

Breast-feeding history and overweight in 11 to 13-year-old children in Iran

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Background: The relationship between breast-feeding history and risk of overweight in pre-adolescent children was investigated.

Methods: Children's breast-feeding history and demographics were obtained in interviewer-administered questionnaires of a multistage cluster sample survey of 800 parents of children aged 11-13 years living in Yazd, Iran. Height and weight were measured in the children. Overweight was defined as body mass index ≥ 90 th age- and sex-specific percentile of the 2000 Centers for Disease Control reference values.

Results: One hundred and four (13.0%) of 800 children were overweight. A total of 783 (97.9%) of the children had been breast fed. There was a markedly lower overweight prevalence among breast-fed than non breast-fed children. Controlling for age and sex, children breast fed for at least 24 months were substantially less likely to be overweight than children breast fed for less than 12 months (OR 0.56, 95% CI 0.31-0.9). A longer overall duration and duration of exclusive breast-feeding were associated significantly with the decreasing prevalence of overweight.

Conclusion: This sample of Iranian children shows high rates of overweight at young ages but also high rates of breast-feeding. The duration of breast-feeding is inversely related with the prevalence of overweight in pre-adolescent children.

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Key words: body mass index; breast-feeding; epidemiology; overweight; pre-adolescent

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Introduction

In Western countries, concern has grown about the increasing numbers of children who are overweight and obese,^[1,2] and similar concerns are emerging in many developing countries.^[3,4] The data of the World Health Organization Monica Project show that over 30% of the people in the Middle East are overweight.^[5] A survey on secondary school students in Bahrain revealed that 15.6% of boys and 14.7% of girls were overweight.^[6] Like many other countries, the incidence rate of obesity in Iranian children has doubled between 1993 and 1999.^[7]

Among the many potential determinants of overweight and obesity, factors such as diet and physical activity have been prominent under the current paradigm of overweight as a condition of energy imbalance. Very few studies, however, have been able to demonstrate a significant excess energy intake in obese individuals, a phenomenon interpreted as underreporting or an interaction with the environment.^[8,9]

Because overweight and obesity in adolescence is strongly linked to continuing weight problems in adulthood,^[10] the associated health risks, knowledge of childhood modifiable risks and protective factors have emerged as an important issue for public health and clinical concerns.^[11] Several recent studies have emphasized the importance of early life factors in the development of insulin resistance syndrome.^[12-14] Low birth weight and ponderal index are found to be related to childhood, adolescent and adult obesity.^[15,16] Infant nutrition, specifically breast-feeding, seems to be associated with a lower incidence of type 2 diabetes in young adults and overweight and obesity in pre-school children and adolescents.^[17-19]

Reviews of the literature on the role of breast-feeding in obesity have reached different conclusions. One found only a small but consistent protective effect on obesity from breast-feeding^[20] While another^[21] concluded that the protective effect of breastfeeding on later obesity remains controversial; further research was needed to distinguish the true effects from those generated by the plethora of potentially confounding variables. Extensive reviews provide a framework for comparison of the included studies, the latest of which was published in 1999.^[21] This systematic review of

childhood predictors for adulthood obesity concluded that there is no clear relationship between infant feeding practices and later obesity. Our study aimed to examine the relation of early life factors, with a particular emphasis on breast-feeding and the duration of breast-feeding in infancy, with the prevalence of overweight in pre-adolescence children aged 11-13 years in a population-based survey.

Methods

Place of study

Yazd, one of the large cities of the Islamic Republic of Iran, is the center of Yazd Province. The city is located 750 km south of the capital Tehran. It has a drought climate and a population of 450 000 (Iran Literacy Movement, unpublished report, 2007).

Sampling method and sample size

Sampling was conducted based on a two-stage cluster sampling method. The study population was 11 to 13-year-old school children, who were living in Yazd city. The total number of schools (secondary school) in Yazd city was 136 consisting of 67 girls' schools and 69 boys' schools. In the first stage, 36 schools (18 girls' schools and 18 boys' schools) were selected at random from a frame of all schools in Yazd city. In the second stage, one single intact class of grade 6 (11- to 13-year-old) was selected from each of the 36 schools randomly. Each cluster (class) included 20-25 students in different schools of the city. Therefore, 18 classes of boys and 18 classes of girls were enrolled in this study, with a total sample size of 400 boys and 400 girls, a combined sample of 800.

