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GROWTH PATTERN OF EXCLUSIVELY AND NON-EXCLUSIVELY BREAST-FED INFANTS IN THE FIRST 4 MONTHS OF LIFE

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ABSTRACT

Thirty-two exclusive and twenty-seven non-exclusively breast-fed infants were followed-up from birth to 4 months of age in a maternity hospital, with a rooming-in program. Face to face BF education was given to mothers in two groups after delivery and also during 4 months post-partum. Body weight (Wt), length (L) and head circumference (HC) of the infants were measured at monthly intervals, and their feeding patterns were recorded. The Wt of exclusively breast-fed infants was higher than non-exclusively breast-fed infants. The faltering of infant's growth from 3 months of age was seen in both groups. From the age of 3 months, the Wt of non-exclusively breast-fed infants was lower than the 50th percentile of the reference value (NCHS), but L and HC increments were similar in both groups. Mean Wt, L and HC of exclusively breast-fed female infants were higher compared to non-exclusive females and also higher than exclusive male and non-exclusively breast-fed male infants. In the present study, the faltering of growth of infants was seen in the first 4 months of age, in comparison to breast-fed infants in the Darling study.

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Keywords: Exclusive breast feeding, Anthropometry, Weight, Length, Head circumference.

INTRODUCTION

Reports on the growth of exclusively breast-fed (EBF) infants are scarce, and most of the studies were performed on breast-fed (BF) and not "exclusively" breast-fed (EBF) infants. The results of several studies showed that growth of BF infants deviated from the National Center for Health Statistics chart,[1-11] but these differences have not been shown by other investigators.[12-17]

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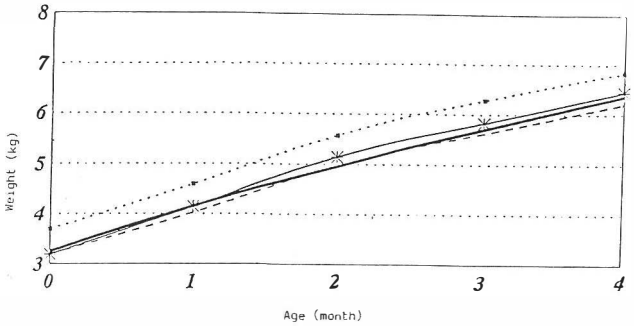

Fig. 1. Mean weight of exclusively and non-exclusively breast-fed [EBF (*) and NEBF (--)] infants compared with the 50th percentile of the NCHS (-) and Darling study(- ■-).

It has also been shown that in the first 2 to 3 months of life, the BF infants tend to grow rapidly and thereafter, their growth is slower compared to NCHS standards.[5] However, the current reference data (NCHS standards) are based on data collected from infants whom the majority were exclusively bottle fed, or were breast-fed for a short period of time. Thus it might not be suitable for BF infants.

The present article is part of an interventional prospective study on the "effect of breast-feeding education to the mothers on the infant's feeding pattern and growth in the first 4 months of life". Although breast-feeding education has been given to all mothers in the education group, the infants' feeding patterns during the study period (4 months) was not similar in this group. Therefore the purpose of the present study is to assess the growth of EBF and NEBF infants in the educated group.

SUBJECTS AND METHODS

The present study is part of an interventional prospective study that was conducted in a public maternity hospital with a rooming-in program, in Shiraz, from March to September 1994. Subjects, who were from an urban population of low socioeconomic status, were selected before delivery with respect to the following criteria: mothers were primiparous or had a previous unsuccessful BF experience, had a normal pregnancy and a vaginal, term delivery (30-42wk), had no chronic disease, and were not taking any medication. All were willing to breast-feed and had no job outside the home. Newborns included in this study were healthy singletons born at 30-42 wk of gestation, with a birth weight of 2500g or more, which was considered appropriate for their gestational age.[10]

Follow up

The initial intervention was a hospital-based BF education program during the postpartum stay (for 24 hours) in the hospital, with follow-up performed by a trained nutritionist. After delivery, these mothers were instructed concerning the advantages of BF for the mother and for the baby; anatomy and physiology of the mammary gland; positioning the baby at the breast; prevention of possible BF problems; rooming-in; BF on demand and to use the breast as the only source of nutrients, with the exception of drops containing vitamins, in the first 4 months of life. On the day of discharge the BF position was observed and educational materials including different aspects of breast-feeding were given to the mothers. Follow-up visits in the lactation clinic (created for the present study) located in the maternity hospital, or in their houses were also scheduled at day 10-15, and 30 after delivery and on monthly intervals during the 4 months of the study. Mothers also were encouraged to attend the clinic at any time, if they had any concern about the infant's condition or their BF performance.

