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Growth Performance of Healthy Exclusively Breast-fed and Non-Exclusively Breast-fed Infants in the First Six Months of Life: A Comparative Study

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Summary

Ahmed H, Ekele BA, Oyeshola OA. Growth Performance of Healthy Exclusively Breast-fed and Non-Exclusively Breast-fed Infants in the First Six Months of Life: A Comparative Study. *Nigerian Journal of Paediatrics* **1998; 25:42.** Longitudinal growth, based on weight for age, length for age and head circumference for age in 176 healthy exclusively breast-fed, full term, appropriate for gestational age infants from birth to six months (Group I) was compared with that of an equal number of infants who received small amounts of water in addition to breast milk (Goup II). There were no significant differences in the growth curves of the two groups of infants. Mean weights from the age of one month to six months were consistently greater than those of the National Centre for Health Statistics (NCHS) standards in both groups, although the difference was greater between the ages of one and four months. Mean weights expressed as percentages of the 50th percentile declined from 113 percent of the NCHS value for the one-month old male infants to 101 percent for the six-month old infants in Group I. Similarly, the percentage declined from 115 percent to 101 percent for males in Group II. The females in both groups showed a similar pattern of growth. Mean values for total gain in weight, length and head circumference in six months did not differ significantly between the two groups of infants. It is concluded that offering token amounts of water to infants does not invalidate the benefits of the Baby Friendly Initiatives as far as normal growth is concerned.

Introduction

IT is generally agreed that breast-feeding is not only the best form of infant nutrition,[1] but also an important child survival strategy,[2-4] and that exclusive breast-feeding for the first six months of life is associated with the lowest risks and with optimum infant health and growth.[3-7] Exclusively breast-feeding means that breast milk is the only source of nutrients, without supplementary water, other drink or food for the first six months of life.[8] This is one of the cardinal components of the Baby Friendly Hospital Initiative (BFHI) which is aimed at protecting, promoting and supporting breast-feeding for optimal maternal and child health.[8]

The aspect of not giving water supplementation in the concept of exclusive breast-feeding, poses the greatest conflict between local beliefs and the WHO/UNICEF breast-feeding recommendations.[9,10] The traditional belief that the breast-feeding infant has an obligatory requirement for water is widespread in Nigeria[9,10] and is the main reason why this component of the BFHI has been most vehemently opposed by mothers in various parts of the

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country.[9,10] Yet, it has been shown that even in the tropics, the exclusively breast-fed infant maintains adequate water balance,[11] and that in communities where the water supply is not safe, exclusive breast-feeding protects the infant by not exposing him to contaminants.[12] Conversely, supplementary water may worsen the infant's nutrition by displacing breast-milk.[11-13] However, in a recent study, it was found that the difference in the morbidity seen in infants whose mothers practised exclusive breast-feeding and in those whose mothers added only water to breast-feeding was not significant.[10]

The present study was undertaken with the aim of comparing the longitudinal growths of healthy, exclusively breast-fed infants and others who were breast-fed, but in addition, also had water, in the first six months of life.

Subjects and Methods

The study was carried out at the Usmanu Danfodiyo University Teaching Hospital (UDUTH), Sokoto, between March 1996 and September 1997. The subjects consisted of full-term healthy babies who were being exclusively breast-fed (Group I) and the same number of full-term, healthy babies, whose mothers in addition to breast-feeding their babies, had commenced supplementary water at various periods between birth and four months, and had continued the supplementation up to the sixth month of life (Group II).

Before the commencement of the study, pilot study was carried out and this revealed that the mean weight gained by 30 infants in the first six months of life was 3.98kg (standard deviation, 0.78kg), using a nomogram devised by Altman[14], and allowing for an increased weight gain, the minimum number of 175 infants in each group, was calculated as being required for a meaningful comparison of the two groups.

