

Impact of Maternal Ramadan Fasting on Growth Parameters in Exclusively Breast-fed Infants

Abolfazl Khoshdel¹, MD; Mostafa Najafi², MD; Soleiman Kheiri³, PhD; Elham Taheri⁴, MD; Jafar Nasiri⁵, MD; Hosein Yousofi⁶, PhD; Amirgholi Jafari⁷, PhD

1. Pediatric Infectious Disease Specialist, Shahrekord University of Medical Sciences, IR Iran
2. Pediatric Psychiatrist, Shahrekord University of Medical Sciences, IR Iran
3. Statistic, Shahrekord University of Medical Sciences, IR Iran
4. General Physician, Shahrekord University of Medical Sciences, IR Iran
5. Gastroenterologist, Shahrekord University of Medical Sciences, IR Iran
6. Parasitologist, Shahrekord University of Medical Sciences, IR Iran
7. Philosophy and Logic Group, Shahrekord University of Medical Sciences, IR Iran

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Abstract

Introduction: There are many advantages of breast milk for infants. The impact of Ramadan fasting of breast-feeding mothers on their exclusively breast-fed infants' growth is still not clear. The objective of this study is to determine the impact of maternal Ramadan fasting on growth parameters of exclusively breast-fed infants.

Methods: This cohort study was conducted during Ramadan and five months after Ramadan on 116 healthy, exclusively breast-fed infants aged 15 days to 6 months. 36 infants, whose mothers fasted throughout Ramadan (case group) and 80 infants, whose mothers did not fast (control group), were enrolled in the study. All infants underwent periodic physical examinations, twice in Ramadan, 3 times in the second month and twice monthly in the next 4 months. The data analyses were done using a repeated measure analysis of variance. Statistical significance was defined as $P < 0.05$. Analyses were performed using SPSS statistical package and repeated measures ANOVA.

Findings: All growth parameters increased during the study period ($P < 0.05$), rate of increase being the same for both groups ($P > 0.05$). There is obvious increasing trend for all growth parameters; this trend depends on age and is almost similar for both groups.

Conclusion: Ramadan fasting by breast-feeding mothers did not adversely affect the growth parameters of exclusively breast-fed infants in short-term.

Key Words: Ramadan fasting, Exclusive breast-feeding, Infant, Growth parameters

* Correspondence author;

Address: Pediatric Department, Hajar Hospital, Sahrekord, IR Iran

E-mail: nikakhosh@gmail.com

Introduction

Ramadan is a holy month in the Islamic calendar and Muslims fast during this month.^[1] Ramadan fasting is one of the five pillars of Islam, and is respected by millions of Muslims all over the world. Believers are commanded to abstain from eating and drinking from sunrise to sunset as a sign of restraint and introspection. Food and fluid intake is restricted to night time and usually, food frequency and quality are reduced.^[2] Islamic tradition exempts pregnant and lactating women from fasting in Ramadan. However, it is common that many Muslim women fast during these periods. It is well known that breastfeeding is very important for infants. Breast-feeding of infants is associated with their better biological, psychological and intellectual development.^[3-6]

It seems that many factors can affect the volume and composition of human milk such as stage of lactation and maternal diet.^[7] Although many factors compromise maternal nutrition, the concentration of milk nutrients and milk volume remain unchanged.^[3,8] For example, one study concluded that moderate dehydration does not affect milk production.^[9] In short term, a child who fails to thrive because of inadequate caloric intake will drop in growth parameters especially in weight. Thus if fasting by exclusive breast-feeding mothers leads to changes in quality or quantity of breast milk and consequently infant's growth, we can realize the fasting effect by evaluating infants' growth parameters.

Number of studies about the impact of Ramadan fasting on maternal nutritional status and breast milk composition has increased in recent decades. However, there are limited data on the impact of Ramadan fasting on growth parameters of breast-fed infants. Therefore, the objective of this study was to determine the impact of Ramadan fasting on exclusively breast-fed infants' growth parameters.