Study design and conduction

This cross sectional study was conducted in September 2006 in the city of Yazd, state of Yazd in the center of Iran. Height was measured to the nearest 0.5 cm using a portable height measurer. Weight was measured to the nearest 0.1 kg using standard digital scales. Weight was measured with child wearing only light clothes and without shoes. Mothers were invited to the schools for completing the questionnaire with an invitation letter which was sent to them by the students. Information of bottle-feeding including duration of bottle-feeding and the age of starting bottle-feeding was obtained from the mothers.

Breast-feeding

The details of the method of infant feeding and the duration of breast-feeding were obtained from the mother at the time of the survey for each child aged 11-13 years.

Information on infant nutrition was ascertained with two questions on breast-feeding behavior. The first question simply asked whether the child was ever breast-fed (yes/no). If answered positively, the next question queried the duration of breast-feeding.

Definition of overweight

Body mass index (BMI) was calculated as weight/height² (kg/m²). Overweight was defined using the 90th age- and sex-specific percentile of the 2000 Centers for Disease Control reference values.^[22] Thus, 11-year-old boys with a BMI greater or equal to 21.2 kg/m² and girls with a BMI greater or equal to 22 kg/m² and 12-year-old boys with a BMI greater or equal to 21.7 kg/m² and girls with a BMI greater or equal to 22.5 kg/m² were classified as overweight. Similarly, 13-year-old boys with a BMI greater or equal to 21.7 kg/m² and girls with a BMI greater or equal to 22.5 kg/m² were classified as overweight.

Statistical analysis

Multivariate logistic regression was used to examine the association between breast feeding and overweight. The following variables were included in the model based on their potential to confound the relationship between breast-feeding and overweight: the child's age, gender, gravid, birth order, education of father, education of mother, and mother's and father's age at birth. A two-tailed *P* value of less than 0.05 indicated statistical significance. All analyses were conducted using SPSS version 13.

Results

The demographic, socio-economic and anthropometric characteristics of the children that stratified by gender are shown in Table 1. The mean ages of mothers and fathers were 36.65±6.34 years and 42.29±12.35 years, respectively. The proportion of questionnaires completed by the children's mothers was 97%.

At 11-13 years of age, girls were lighter and taller than boys. Consequently, the prevalence of overweight was markedly lower in girls (8.5%) than in boys (17.5%) using the 90th percentile of the 2000 Centers for Disease Control reference values. The Chi-square test showed that there was a significant difference in prevalence of overweight between boys and girls (*P*=0.0001).

The mean (SD) duration of breast-feeding in the breast-fed children was 19.3 (7.73) months and that of bottle-fed children was 5.4 (4.6) months.

Table 2 shows the breast-feeding history of children. Approximately 98.5% of girls and 97.1% of boys had been breast-fed. Of the children, 21.7% of the

Table 1. Demographic and anthropometric characteristics of the enrolled children

Variables	Boys (n=400)	Girls (n=400)	Total (n=800)
Age (y), mean±SD	12.29±5.53	11.90±0.63	12.09±3.93
Mother's age (y), mean±SD	36.36±6.38	36.93±6.28	36.65±6.34
Father's age (y), mean±SD	42.87±16.02	41.70±6.87	42.29±12.35
Height (cm), mean±SD	146.70±10.44	150.07±7.82	148.40±9.40
Weight (kg), mean±SD	41.63±10.40	39.90±10.90	40.77±10.70
Obesity (BMI ≥90th percentile)*	17.5	8.5	13.0
Educational level (mother) (%)			
Illiterate	12 (3.0%)	8 (2.0%)	20 (2.5%)
Elementary	151 (38.2%)	85 (21.5%)	236 (29.8%)
Guidance	113 (28.5%)	133 (28.5%)	226 (28.5%)
High school	92 (23.2%)	147 (37.1%)	239 (30.2%)
University	28 (7.1%)	43 (10.9%)	71 (9.0%)
Educational level (Father)			
Illiterate	5 (1.3%)	7 (1.8%)	12 (1.5%)
Elementary	136 (34.4%)	55 (14.0%)	191 (24.3%)
Guidance	78 (19.7%)	104 (26.6%)	182 (23.1%)
High school	121 (28.1%)	144 (36.7%)	255 (32.4%)
University	65 (16.5%)	82 (20.9%)	147 (18.7%)

*: $P=0.0001$, comparison between the boys and girls.