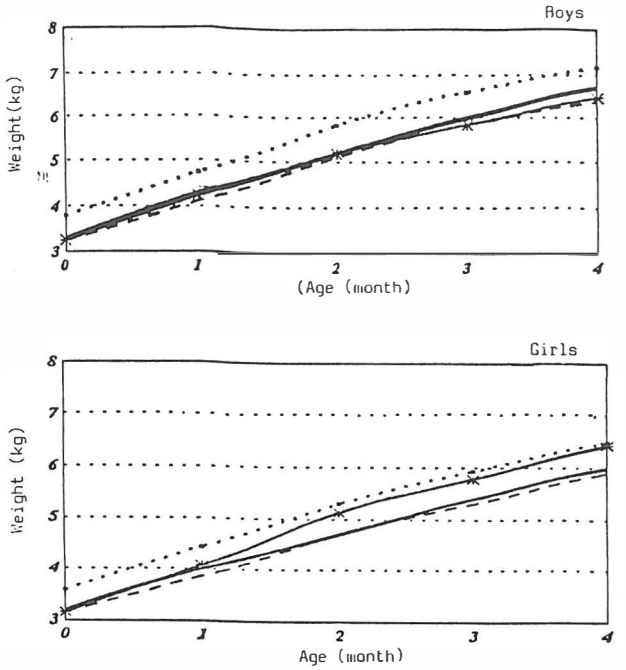

Fig. 2. Mean weight of exclusively and non-exclusively breast-fed [EBF(*) and NEBF (--)] boys and girls compared with the 50th percentile of the NCHS(-) and Darling study (- ■ -).

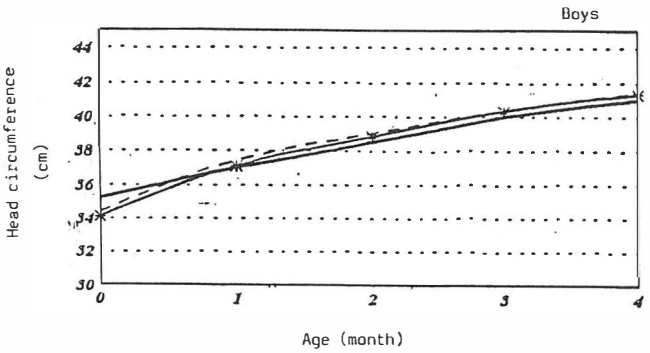

Fig. 3. Mean length of exclusively and non-exclusively breast-fed [EBF(*) and NEBF (--)] infants compared with the 50th percentile of the NCHS(-) and Darling study (- ■ -).

Anthropometric measurements, including mother's weight (Wt) and height (Ht) before delivery, and infant's body weight (Wt), length (L) and head circumference (Hc) were performed and recorded by a nutritionist after delivery and on each visit. Measurements were done by using standardized procedures[18] and necessary care was taken to standardize the equipment and the methodology. Weight was assessed by using a Seca mechanical scale (10g accuracy), length was measured on an infant measuring

*EPI: EPI Info., ver: 5.018, WHO/CDC, 1991
PE2: Personal Editor II, written by Jim Willy, (c)copyright IBM Corporation, 1982, 1985.
HG: Harvard Graphics, ver. 3.0, Copyright(c), Software Publishing Corp. 1991.