The subjects were recruited at birth from among babies born at the UDUTH, when the weight, length and head circumference were measured and recorded. These measurements were then repeated at monthly intervals in the Well-Baby Clinic organised by the Department of Community Health, UDUTH where they were booked to receive immunisation. Weight was measured to the nearest gram and recumbent length measured with the feet and heels at right angles to the foot board and with the head supported at right angles to the head-piece, so that the inner and outer canthi of the eyes were in a vertical plane. The head circumference was measured by applying a tape measure firmly over the glabella and supraorbital ridges anteriorly and that part of the occiput posteriorly that gave the maximum circumference. The tapes used for the measurements were of shrink-resistant, durable material which were checked regularly against a standard ruler.[15] Appointments for monthly longitudinal growth monitoring were given irrespective of the schedules for immunisation. At each attendance, the weight, length and head circumference were measured and recorded. Other data collected during the study included the sex, ethnic group, educational levels attained by mothers, including the socio-economic classes of the parents of the infants according to the method proposed by Olusanya *et al*,[16] sources of water supply, method of dispensing water of the infants, age at which water was introduced, reasons for giving extra water, frequency of water supplementation per day, rough estimate of the volume of water given and cultural practices of water supplementation to infants in the first six months of life. It was not possible to test-weigh the infants in group II, to determine the daily amounts of milk and water ingested, and thus calculate the amount of calories displaced by water. Instead, an estimate of the quantity of water given was made on the basis of the information given by the mothers who were at no time instructed or encouraged to offer water to their babies; instead, they were encouraged to adhere to the principles of exclusive breast feeding. During the course of growth monitoring, any infant in Group I whose mother admitted to giving some water to her baby was moved to Group II. The study was continued until the required sample size in each study group was obtained.

Data from infants with incomplete documentation and those who subsequently received other supplementation besides water were excluded from further analysis. Comparison of the means of various parameters was evaluated by using the Student's 't' test, while the chi-square test was used for comparing proportions. The means of the weight at different ages of each group were also compared with the 50th percentile of the National Centre for Health Statistics (NCHS) charts.

Table I

A Comparison of Longitudinal Growth Data in Two Groups of Male Infants: Weight for Age Compared with NCHS 50th Percentile

Age (mons)	NCHS 50th centile weight for age (kg)	Group I (EBFI) (n=93) Mean weight ± SD (kg)	Group I (EBFI) (n=93) Mean weight as % of 50th centile of NCHS	Group II (FBFI) (n=90) Mean weight ±SD (kg)	Group II (FBFI) (n=90) Mean weight as % of 50th centile NCHS	P value
At birth	3.27	3.35 ± 0.55	102	3.34 ± 0.44	102	NS
1	4.29	4.88 ± 0.35	113	4.96 ± 0.42	115	NS
2	5.10	5.51 ± 0.44	108	5.6 ± 0.49	110	NS
3	5.98	6.49 ± 0.63	109	6.47 ± 0.84	108	NS
4	6.60	6.98 ± 0.64	106	6.9 ± 0.78	105	NS
5	7.25	7.39 ± 0.41	102	7.32 ± 0.46	101	NS
6	7.85	7.92 ± 0.43	101	7.89 ± 0.39	101	NS

EBFI = Exclusively breast-fed infants
FBFI = Fully breast-fed infants
NS = Not significant
NCHS = National Centre for Health Statistics