Material & Methods

This cohort study was designed in health care centers affiliated to Shahrekord University of Medical Sciences, Shahrekord, Iran. This study

was performed from Ramadan of September 2006 to February 2007 (Islamic year 1427-28).

One hundred and fifteen healthy infants were included in the study. The infants were 15 days to 6 months old, with no complaints and had attended two Health care centers during the first week of the month Ramadan for a routine check up. Infants included in the present study were exclusively breast-fed, had no problems during their prenatal periods, and were born following a normal pregnancy. Twins, premature infants, low birth weight infants and infants with significant congenital abnormalities were excluded from the study. In addition, infants who had irregular periodic checkups or had certain diseases that may have affected their growth rate, such as acute gastroenteritis or upper respiratory tract infection, were not included in the study. All of mothers were non-smokers and none of them was taking any medications or dietary supplements. They had no chronic disease. The 116 infants were assigned into two groups. The first group consisted of 36 infants of mothers who were fasting during Ramadan. The second group consisted of 80 infants of mothers who were not fasting.

Demographic variables, sex and age of each infant were recorded in a data form. After recruitment, all infants underwent periodic physical examination twice in Ramadan, 3 times in the second month and twice monthly in the following 4 months. Two nurses, specifically trained in the methods, performed all anthropological measurements. One of the nurses used to take the measurements and the other one recorded them. In addition, the second nurse assisted the one taking the measurements in positioning the child. They made all measurements in duplicate using standard anthropological techniques. They took the mean of the two readings as the final value.

Recumbent length was measured as the distance from the crown to the heel with a length board. Length was measured to the nearest 1 mm. Weight was measured on a beam balance scale (Seca, Germany) and recorded to the nearest 1 gr. Head circumference was measured with a non-elastic tape measure. Weight, length and head circumference values for infants in each group

were recorded and then evaluated with respect to the results of published data reported from National Center for Health Statistics (NCHS)^[10,11].

To participate, parents and children had to be willing to comply with requirements of the study. After a description of the procedures and purpose of the study, these mothers voluntarily participated in the study.

Considering weight as the most important growth parameter and assuming standard deviation of weight in infants aged below six months is equal to 900 grams, using a 95 percent confidence and 80 percent for test power with an effect size of 600-gram sample size was calculated as 36 cases in each group. Because of more availability of the control group, the sample size of this group was multiplied by approximately 2.5 and 80 cases were studied in control group.

Descriptive statistics included mean and standard deviation (SD) used for growth parameters. Chi-square test was used to test equality of sex in both groups. The T test used to test the equality of age between the two groups. Distribution of the data was normal, so the

parametric repeated measure analysis of variance was used to determine whether any differences exist among growth parameters of infants between two groups during the study period. Statistical significance was defined as P-value less than 0.05 and analyses were performed using SPSS statistical package.

Findings

In this study, 116 infants participated. Fifty-four (46.6%) were boys and this proportion was the same in both groups ($P>0.05$). The beginning age of infants in the case group was from 0.5 to 6 months with a mean (SD) of 3.4 (1.4) and in the control group it was from 0.5 to 5 months with a mean (SD) of 2.3 (1.4) months. The mean (SD) of growth parameters of the two groups including weight, length and head circumference during six months with thirteen measurements is shown in table 1. The increasing mean of weight during the study was 39.9% in the case group and 60.6% in the control group. The mean of length increased 17.5% in the case group and 20.7% in the control

Table - Results of infants' growth parameters during study for the case and control group

