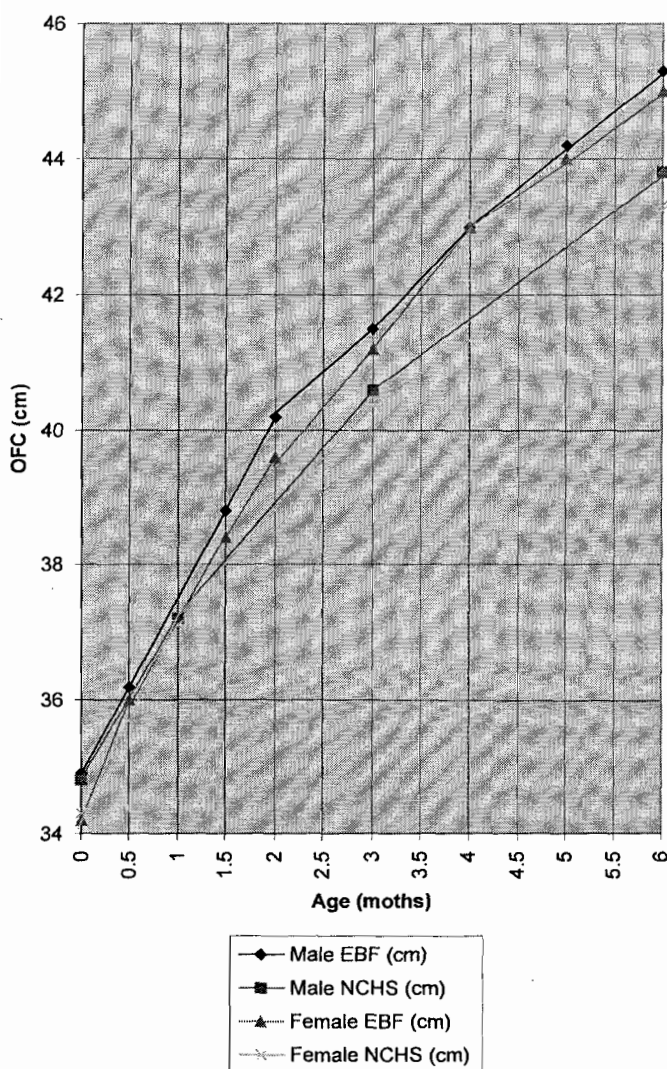


Figure 1c. Growth curve of the 50th centile OFC of the male and female study group compared to the 50th centile NCHS.