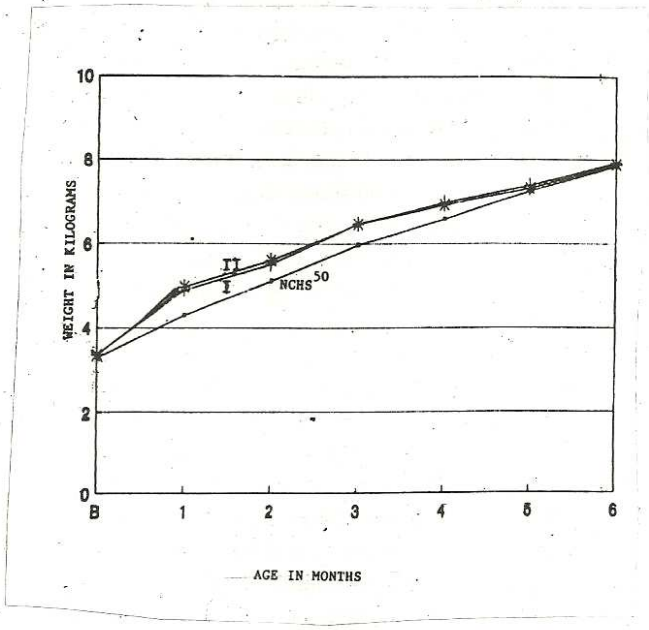

Fig. 1. Comparison of growth curves (mean weight for age) of Groups I and II male infants with the 50th percentile NCHS standard curve. Group I = exclusively breast-fed male infants; Group II = breast-fed male infants who also received token amounts of supplementary water; $NCHS^{50}$ = National Centre for Health Statistics 50th percentile growth curve for male infants; B = at birth.

Results

A total of 360 infants, made up of an equal number in each of the two groups, were studied. The male: female ratio in the two groups were 1.12:1 and 1.06:1, respectively ($p>0.5$). The socio-economic classes of the parents of the 175 infants in group I were as follows: 47 (27 percent) infants belonged to the lower class, while 86 (49 percent) and 42 (24 percent) came from the middle and upper classes, respectively. In group II the distribution of the 175 infants according to socio-economic class showed that 66 (38 percent) belonged to the lower class, 76 (43 percent) were from the middle class and 34 (19 percent) were from the upper class. In both groups of infants the middle socio-economic class was more represented than the other classes of the 350 infants (both groups combined), 113 (32 percent) came from the lower socio-economic class, 161 (46 percent) and 72 (22 percent) belonged to the middle and upper classes, respectively.

A comparison of the logitudinal growth data (mean weight for age) between the males in the two groups of infants and with the 50th percentile of the NCHS charts is shown in Table I. There was no significant difference in the birth-weights and the mean weights at different ages in the two groups ($p>0.05$). Furthermore, the mean weights in the two groups compared favourably with the corresponding NCHS standards, being 102 percent of the 50th percentile at birth in both groups. The mean weights, though consistently greater than the 50th percentile of the NCHS standards in each group (Table I and Fig 1), however, declined from 113 percent and

Table II

A Comparison of Longitudinal Growth Data in Two Groups of Female Infants: Weight for age compared with NCHS 50th percentile.

Age (mons)	NCHS 50th centile weight for age (kg)	Group I (n=82) Mean weight ± SD (kg)	Group I (n=82) Mean weight as % of 50th centile of (NCHS)	Group II (n=85) Mean weight ± SD (kg)	Group II (n=85) Mean weight as % of 50th centile (NCHS)	P value
At birth	3.23	3.1 ± 0.28	96	3.21 ± 0.49	99	NS
1	3.98	4.57 ± 0.42	115	4.58 ± 0.47	115	NS
2	4.65	5.29 ± 0.53	114	5.35 ± 0.62	115	NS
3	5.4	5.74 ± 0.55	106	5.84 ± 0.58	108	NS
4	6.0	6.58 ± 0.63	110	6.57 ± 0.67	110	NS
5	6.6	6.89 ± 0.41	104	6.98 ± 0.35	106	NS
6	7.21	7.27 ± 0.36	101	7.24 ± 0.45	100	NS

NCHS = National Centre for Health Statistics, NS = Not significant.