	Weight (g)		Height (cm)		Head Circumference (cm)	
	Case	Control	Case	Control	Case	Control
time 1	5996 (1101)	5060 (1214)	59.5 (4.8)	56.4 (4.3)	40.9 (2.1)	38.9 (2.1)
time 2	6528 (1005)	5736 (1203)	61.2 (4.4)	58.4 (4.4)	41.1 (2.1)	40.1 (2.2)
time 3	6779 (992)	5891 (1306)	62.2 (4.4)	59.3 (4.4)	41.6 (1.9)	40.4 (1.9)
time 4	7043 (673)	6343 (1150)	63.1 (4.4)	60.5 (4.4)	42 (1.8)	41.1 (2.0)
time 5	7333 (956)	6603 (1153)	64.1 (4.4)	61.3 (4.4)	42.8 (2.0)	41.7 (2.0)
time 6	7189 (911)	6698 (1074)	64.5 (4.3)	62.6 (4.4)	43 (1.8)	42 (1.9)
time 7	7347 (884)	6936 (1070)	65.2 (4)	63.4 (4.4)	43.3 (1.8)	42.3 (1.8)
time 8	7499 (863)	7141 (1094)	65.9 (3.9)	64.4 (4.3)	43.5 (1.8)	42.6 (1.8)
time 9	7715 (873)	7391 (1138)	66.8 (3.8)	65.2 (4.3)	43.9 (1.8)	42.9 (1.7)
time 10	7857 (919)	7559 (1148)	67.5 (3.8)	66.1 (4.2)	44.2 (1.8)	43.3 (1.7)
time 11	8036 (960)	7763 (1202)	68.3 (3.9)	66.9 (5)	44.5 (1.8)	43.7 (1.7)
time 12	8196 (932)	7933 (1221)	69 (4.1)	67.2 (4.6)	44.9 (1.9)	44 (1.7)
time 13	8386 (963)	8125 (1237)	69.6 (4.3)	68.1 (4.7)	45.2 (2.0)	44.4 (1.7)

Table 2- The results of repeated measure ANOVA for growth parameters of infants in case and control group

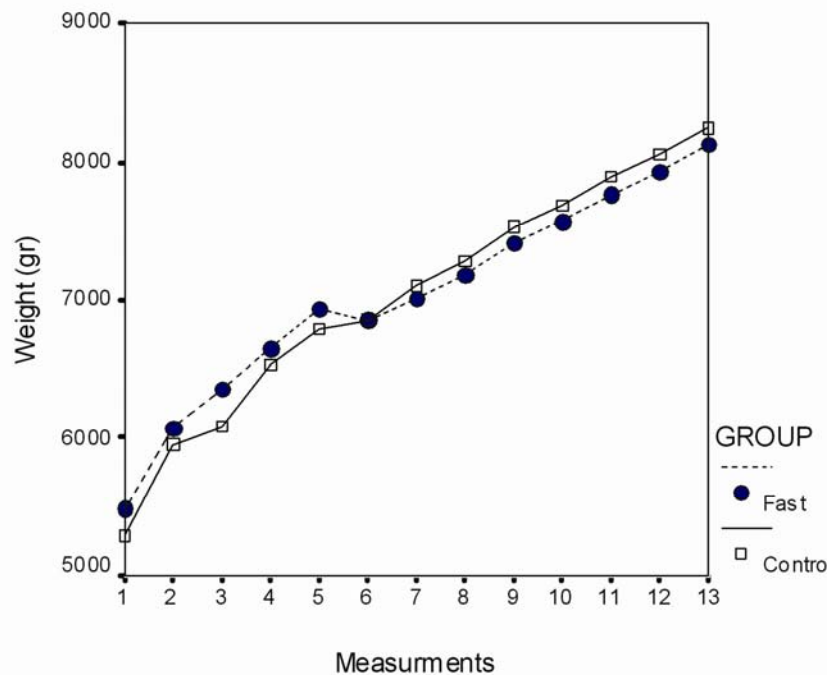
	weight			Height			Circumference		
	F	df	P	F	df	P	F	df	P
Within Subject Effects									
Time	141.1	2.65	< 0.001	111.6	2.21	< 0.001	101.1	2.43	< 0.001
Time * Age	13.8	2.65	< 0.001	4.16	2.21	0.01	2.77	2.43	0.05
Time * Group	2.4	2.65	0.07	1.2	2.21	0.3	2.04	2.43	0.1
Between Subject Effects									
Age	81.4	1	< 0.001	132.8	1	< 0.001	71.5	1	< 0.001
Group	2E-04	1	0.9	0.164	1	0.7	0.6	1	0.4

X * Y means interaction between X and Y variables

group. The mean head circumference of infants was 10.5 % higher for the case group and 14.1% for the control group at the end of the study. Higher increasing of growth parameters of the control group is due to high velocity of growth in this group.