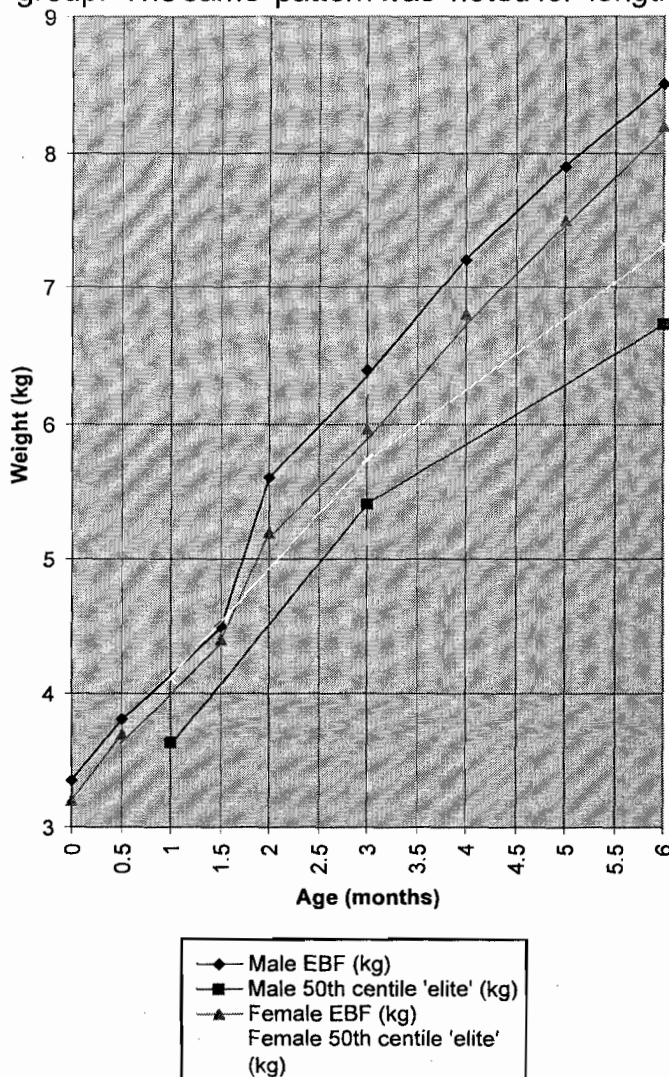


Figure 2a. Growth curve of the 50th centile weights of the male and female study group compared to the 50th centile 'Elite'

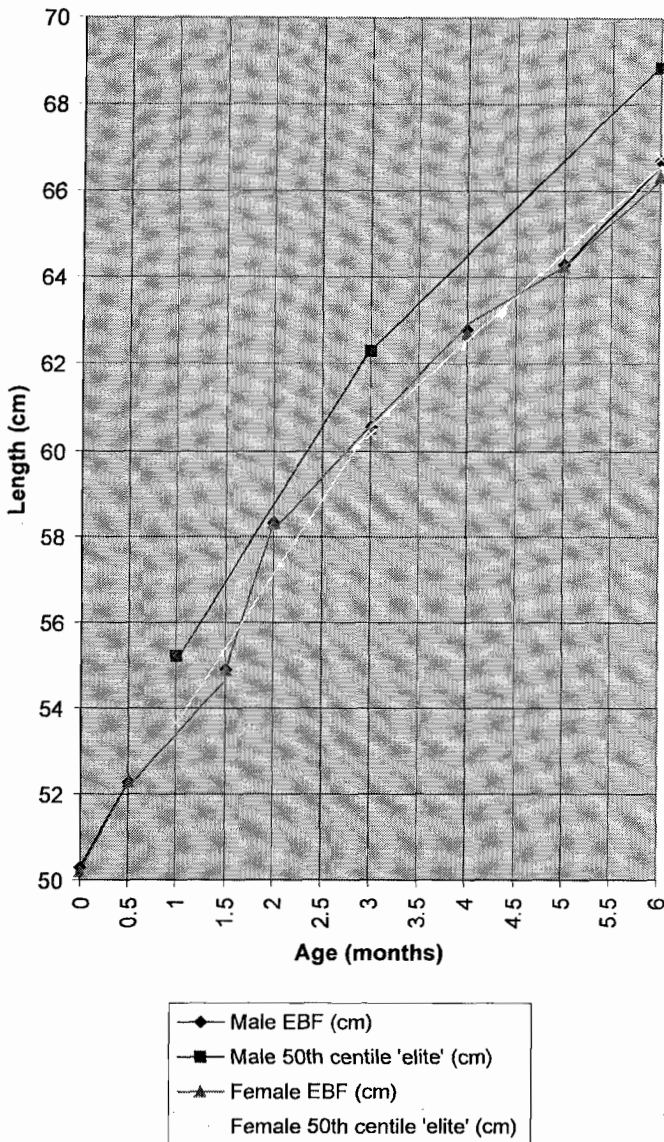


Figure 2b. Growth curve of the 50th centile lengths of the male and female study group compared to the 50th centile 'Elite'.

(100%, 102%) until the 6th month when the study females were 99.7% of the 'Elite'. The females were shorter by 0.2 cm at the 6th month.