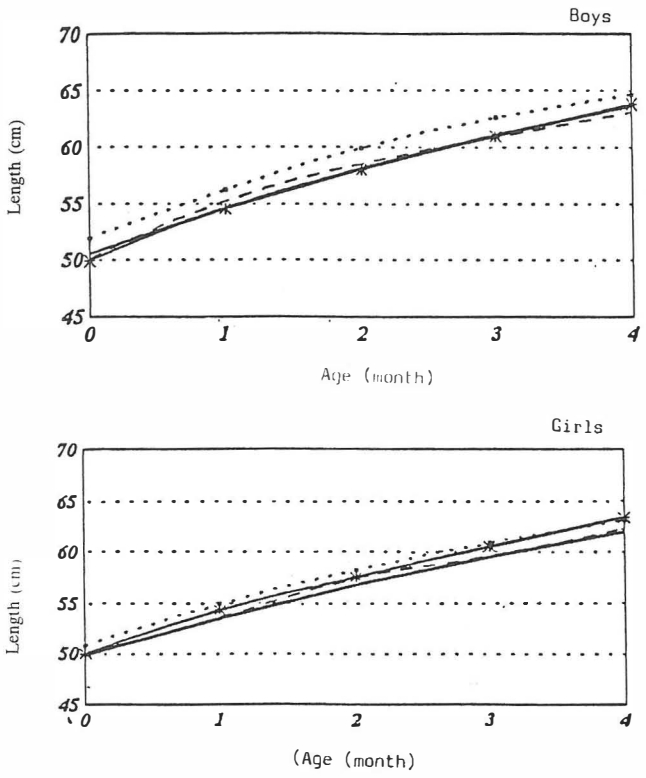

Fig. 4. Mean length of exclusively and non-exclusively breast-fed [EBF(*) and NEBF (--)] boys and girls compared with the 50th percentile of the NCHS(-) and Darling study (- ■ -).

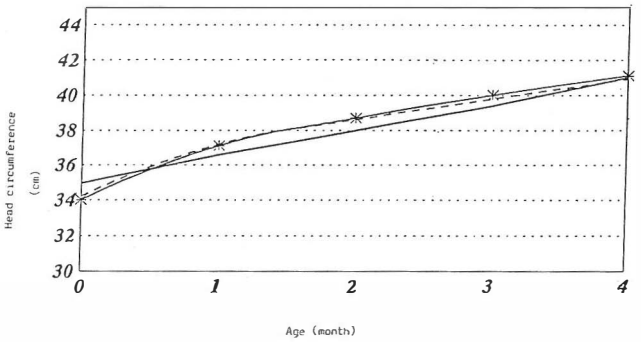

Fig. 5. Mean head circumference of exclusively and non-exclusively breast-fed [EBF(*) and NEBF (--)] infants compared with the 50th percentile of standard (-).

board (to the nearest 0.5 cm), and head circumference was measured by a plastic tape (to the nearest mm).

In spite of giving breast-feeding education to all mothers, the feeding pattern of infants were not similar during the study. The most common reason for starting supplementary

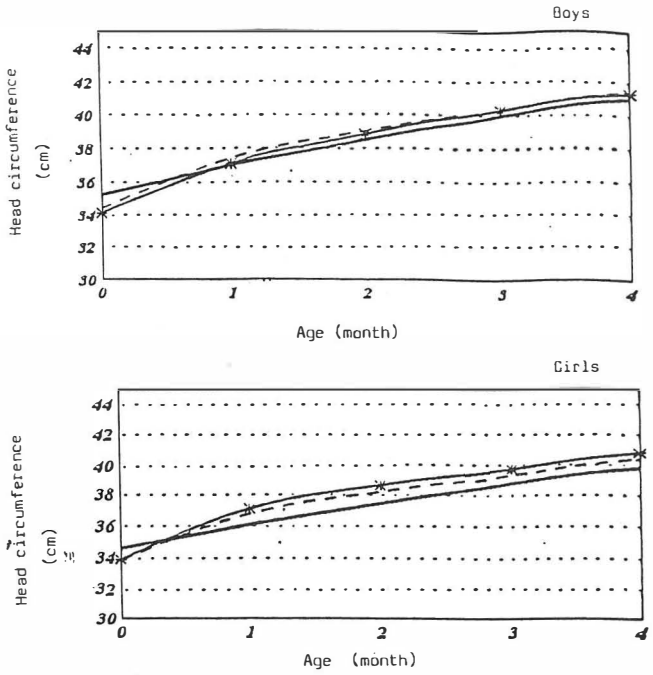

Fig. 6. Mean head circumference of exclusively and non-exclusively breast-fed [EBF(*) and NEBF(--)] boys and girls compared with the 50th percentile of the standard (-).

feeding was milk insufficiency, as indicated by the mothers, who did not breast-feed their infants exclusively. Thus, at the end of the fourth month, infants were divided into two groups, exclusively and non-exclusively breast-fed (EBF and NEBF).

Analysis

Data were analyzed using the statistical analysis software EPI, PE2 and HG.*

Weight (Wt), length (L) and head circumference (HC) were compared, using z scores. Chi-square and Student's t-test were used for determining the relationship between variables, and comparison of means, respectively.

RESULTS

Data on infant's mean weight (Wt), length (L), and head circumference (HC) of EBF and NEBF boys and girls with respect to the NCHS 50th percentiles and the Darling study[16] are shown in Tables I-III. EBF infants gained more Wt than NEBF infants, but the difference was not statistically significant. From the 3rd month, the mean Wts of NEBF infants were below the EBF infants and the NCHS 50th percentile (Fig. 1). L and HC of the infants were similar in EBF and NEBF infants (Figs. 3 and 5).