For each of the growth parameters, a repeated measure analysis of variance model was used while 13 measurements were entered as within-subject variables and the group as between subject factor. Because age was different in the

two groups and a positive association between age and growth parameters existed, age at the beginning of the study was entered into the model as covariate. The multivariate F test of Greenhouse-Geisser was used for within subject analysis. Table 2 summarizes the results of repeated measures analysis of variance. The plots of estimated marginal mean of each growth parameter based on the repeated measure analysis of variance model has been drawn and shown in figure 1 to figure 3.

**Figure 1-** Estimation marginal mean of infants' weights during the study

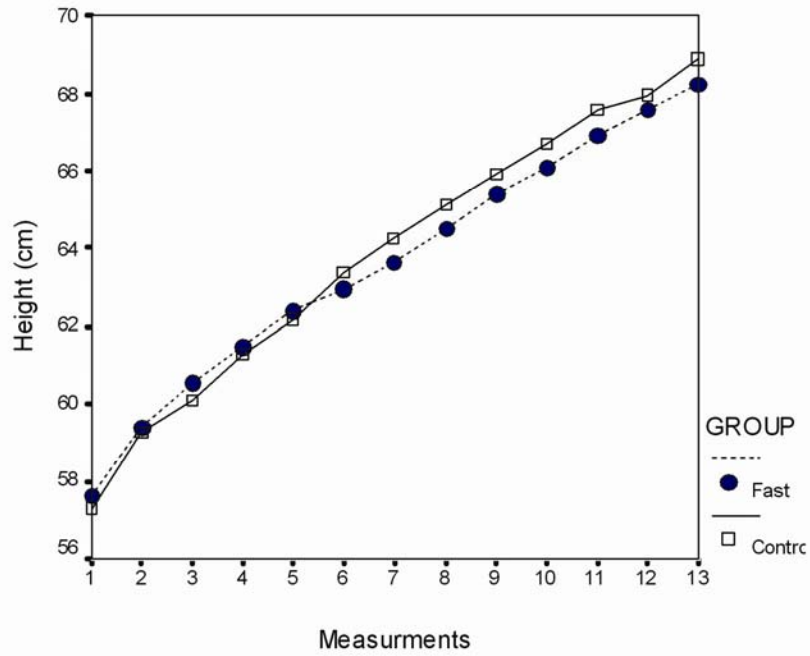


Figure 2- Estimation marginal mean of infants' height during the study

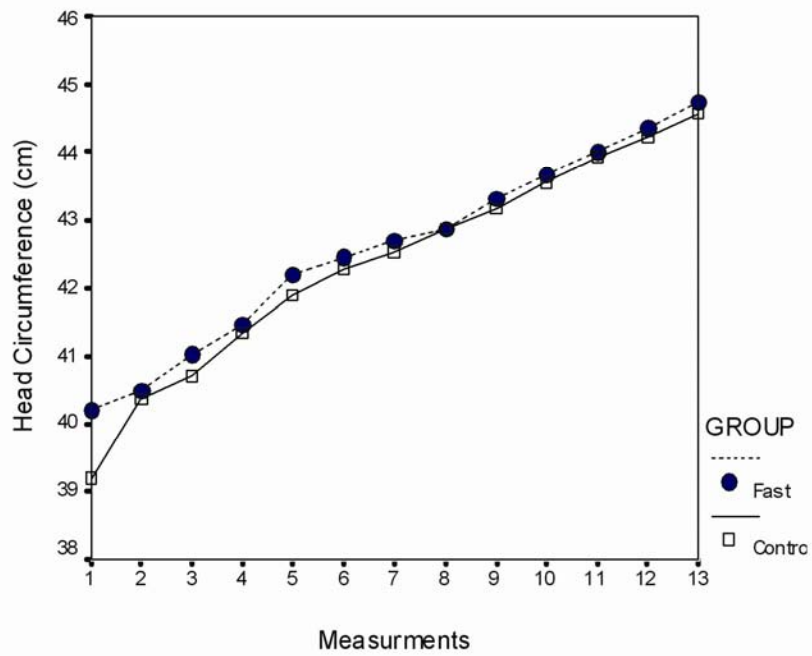


Figure 3- Estimation marginal mean of infants' head circumference during the study