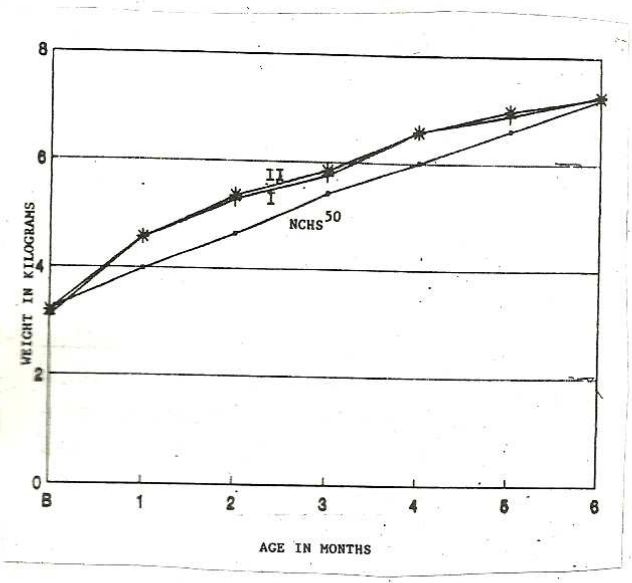

Fig. 2. Growth curves (mean weight for age) of Groups I and II female infants compared with the 50th percentile curve of NCHS standard ($NCHS^{50}$).

115 percent of the standards at the age of one month to 101 percent each, at the age of six months in both groups. With regard to the female infants, similar non-significant differences were found in the mean weights of the infants in both groups throughout the age range ($p>0.05$) (Table II). Furthermore, although the mean birthweights of both groups were 96 and 99 percent respectively, of the 50th percentile of the NCHS standards, the mean weights at the age of one month had increased to 115 percent of the standards in either group before declining to 101 percent and 100 percent of the 50th percentile in groups I and II, respectively. Fig 2 shows the growth curves (mean weight for age) in the two groups compared with the NCHS 50th percentile curve.

Comparisons of gains in weight, length and head circumference in the first six months of life in both groups (Tables III and IV) showed no significant differences between the two groups of either sex ($p>0.05$).

Table III

Comparison of the Mean Gain in Weight, Length and Head Circumference in the First 6 Months of Life between Two Groups of Male Infants

Anthropometric Measurements	*EBFI Group I (n = 93)*	*FBFI Group II (n = 90)*	*P value*
Total gain in weight (kg)			
Mean ± 1SD	4.57±0.4	4.55±0.36	>0.5
Total gain in length (cm)			
Mean ± 1SD	17.5±0.35	17.2±0.24	>0.1
Total gain in OFC (cm)			
Mean ± 1SD	9.1±0.5	9.0±0.6	>0.1

EBFI = Exclusively breast-fed infants
FBFI = Fully breast-fed infants

Table IV

A Comparison of the Total Gain in Weight, Length and Head Circumference in the First Six Months of Life in Two Groups of Female Infants

Anthropometric Measurements	EBFI Group I (n=82)	EBFI Group II (n=85)	Pvalue
Total gain in weight (kg)			
Mean ± 1SD	4.17±0.3	4.13±0.2	>0.1
Total gain in length (cm)			
Mean ± 1SD	15.75±0.25	15.8±0.45	>0.5
Total gain in OFC (cm)			
Mean ± 1SD	8.3±0.6	8.2±0.54	>0.1

EBFI = Exclusively breast-fed infants
FBFI = Fully breast-fed infants

Analysis of the ethnic representations in the two groups showed no difference, with the majority (55 percent and 56 percent, respectively) being from the Hausa/Fulani ethnic group; other groups included Yorubas, Igbos and others (x^2=1,530; df=3: p>0.05).

Similarly, analysis of the educational status of the mothers showed that 80 percent in group I had no formal education compared with 76 percent in group II (x^2=1,226; df=1; p>0.05).