The mean Wt and L of EBF and NEBF infants in the present study were below the Darling study (Figs. 1 and 3), but the growth of EBF girls was faster than the boys and was

Table I. Weight of infants from birth to 4 months according to feeding pattern, and its comparison to the NCHS[5] and Darling study.[14]

Age (month)	Sex	Weight (kg)				NCHS 50th percentile (kg)	Darling Study(kg) $\bar{X}$ (S.D.)
		EBF*		NEBF**			
		No.	$\bar{X}$(S.D.)	No.	$\bar{X}$(S.D.)		
Birth	Boys	14	3.25(0.35)	16	3.24(0.44)	3.30	3.80(0.53)
	Girls	18	3.15(0.36)	11	3.15(0.41)	3.20	3.58(0.47)
0	Total	32	3.19(0.35)	27	3.20(0.42)	3.25	3.67(0.50)
	Boys	14	4.23(0.48)	16	4.11(0.52)	4.30	4.75(0.52)
1	Girls	18	4.07(0.45)	10	3.86(0.41)	4.00	4.43(0.49)
	Total	32	4.14(0.46)	26	4.01(0.49)	4.15	4.59(0.51)
	Boys	14	5.18(0.63)	16	5.12(0.68)	5.20	5.83(0.65)
2	Girls	18	5.13(0.55)	10	4.70(0.60)	4.70	5.30(0.52)
	Total	32	5.15(0.58)	26	4.96(0.67)	4.95	5.56(0.59)
	Boys	13	5.85(0.59)	15	5.85(0.76)	6.00	6.60(0.71)
3	Girls	18	5.79(0.71)	11	5.30(0.83)	5.40	5.94(0.62)
	Total	31	5.82(5.82)	26	5.62(0.82)	5.70	6.27(0.69)
	Boys	14	6.47(0.57)	16	6.38(0.68)	6.70	7.18(0.84)
4	Girls	18	6.43(0.81)	11	5.91(0.82)	6.00	6.49(0.73)
	Total	32	6.44(0.70)	27	6.20(0.76)	6.35	6.83(0.78)

* Exclusive breast-feeding (EBF)
** Non-exclusive breast-feeding (NEBF)

similar to the Darling study (Figs. 2 and 4).

DISCUSSION

Results of this study showed that the EBF infants tended to gain weight slightly faster, and NEBF infants a little slower than the current reference data (Fig. 1). After the 3rd month, the increase in Wt was reduced, especially in the NEBF group. Several studies also showed that growth of BF infants deviated from the NCHS standard.[1-11, 19]

Unfortunately, with the drop in infant's growth rates, the health care providers prescribe supplements. This drop in growth rate might be due to some problems related to breast feeding that can be corrected with proper lactation counseling, or even be normal in healthy exclusively breast-fed infants after the 3rd month who later experience significant changes in their growth rate during the first year of life.[8, 17-24]

Differences in weight, especially among EBF and NEBF girls were the most pronounced (Fig. 2), whilst length and head circumference of EBF and NEBF infants were similar (Figs. 3 and 5). These results suggest that EBF infants generally, and EBF girls in particular, tended to gain more weight than NEBF infants. In girls, the increase in the growth rate was less in NEBF compared to EBF infants (Fig. 2). This probably is due to introduction of nutritionally inadequate liquid and complementary foods to the NEBF female in less developed countries, especially in low socioeconomic families.[25, 26]

As reported by other investigators, complementation by 2-3 months was strongly associated with a low nutritional status.

In EBF girls, the increase in Wt, L and HC (Figs. 2, 4 and 6) was more pronounced than in EBF boys in this study, and in those of NCHS, Darling study[8] and HC reference data.[27] It is indicated that the increase in these 3 variables in the first months of life in girls rather than boys, might be due to energy intake higher than the recommended levels.[28]

The growth rate of infants in the present study (Figs. 1-4) was lower than the Darling study.[3] This might be due to the differences in birth Wt and L, genetic or environmental factors.

It should be noted that the subjects in the present study were from low socioeconomic status and were randomly selected from a public maternity hospital. Therefore, the growth patterns of these infants can not represent optimal environmental conditions. In more favorable conditions growth patterns of infants probably show greater deviation from the NCHS standards.