From the results shown in Table 2, one can conclude that weight, length and head circumference increased during the study period ($P < 0.05$), but based on interaction of time and group, the rates of changes are equal for both groups ($P > 0.05$). There is obvious increasing trend for all growth parameters and the trends are somewhat similar for both groups. The group was not significant for all growth parameters ($P > 0.05$), showed no difference between growth parameters of the two groups while controlling for age. The age and the interaction between time and age are significant factors for all growth parameters ($P < 0.05$), i.e. growth is dependent of the age of the infants and the existing trend is dependent of the age too.

Discussion

Muslims refrain from eating and drinking from sunrise to sunset during Ramadan. They are otherwise allowed to eat and drink during the remaining hours. Many Muslim women are eager to fast during Ramadan but concerned that fasting may adversely affect breast milk volume or its composition and consequently infant growth. The impacts of Ramadan fasting on growth parameters of exclusively breast fed infants were examined in this study.

Our results indicated that Ramadan fasting had no significant impact on the infants' growth parameters. The present results are in agreement with previous studies that have indicated Ramadan fasting didn't affect breast milk quality and volume and consequently the growth of infants.^[3,8]

It has been reported in Rakicioğlu et al^[8] study that dietary changes during lactation and daily feeding frequencies had no affect on major milk nutrients, such as lactose, fat and protein. A decrease in the number of meals (only two meals) resulted in insufficiently daily food intake during Ramadan.^[12] Prentice et al^[13] showed that milk synthesis was largely unaffected by maternal fasting during Ramadan when women consumed one food or fluid during sixteen hours.

Bener et al^[3] indicated that no significant changes were found in total fat, protein, lactose, total solids, non-fat solids, triglycerides and cholesterol content of breast milk. They concluded that Ramadan fasting did not affect breast milk quality and volume.^[3] Kavemanesh and Abolghasemi^[14] in their retrospective cohort study determine the effects of maternal Ramadan fasting during pregnancy on neonatal birth weight as an important aspect of fetal health. They conclude that maternal Ramadan fasting did not have a significant effect on the neonatal birth weight.^[14]

In one animal study between rat groups, acute food restriction during lactation causes a 50% reduction in milk volume^[15] and a 32% reduction in litter weight.^[16] Dissimilar results may be attributed to the metabolic differences between lactation in rodents than in women.^[17] Although fasting is not ordered for pregnant and lactating women in Islam, fasting by lactating mothers is common during Ramadan. It was found that fasting caused a decrease in breast feeding frequency and increased in supplementing infant with supplementary foods.^[18]

On the other hand, infant feeding is a very important matter, for both family and the pediatrician. Feeding pattern is probably the most important factor affecting growth. It is concluded from many studies that exclusive breast-feeding is the most appropriate feeding pattern for newborn infants during the first six months of life, the most important fraction of human life.^[19-22] Some authors have reported that any barrier to programs attempting to promote exclusive breast-feeding should be avoided and the confidence of breast feeding women should not be undermined. This is especially critical in developing countries, as the risks of introducing complementary foods under unsanitary conditions may be considerable.^[11]

Our study is a short-term follow up and we follow infants up to six months; therefore, we may miss late impacts of mother fasting on growth parameters of exclusively breast-fed infants in long time. We recommend more study to evaluate long-term effects of mother's fasting on growth parameters of the infant to obtain statistically reliable and documented results.

Conclusion

Ramadan fasting by breast-feeding mothers of infants is common, and rates of mother fasting are affected by beliefs of mothers on the impacts of fasting on breast-feeding. We believe that child health care providers need to study the impacts of Ramadan fasting on infants' growth parameters, inform mothers about importance of breast-feeding and get informed about relevant religious recommendations about fasting by lactating mothers to combat the possible unfavorable impacts of fasting on infants and children.

