Effect of exclusive breastfeeding and complementary feeding on infant growth and morbidity

T. Khadivzadeh[1] and S. Parsai[2]

تأثير الاقتصار على الإرضاع من الثدي والتغذية التكميلية على نمو الطفل وإصابته بالأمراض

طلعت خديوزادة، سوسن بارساي

الخلاصة: تم إجراء دراسة أترابيَّة في جمهورية إيران الإسلامية في الفترة بين كانون الثاني/يناير 1997 وشباط/فبراير 1998 لمقارنة نمو فئة من الأطفال وإصابتهم بالأمراض بعد الاقتصار على إرضاعهم من الثدي لمدة ستة أشهر مع مئة من الأطفال الذين يرضعون من الثدي مع إضافة أطعمة تكميلية في أعمار تتراوح بين 4–6 أشهر. وتم تقييم نماذج إطعام الأطفال، وقياسات الوزن والطول وتسجيلها. ولم يكن هناك أي فارق هام في طول ووزن الأطفال المكتسب خلال الفترة 4–6 أشهر. أما معدل حدوث الإسهال في عمر 4–6 أشهر فقد كان أخفض بشكل واضح بين من تقتصر تغذيتهم على الإرضاع من الثدي (11٪) مقارنة مع من يتناولون تغذية تكميلية (27٪)، وكذلك فإن الالتهابات التنفسية كانت أيضاً أخفض فيمن تقتصر تغذيتهم على الإرضاع من الثدي (23٪) بالمقارنة مع من يتناولون تغذية تكميلية (35٪). وقد استنتجنا من ذلك أن الاقتصار على الإرضاع من الثدي يفوق في فائدته الإطعام التكميلي حتى الشهر السادس من العمر على الأقل.

ABSTRACT A cohort study was conducted in the Islamic Republic of Iran between January 1997 and February 1998 to compare the growth and morbidity of 100 infants who were exclusively breastfed for 6 months and 100 who received breast milk and complementary foods between 4–6 months. Infants' feeding pattern, weight and height were assessed and recorded. There were no significant differences in infants' weight and height gain between 4 and 6 months. The rate of diarrhoea between ages 4 and 6 months was significantly lower in exclusively breastfed infants than in complementary food-fed infants (11% versus 27%) and respiratory infections were also lower (23% versus 35%). We conclude that exclusive breastfeeding is superior at least until an infant is 6 months of age.

Effet de l'alimentation au sein exclusive et de l'alimentation complémentaire sur la croissance et la morbidité des nourrissons

RESUME Une étude de cohorte a été réalisée en République islamique d'Iran entre janvier 1997 et février 1998 pour comparer la croissance et la morbidité de 100 nourrissons qui ont été exclusivement nourris au sein pendant 6 mois et de 100 nourrissons qui ont reçu du lait maternel et des aliments de complément entre l'âge de 4 et de 6 mois. Le mode d'alimentation, le poids et la taille des nourrissons ont été évalués et consignés. Il n'y avait aucune différence significative dans le gain de poids et de taille des nourrissons entre 4 et 6 mois. Le taux de diarrhée entre l'âge de 4 et 6 mois était significativement moins élevé chez les enfants nourris exclusivement au sein que chez les enfants ayant reçu une alimentation complémentaire (11 % contre 27 %) et les infections respiratoires étaient également moins nombreuses (23 % contre 35 %). Nous concluons que l'allaitement au sein exclusif est supérieur au moins jusqu'à ce que le nourrisson ait atteint l'âge de 6 mois.

[1]Educational Development Centre, Meshed University of Medical Sciences, Meshad, Islamic Republic of Iran.
[2]Department of Social Medicine, Shaheed Beheshti University of Medical Sciences, Tehran, Islamic Republic of Iran.
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Introduction

Breastfeeding provides significant nutritional, health and psychological benefits to both mothers and infants [*1*]. It is suggested by the World Health Organization and the United Nations Children's Fund (WHO/UNICEF) that exclusive breastfeeding is adequate for the first 4 to 6 months of life [*2*]. Mothers are advised by the Iranian National Breastfeeding Committee to breastfeed their infants exclusively up to 6 months of life. There has been no research in the Islamic Republic of Iran to investigate the effect of this approach on infant growth and health.

Some investigations have claimed that breastfeeding provides the required nutrition in the first 2 or 3 months of life, but later cannot provide adequate growth for many infants [*3,4*]. In other investigations, exclusive breastfeeding was considered to provide sufficient growth and health up to 6 months of age [*5–11*] or provide more weight gain [*12*].

This study was conducted in Meshed from January 1997 to February 1998 in order to compare the growth and morbidity of infants who were exclusively breastfed for 6 months and those who were given complementary foods between 4–6 months old.