Table II. Length of infants from birth to 4 months according to feeding pattern, and its comparison to the NCHS [6] and Darling study.[14]

Age (month)	Sex	Length (cm) EBF* No.	EBF* $\bar{X}$(S.D.)	NEBF** No.	NEBF** $\bar{X}$(S.D.)	NCHS 50th percentile (cm)	Darling study (cm) $\bar{X}$(S.D)
Birth	Boys	14	49.9(1.8)	16	50.1(1.9)	50.5	51.9(2.4)
	Girls	18	50.0(1.8)	11	49.9(1.4)	49.9	50.8(2.5)
0	Total	32	49.9(1.8)	27	50.0(1.7)	50.2	51.4(2.5)
	Boys	14	54.6(2.0)	16	55.2(2.2)	54.6	56.2(2.2)
1	Girls	18	54.3(1.4)	10	53.6(1.5)	53.5	54.9(2.1)
	Total	32	54.4(1.7)	26	54.6(2.1)	54.05	55.5(2.2)
	Boys	14	58.0(1.9)	16	58.5(2,4)	58.1	59.9(2.2)
2	Girls	18	57.5(1.7)	10	57.4(1.9)	56.8	58.2(2.1)
	Total	32	57.7(1.8)	26	58.1(2.3)	57.45	59.1(2.2)
	Boys	13	61.0(1.9)	15	60.9(2.7)	61.1	62.6(2.3)
3	Girls	18	60.5(2.3)	11	59.6(1.6)	59.5	60.9(2.1)
	Total	31	60.7(4.1)	26	60.4(2.4)	60.3	61.6(2.2)
	Boys	14	62.8(1.4)	16	63.1(3.0)	63.7	64.6(2.5)
4	Girls	18	63.4(2.3)	11	62.3(2.1)	62.0	63.1(2.2)
	Total	32	63.5(1.9)	27	62.9(4.8)	62.85	63.9(2.4)

* Exclusive breast-feeding (EBF)
** Non-exclusive breast-feeding (NEBF)

Table III. Head circumference (HC) of infants from birth to 4 months according to feeding pattern, and its comparison to the reference data.[20]

Age (month)	Sex	HC(cm) EBF* No.	EBF* $\bar{X}$(S.D.)	NEBF** No.	NEBF** $\bar{X}$(S.D.)	Reference data 50th percentile
Birth	Boys	14	34.1(1.3)	16	34.4(1.2)	35.25
0	Girls	18	33.9(1.1)	11	33.9(1.8)	34.64
	Total	32	34.0(1.2)	27	34.2(1.5)	34.94
	Boys	14	37.1(1.4)	16	37.4(1.2)	37.01
1	Girls	18	37.1(1.1)	10	36.8(0.9)	36.13
	Total	32	37.1(1.2)	26	37.2(1.1)	36.57
	Boys	14	38.8(1.0)	16	29.0(1.3)	38.50
2	Girls	18	38.6(1.1)	10	38.2(0.8)	37.46
	Total	32	38.7(1.1)	26	38.6(1.2)	37.98
	Boys	13	40.3(1.1)	15	40.3(1.5)	40.00
3	Girls	18	39.7(1.2)	11	39.3(1.0)	38.80
	Total	31	40.0(1.3)	26	39.8(1.4)	39.40
	Boys	14	41.3(1.1)	16	41.4(1.0)	41.60
4	Girls	18	40.8(1.2)	11	40.4(1.0)	40.29
	Total	32	41.1(1.1)	27	40.9(1.1)	40.95

* Exclusive breast-feeding (EBF)
** Non-exclusive breast-feeding (NEBF)

Difference in weight between EBF and NEBF infants was more pronounced after the introduction of liquids or complementary foods. The nutritional quality of liquids and supplementary food, especially in low socioeconomic groups, offered to the infants are lower than breast milk. Thus, it can be concluded that it is probably normal for the EBF infants in the present study to gain more weight than the NEBF infants.

The mothers of both EBF and NEBF infants (both participated in breast-feeding education programs), under the influence of near relatives, especially in NEBF infants, even if their infants were healthy, introduced liquids and complementary foods to their infants at ages that were not recommended to them. This will have an unsatisfactory effect on programs that attempt to promote exclusive breast feeding during the first 6 months of life. The introduction of liquids and complementary foods in the first months of life, especially when prepared under unsanitary conditions, are not only nutritionally inadequate, but will reduce the infant's appetite, the number of breast feedings, the inadequate milk production[10-29] and also cause infectious disease.[29-32]

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