It is worthy of note that while the babies were under the constant supervision of nurses and midwives in the postnatal ward of the hospital, only 7 (4 percent) of the 175 infants in group II were offered water by the mothers within 24 hours of birth. Subsequently, and despite the advice against water supplementation, water was still introduced, within a week of discharge to 69 (39.4 percent) of the infants. It was first introduced between the ages of one week to three months in 91 (52 percent) of the infants, and the remaining 8 (4.6 percent) infants were so introduced after the third month of life. In all cases; the water was dispensed using cup and spoon and no feeding bottles were used. In 168 (96 percent) infants, the water was given either at the end of a feed or between feeds as oppossed to being given as prelacteal feeds. The frequency of water supplementation per day ranged from one to three times, and the quantity offered ranged from five to 45ml per day. Reasons for giving extra water included: disagreement with the aspect of water in BFHI (70 mothers, 40 percent), pressure from relations (32 percent), hot weather (17 percent), hunger in the mother due to excessive sucking (4 percent), mothers fasting (4 percent) and no reason (3

percent). The source of the water given in all cases was the municipal potable water supply system.

Discussion

Longitudinal growth monitoring is an important method of overall nutritional assessment of infants.[18] Growth performance of exclusively breast-fed infants (EBFI) in the first 4 months of life in relation to human milk intake was studied in details by Butte *et al*, in 1984,[18] six years before the Innocenti Declaration.[3] In that study it was found that the mean weights of these infants were consistently greater than the mean weights of the NCHS study population, although the weight for age percentile decreased after the first month at a rate of 2.6 percentile per month.[18] In the same vein, the present study has also shown that growth in weight was consistently above the 50th percentile in both groups of children studied. Furthermore, although it has been established that supplementary water may worsen an infant's nutrition by displacing breast-milk,[11-13] there was no significant difference in the growth patterns of the two groups of infants studied during the first six months of life. This finding suggests that the amount of supplementary water taken by group II infants was negligible and did not displace enough breast-milk to cause a significant caloric deprivation. In support of this contention is the fact that the majority of the mothers in our study offered water to their infants at the end of a feed as opposed to a prelacteal feed; the amount was small because on many occasions, the infant rejected ingestion after taking the first sips.[10] Hausa and Fulani mothers in the Sokoto environment normally give token amounts of previously boiled and cooled water; unboiled water is usually not given to a baby even in the villages. Furthermore, the practice of boiling the drinking water of the baby is compulsory for at least, the first three to four months of the puerperium.[19] For older infants, the water offered in Sokoto area is usually the same as that normally consumed by the family,[10] and in many cases, the water is dispenced using cup and spoon.

It is true that in our study, no test-weighing was carried out in group II infants to determine the quantity of water ingested by the infants and the quantity of breast-milk and the calories the supplementary water had displaced. Nevertheless, the growth performance data showed no statistically significant difference in the growth pattern between the two groups of infants studied. Also for ethical reasons, it was impossible to deliberately give continuous water supplementation in measured amounts to all the infants in group II from birth to six months. Therefore, it can be argued that this control group was not perfect. Nevertheless, in all cases, exclusive breast feeding was not strictly adhered to in group II according to BFHI since token amounts of water were introduced by the mothers at various times between birth and four months and continued well into the sixth month of life. Group II infants were therefore, clearly different from group I in whom no water supplementation was given at all from birth to six months. With regards to the socio-economic classes of the parents of the infants, the vast majority of the infants (68 percent) belonged to the middle and upper social classes and the growth pattern of the infants may not be entirely representative of what is obtainable in the community in general. Nevertheless, in both groups of infants the middle socio-economic classes predominated and there was no statistically significant differences in the socio-economic status between those infants exclusively breast-fed and those that were given 'token' amounts of water between birth to six months.

In conclusion, while we recognise that the giving of water to neonates and infants below the age of six months can be potentially hazardous because of the possibility of contamination of the water and the displacement by this water of calories,[11-13] the offering of token amounts of clean water does not seem to have deleterious effect on the growth of infants between birth and six months. Offering 'token' amount of clean water may therefore, not invalidate the benefits of BFHI programme as far as normal growth is concerned. This study does not claim any advantage for water supplementation in breast-fed infants, and does not advocate this practice no matter how small or clean the water may be. What this study has shown is that our campaign against water should not, and does not need to be taken to extreme absurdity as appears to be the case in some health centres where even the flushing of a blocked nasogastric feeding tube *in-situ* with as little as 1-2ml of sterile water to permit easy flow of some expressed breast milk is frowned upon, as being against the spirit of BFHI.