Methods

Meshed is the largest city of Khorasan Razavi province in the north-east of the Islamic Republic of Iran. Based on the 1996 census, Meshed's urban population was 1 887 405, of whom 31 598 were under 1 year old.

Participants

The sample of this cohort study comprised 200 healthy, full-term infants who received health care at 5 health care centres randomly selected from 54 urban health care centres in Meshed. The criteria for entry to the study were: all babies at the end of the 4th month of life who had been exclusively breast-fed, had normal growth, were healthy at entry to the study and whose mother was healthy and attended mother and child health care on a regular basis. In order to recruit infants fulfilling these criteria, 498 pairs of mothers were interviewed. Two equal groups were formed: 100 mothers who had decided to continue exclusive breastfeeding until the end of 6 months after the birth, and 100 mothers who had decided to use complementary foods after 4 months, based on the timetable for initiating complementary foods introduced by the Iranian Ministry of Health and Medical Education.

The two groups were matched for sex, weight and height of the infants. All mothers received mother and child health care on a regular basis, and instructions about the correct practice and techniques of breastfeeding. At the time of entrance to the study (when the infants were 4 months old) the instructions were repeated, and only the mothers whose breastfeeding techniques were correct entered the study. Mothers who wanted to begin complementary foods were instructed about appropriate kinds of food and when to give them, i.e. after breastfeeding.

Data collection

The infants' weight and height were measured at entry to the study at 4 months and at the end of age 5 and 6 months. Gestational age and birth weights were obtained from official birth certificates. Infant weight were measured to the nearest 10 g using Seca scales with a light cover at the end of 4, 5 and 6 months. Infant length was measured to the nearest 1 mm using a re-

cumbent board. The reliability of the weighing scales was checked using a 1 kg standard mass on a daily basis.

Mothers were asked to bring their infants to the health centres for vaccination at age 4.5 months, and at this visit we confirmed their infant feeding practices.

All mothers were instructed to bring their infant to the health centre if he/she had any symptoms such as fever, cough or diarrhoea. Infants who were ill or who did not have normal weight gain were referred to the physician at the health care centres. The physicians recorded their diagnoses and referred the infants and/or prescribed drugs as necessary. For infants without normal weight gain, health education was given and mothers were advised to continue the selected method of feeding. To obtain more complete morbidity data, mothers were also asked about any illnesses that were not presented to the health centre.

Data analysis

Mean, standard deviation, and 95% confidence intervals (CI) were calculated for all length and weight measures. Comparison of growth between the 2 groups were made using the Student *t*-test, and a chi-squared test was used to compare the rate of morbidity in the two groups. Relative risk (RR) of illness was calculated.

Results

As shown in Table 1, the exclusively breastfed infants and those who received complementary foods were similar in terms of sex, weight and height at entry to the study (end of age 4 months), and maternal age and education. Although significantly more mothers who breastfed had attended antenatal care, both groups had received regular care at the health centres for 4 months before the study started.

During the study, 2 infants in the exclusively breastfed group and 5 in the complementary food-fed group were excluded for not complying with the selected method of feeding.

The comparison of growth measures of exclusively breastfed and complementary food-fed infants showed no difference in infants' weight at age 5 months (7257 ± 688 g versus 7262 ± 765 g, $P = 0.96$) or 6 months (7719 ± 763 g versus 7762 ± 843 g, $P = 0.95$) (Table 2). There were also no significant differences in length after age 5 months (64.8 ± 3.0 cm versus 64.9 ± 2.9 cm, $P = 0.8$) or 6 months (66.5 ± 3.0 cm versus 66.6 ± 3.1 cm, $P = 0.86$).

There were no significant differences in weight gain (922 ± 500 g versus 1015 ± 419 g, $P = 0.86$) and length gain (3.6 ± 1.3 cm versus 3.5 ± 1.1 cm, $P = 0.7$) from 4 to 6 months between exclusively breastfed and complementary food-fed infants (Table 2).

Mean daily weight gain of exclusively breastfed infants was 16.7 g per day at 5 months and 15.4 g per day at 6 months of age versus 18.4 g per day and 15.5 g per day respectively in complementary food-fed infants.

Diarrhoeal diseases occurred in 11% of exclusively breastfed infants versus 27% of complementary food-fed infants ($P = 0.004$; RR = 2.45; 95% CI = 1.20–4.67) and respiratory infections in 23% of exclusively breastfed infants versus 35% of complementary food-fed infants ($P = 0.06$; RR = 1.52; 95% CI = 0.97–2.37) in the 2-month study period.