DISCUSSION

This study suggests that exclusive breastfeeding leads to better early weight gain than bottle-feeding. Chandra¹⁰, Omoigberale and Ibadin¹¹, Ramasethu *et al*¹² and Ahn and Maclean¹³ each reported a doubling time of birth weights at 3 months as noted in this study. This

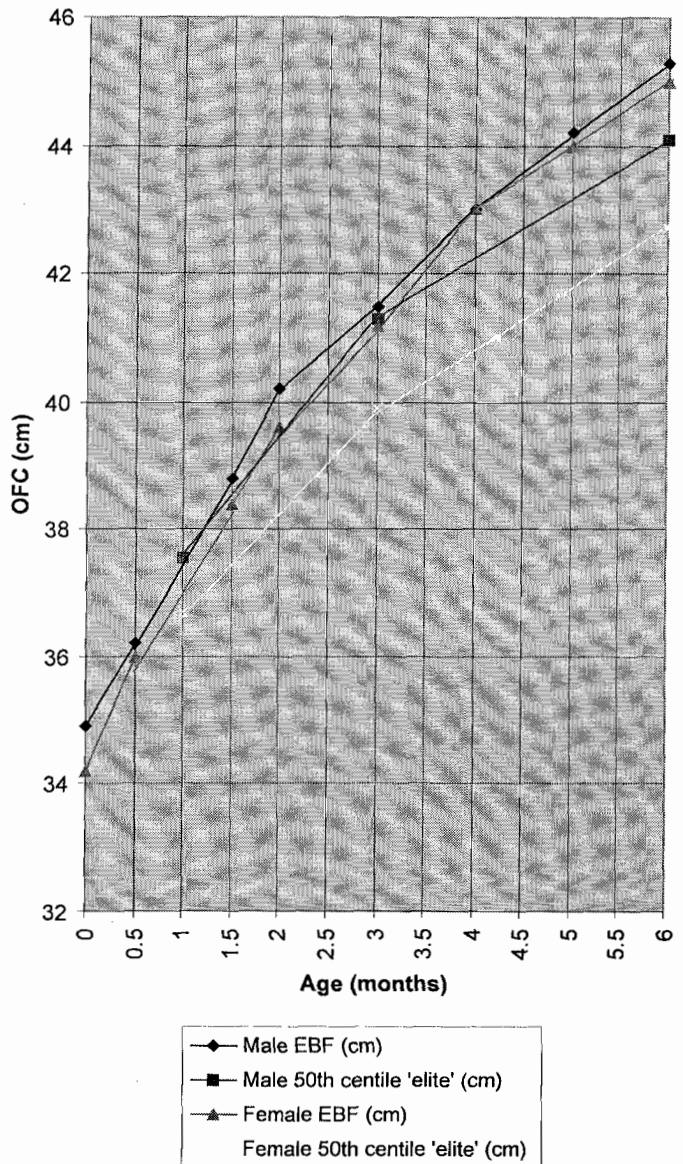


Figure 2c. Growth curve of the 50th centile OFCs of the male and female study group compared to the 50th centile 'Elite'.

is at least one month earlier than the doubling time of formula fed infants, which is usually between the 4th and 6th months¹⁴. This could be accounted for by the increased caloric intake due to demand feeding of the exclusively breastfed infants. Also, unlike bottle fed infants, the exclusively breastfed have no exposure to contaminated food and fluids, and therefore have reduced risks of exposure to diarrhoeal diseases which will compromise growth. It may also be due to non-exposure to over-dilution of milk with resultant decreased caloric intake as found with formula feeding.

The cumulative weight increment in the first 6 months for males and females of this study group of 5.2 ± 0.2 kg and 4.9 ± 0.2 kg is comparable to the $4.91 (\pm 0.69)$ kg and $4.5 (\pm 0.7)$ kg respectively recorded by Juez *et al* among Chilean children¹⁵. The age of maximal growth in weight and length noted at 2 months, as well as, the subsequent decelerating rate of growth with increased duration of exclusive breastfeeding, is similar to the findings of Juez *et al*¹⁵, Ahn and Maclean¹³, Eregie and Abraham⁹, Diaz *et al*¹⁶ and Naing and Oo¹⁷. This deceleration noted later may be due to increased activity of the infants, such as crawling, as more developmental milestones are achieved. Thus exclusively breastfed infants gain weight less rapidly in the latter part of the first six months of life but this is most likely a normal physiological phenomenon. The infants are well and thriving and only "appear to be faltering". This is especially important for paediatricians and health workers to note. Otherwise, mothers may be wrongly counselled that their milk production is inadequate and that complementary foods should be added. This would create a crisis of confidence among mothers who are exclusively breastfeeding and can be a significant barrier to programmes such as the Baby Friendly Hospital Initiative (BFH), which are aimed at promoting exclusive breastfeeding in the first six months of life.