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References

1. The Holy Quran. Sura 2, Verse 185.
2. Ziaee V, Razaee M, Ahmadinejad Z, et al. The changes of metabolic profile and weight during Ramadan fasting. *Singapore Med J*. 2006;47(5):409-14.
3. Bener A, Galadari S, Gillett M, et al. Fasting during the holy month of Ramadan does not change the composition of breast milk. *Nutr Res*. 2001;21(6):859-64.
4. Anderson JW, Johnstone BM, Remley DT. Breast feeding and cognitive development: a meta-analysis. *Am J Clin Nutr*. 1999; 70(4):525-35.
5. Drane DL, Logemann JA. A critical evaluation of the evidence of the association between type of infant feeding and cognitive development. *Paediatr Perinat Epidemiol*. 2000;14(4):349-56.
6. Heining MJ. Host effect benefits of breast feeding for the infant. Effect of breastfeeding duration and exclusivity. *Pediatr Clin North Am* 2001;48(1):105-23.
7. Lönnerdal B. Effects of maternal dietary intake on human milk composition. *J Nurtr*. 1986;116(4):499-513.
8. Rakicioğlu N, Samur G, Topçu A, et al. The effect of Ramadan on maternal nutrition and composition of breast milk. *Pediatr Inter*. 2006;48(3):278-83.
9. Bentley GR. Hydration as a limiting factor in lactation. *Am J Hum Biol*. 1998;10(2): 151-61.
10. Clinical growth charts: Developed by NCHS in collaboration with the National Center for Chronic Disease Prevention and Health Promotion (2000). Available at: <http://www.CDC.gov/growthcharts>. Access date: June 25, 2007.
11. Dewey KG, Peerson JM, Brown KH, et al. Growth of breast-fed infants deviates from current reference data: a pooled analysis of US, Canadian, and European data sets. World Health Organization Working Group on Infant Growth. *Pediatr*. 1995; 96(3Pt1): 495-503.
12. Bener A, Hamad A, Fares A, et al. Is there any effect of Ramadan fasting on stroke incidence? *Singapore Med J*. 2006;47(5): 404-8.
13. Prentice AM, Lamb WH, Prentice A, et al. The effect of water abstention on milk synthesis in lactating women. *Clin Sci*. 1984;66(3):291-8.
14. Kavehmanesh Z, Abolghasemi H. Maternal Ramadan fasting and neonatal health. *J Perinatol*. 2004;24(12):748-50.
15. Brigham HE, Sakanashi TM, Rasmussen KM. The effect of food restriction during the reproductive cycle on organ growth and milk yield and composition in rats. *Nutr Res*. 1992;12(7):845-56.
16. Kliewer RL, Rasmussen KM. Malnutrition during the reproductive cycle: effects on galactopoietic hormones and lactation

- performance in the rat. *Am J Clin Nutr.* 1987;46(6):926-35.
17. Rasmussen KM. Effects of under- and over nutrition on lactation in laboratory rats. *J Nutr.* 1998;128(2):390-3.
 18. Ertem IO, Kaynak G, Kaynak C, et al. Attitudes and practice of breast feeding mothers regarding fasting in Ramadan. *Child Care Health Dev.* 2001;27(6):545-54.
 19. Donma O, Donma MM. Infant feeding and growth: A study on Turkish infants from birth to 6 months. *Pediatr Int* 1999;41(5): 542-8.
 20. Kaste LM, Gift HC. Inappropriate infant bottle feeding. Status of the healthy people 2000 objective. *Arch Pediatr Adolesc Med.* 1995;149(7):786-91.
 21. Lucas A, Morley R, Cole TJ, et al. Breast milk and subsequent intelligence quotients in children born preterm. *Lancet.* 1992; 339(8788):261-4.
 22. Lanting CI, Fidler V, Huisman M, et al. Neurological differences between 9-year-old children fed breast-milk or formula milk as babies. *Lancet.* 1994;344(8933): 1319-22.