Discussion

These results indicate that introducing complementary foods to breastfed infants does not significantly increase the rate of growth between ages 4–6 months. Dewey

Table 1 **Characteristics of the mothers and infants in the 2 study groups at entry to the study**

Characteristic	Exclusive breastfeeding (*n* = 100)	Complementary feeding (*n* = 100)	Significance
Infant sex (%)			$\chi^2 = 0.18$; ***P*** = 0.67
Female	49	45	
Male	51	55	
Infant mean weight ± SD ***(g)***	6757 ± 742	6711 ± 748	***t*** = 0.54; ***P*** = 0.59
Infant mean length ± SD ***(cm)***	62.9 ± 29	63.1 ± 29	***t*** = 0.46; ***P*** = 0.63
Maternal mean age ± SD ***(years)***	24.3 ± 4.7	24 ± 4.5	***t*** = 0.49; ***P*** = 0.65
Maternal education level (%)			$\chi^2 = 1.67$; ***P*** = 0.79
Illiterate	16	12	
Elementary school	19	25	
Middle school	36	35	
High school	20	21	
Higher education	9	7	
Mother had antenatal care[a] (%)			$\chi^2 = 8.35$; ***P*** = 0.0035
Yes	73	52	
No	27	48	

Infants were aged 4 months at entry.
n ***= number of participants.***
SD ***= standard deviation.***
[a]***Mothers who received regular antenatal care at the health centres or those who made more than 6 antenatal visits at private clinics.***

et al. showed no significant differences between the weight, length or head circumference of infants who were exclusively breastfed and infants who were breastfed but received twice daily complementary foods between 4 and 6 months of life [*11*]. Eregie and Abraham also showed no differences between the mean weights and rates of weight gain of exclusively or partially breastfed infants at each completed month for the first 6 months of life [*5*]. Simondon and Simondon reported no significant differences between the weight gain of infants who received complementary foods and those who predominantly received breast milk [*6*]. Our results are also similar to those of an interventional study from 4 to 6 months that showed neither weight gain nor length gain differed between two groups of infants who received exclusive breastfeeding or a 20% higher protein intake [*7*]. The results of the present study are also consistent with those from the DARLING [Davis Area Research on Lactation in Infant Nutrition and Growth] study that found that protein density of the infant diet was unrelated to growth throughout the first year of life [*8*]. Diaz et al. compared the monthly weight and length of fully breastfed infants with the WHO/National Center for Health Statistics data and showed that breastfeeding was adequate to support infant growth for the first 6 months of life [*9*].

Table 2 **Comparison of growth and rates of infectious diseases over 2 months in infants breastfed or complementary food-fed from 4–6 months**

Variable	Exclusive breastfeeding (*n* = 98)	Complementary feeding (*n* = 95)	Significance
Mean weight ± SD (g)			
5 months	7257 ± 686	7262 ± 765	***t*** = 0.05; ***P*** = 0.96
6 months	7719 ± 763	7726 ± 843	***t*** = 0.06; ***P*** = 0.95
Increase 4–6 months	922 ± 500	1015 ± 419	***t*** = 0.98; ***P*** = 0.86
Mean length ± SD ***(cm)***			
5 months	64.8 ± 30	64.9 ± 29	***t*** = 0.15; ***P*** = 0.8
6 months (cm)	66.5 ± 3.0	66.6 ± 3.1	***t*** = 0.17; ***P*** = 0.86
Increase 4–6 months	3.6 ± 1.3	3.5 ± 1.1	***t*** = 0.59; ***P*** = 0.5
Diarrhoea (%)			χ^2 = 8.3; ***P*** = 0.004
Yes	11	27	
No	89	73	
Respiratory infection (%)			χ^2 = 3.44; ***P*** = 0.06
Yes	23	35	
No	77	65	

n = ***number of participants.***
SD = ***standard deviation.***

In a study in Honduras, infants given solid foods consumed less breast milk after solid foods were introduced [*13*]. The displacement of breast milk occurs when solid foods are introduced, as the time spent breastfeeding declines and breast milk intake decreases [*9,11*]. Hop et al. showed that from 3 to 60 months of age exclusively breastfed infants gained more weight compared with partially breastfed and weaned infants [*12*].

In our study, the rates of both diarrhoea and respiratory infections were relatively high in both groups. However, the rate of diarrhoea between ages 4 and 6 months was significantly lower (P = 0.004) in exclusively breastfed infants than in complementary food-fed infants (11% versus 27%) and respiratory infections were also lower (23% versus 35%). The higher rate of diarrhoea in complementary food-fed infants may be because foods were not hygienically prepared. There is also evidence that intake of breast milk provides an effective defence against infections [*14*].

Although daily infant weight gains in both groups in this study (from 15.6 g to 18.7 g per day) were lower than that in the Honduras and DARLING studies [*7,13*], we conclude that exclusive breast feeding is not likely to limit growth between 4 and 6 months of age. Exclusive breastfeeding is superior at least until an infant is 6 months of age.

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