Eregie and Abraham⁹, Omoigberale and Ibadin¹¹, Diaz *et al*¹⁶ and Simeos and Pereira¹⁸ have reported the mean daily weight gain of >30 gm/day in the first 3 months as obtained in this study. The total length gain in the first 6 months of 16.4cm is similar to the findings of Ahmed *et al*¹⁹ and Juez *et al*¹⁵. The OFC gain in the first 6 months of life is comparable to the values reported by Eregie and Abraham⁹ and Ahmed *et al*¹⁹ in Nigeria. The maximal OFC gain at 2 weeks may be due to normal moulding of the head after birth, which may not have resolved by 2 weeks. Juez *et al*¹⁵ and Simeos and Pereira¹⁸ had also recorded the increasing difference at the 2nd and 3rd months in the mean weights of the males and females, which was noted in our study group. The reason for this is unknown, but it may be as a result of the smaller

amount of breast milk obtained by females while sucking as reported by Duncan *et al*²⁰. More research needs to be done to further confirm or refute this.

That exclusively breastfed infants were heavier than the 50th centile of the NCHS infants as reported in this study conforms to other reports^{13, 19}. The pattern showing that the NCHS males are longer than the exclusively breastfed males has been reported by Juez *et al*¹⁵. This difference may be genetic.

The distribution of the W/A, W/H and H/A Z-scores of the males and females of the study group which is within normal limits shows that the exclusively breastfed infants are neither wasted nor stunted.

The similar growth pattern noted when comparing the exclusively breastfed group with the 'Elite' and the NCHS groups confirms that the 'Elite' group of the Janes' chart compares well with the NCHS as reported by Janes⁸. The heavier weights, longer lengths and bigger OFCs noted in the exclusively breastfeeding group when compared to the 'Elite' confirm that breastfeeding alone can sustain a child for six months and is therefore recommended for children from all socio-economic groups, including the elites. This higher trend could be due to the fact that as years go by, there are changes in growth trend of children until the maximal growth potential is reached. The 'Elite' standard, which is about 30 years old, has never been revalidated or revisited.

The exclusive breastfeeding rate at 6 months for the University of Port Harcourt Teaching Hospital from this study is 58.3%. This is an improvement on the 0.1% and 22% reported for Nigeria in 1990 and 2001 respectively in the State of the World's children^{21,22}. It is similar to 57% recorded in Benin¹¹ in 1999 and higher than 40.96% reported in Jos²³ in 2000. This tremendous improvement can be attributed to the impact of the BFHI on the UPTH since its designation 9 years ago as a Baby Friendly Hospital. It is also due to encouragement given to participating mothers during this study. This is consistent with the findings of other authors who noted that when mothers are actively mobilised and

preparative measures taken, the exclusive breastfeeding practices improved among them^{24 25}. It can be concluded from this study that the growth in weight, length and OFC of exclusively breast fed infants is adequate from birth to 6 months of life and that exclusively breastfed infants gain weight less rapidly in the latter part of the first six months of life but this is most likely a normal physiological phenomenon. The infants are well and thriving and only "appear to be faltering". This fact is especially important for Paediatricians and health workers. Thus complementary feeds are recommended only after the first 6 months of life. This strengthens the fact that exclusive breastfeeding is the natural way of feeding infants. It is recommended that exclusive breastfeeding should be promoted, supported and protected in the first six months of life and that the growth of exclusively breastfed infants should be compared to growth standards drawn from exclusively breastfed infants.

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