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Table III shows the associated conditions in the 61 children with severe PEM (both HIV positive and negative). The commonest associated conditions were diarrhoea, oral candidiasis and pneumonia, which occurred in 70.5 percent, 52.5 percent and 36.1 percent respectively. Although these conditions occurred more frequently in the group of children with severe PEM who were HIV positive compared with those who were HIV negative, this was not statistically significant (P>0.05).

Discussion

The present study which shows a very high prevalence of 37.7 percent of HIV infection among children with PEM, indicates that HIV infection might be increasing at an alarming rate in our environment. Thus the prevalence obtained among the children in the present study is much higher than the 3 percent reported among malnourished children from Ogbomoso in south-western Nigeria by Fischer *et al*[9] in 1990. The prevalence in the present study is however, less than that of 45 percent reported in 1987 by Musey *et al*[10] among malnourished children in Burundi. Previous studies have shown that majority of children with HIV infection in this environment present with wasting, [5,6] which is also one of the three major criteria for the clinical diagnosis of paediatric AIDS in Africa as proposed by WHO.[8] Although PEM can result from several other causes, the high prevalence of HIV infection among children with PEM compared with controls obtained in the present study would suggest that HIV infection is becoming an important cause of PEM among children. Factors which may contribute to malnutrition in HIV infected children, include reduced oral intake and gastrointestinal disorders such as chronic diarrhoea, malabsorption and gastrointestinal bleeding, resulting from infectious, neoplastic or non-specific ("HIV enteropathy") causes.[14]

The high prevalence of HIV infection obtained among children in the present study probably reflects a high prevalence of HIV infection among women of reproductive age in our environment. It has been previously shown that through the detection of children with AIDS, previously unsuspected HIV positive parents could be discovered;[6] this was indeed the case in the present study, as all the eight mothers who were HIV positive were asymptomatic and only discovered because of the symptomatic children. All the mothers of the children in the present study were married and it is possible that they acquired the infection either through their infected husbands or extra-maritally. Thus, as previously suggested, the concept of some well defined "high risk groups" in our environment should be discarded since all groups are indeed "high risk groups".[10] It is only individual sexual behaviour that largely determines the risk of infection. Although the diagnosis of Paediatric AIDS below the age of 12 months remains problematic because of passively transferred maternal antibodies,[7] PEM in the absence of any other known cause, and in the presence of positive HIV antibodies should strongly support the diagnosis of AIDS. Moreover, the mean age of 12 months in the children with PEM in the present study suggests true HIV infection, rather than passively transferred maternal antibodies.[7] In the present study, only sera samples that were positive by repeat ELISA were further subjected to WB test. Negative ELISA samples were considered HIV negative. However, previous studies by Fischer *et al*[9] among malnourished children had found a high prevalence of sera samples that were negative by ELISA but were either reactive or indeterminate by WB test and suggested that the WB test may be less reliable than ELISA in the diagnosis of HIV infection in Africa. The reason for this remains unclear.

Routine HIV screening has previously been advocated for children presenting with PEM in our environment and the findings of the present study would support such earlier recommendations.[6] Although it would be ideal to carry out routine HIV screening in all children with PEM, the ethical and social implications of such a policy need to be carefully considered in view of the inadequacy of social support systems in our environment. Patients with HIV infection in our environment are still subjected to discrimination and carry a lot of stigma. Furthermore, there is at present, no effective treatment as anti-retroviral drugs currently in use elsewhere are either not available or beyond the reach of most people in our environment. Children with PEM and their parents who may be HIV infected therefore need to be counselled, educated and offered the option of screening. Establishment of HIV counselling services, where such do not exist, in each screening centre, for pre and post-sampling counselling and follow up of infected patients is

therefore, strongly advocated. In view of the increasing incidence of HIV infection in our environment. AIDS awareness programmes and preventive measures need to be vigorously intensified and sustained.

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