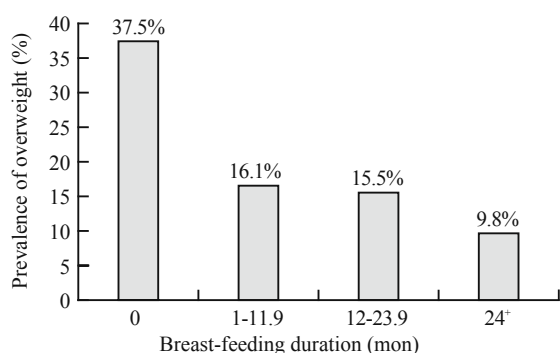


Fig. Prevalence of overweight by duration of breast-feeding in 11 to 13-year-old children.

Table 2. Percentage of breast-feeding among children in Yazd

Variables	Girls (n=400)	Boys (n=400)	Total (n=800)
Breast fed (any)			
Yes	98.5	97.1	97.9
No	1.5	2.8	2.1
Breast-feeding duration			
1-11.9 mon	21.7	19.0	20.4
12-23.9 mon	61.3	67.7	64.5
24+ mon	15.5	10.5	13.0
Exclusive breast-feeding			
<12 mon	20.7	23.6	22.1
12-23.9 mon	24.7	24.6	24.6
24+ mon	51.6	47.1	49.4

Table 3. Association of breast-feeding with obesity among children

Durations	Adjustment 1			Adjustment 2		
	OR	95% CI	P value	OR	95% CI	P value
Breast-feeding			0.052			0.061
1-11.9 mon	1	-		1	-	
12-23.9 mon	0.93	0.50-1.71	0.801	0.92	0.50-1.70	0.692
24+ mon	0.56	0.31-0.90	0.048	0.56	0.31-1.01	0.061
Exclusive breast-feeding			0.038			0.070
<12 mon	1	-		-	-	
12-23.9 mon	0.35	0.09-1.20	0.240	0.35	0.10-1.22	0.130
24+ mon	0.25	0.07-0.85	0.020	0.26	0.07-0.87	0.031

Adjustment 1 includes age, sex; Adjustment 2 includes age, sex, gravida, education of father, and education of mother.

girls were breast fed for less than 12 months compared to 19.0% of the boys. Correspondingly, only 61.3% of the girls were breast fed for 12-24 months compared to 67.7% of the boys.

The prevalence of overweight was substantially higher in children who had never been breast-fed (37.5%) than in those who had been breast fed (12.5%).

With the increasing duration of breast-feeding, the prevalence of overweight decreased (Fig.). A similar phenomenon was observed for exclusive breast-feeding.

Analyses of 783 breast fed children demonstrated a positive effect of the duration of exclusive breast-feeding. Compared to children who were breast fed for less than 12 months, children who were breast fed

for 12-24 months (OR 0.35, 95% CI 0.09-1.20) and children breast fed for more than 2 years (OR 0.25, 95% CI 0.07-0.85) were substantially less likely to be overweight.

With the increasing duration of breast-feeding, a dose-response like relation to the odds of overweight was observed (The Wald test for trend in total model 1, $P=0.052$). A very similar trend ($P=0.038$) was observed for exclusive breast-feeding. No interactions between breast-feeding and any of the other variables considered were observed. Additional adjustment for gravida, education of father and education of mother, tended to decrease the strength of the associations only slightly (Table 3).

Additional confounders considered, such as birth order, mother's or father's age at birth, did not influence the results (even though they were in part associated with the outcome) and were therefore omitted from the final analyses presented here.

Discussion

This is the first study in Iran to investigate the influence of breast-feeding on overweight in 11 to 13-year-old children. We found that the duration of breast-feeding was inversely related to the prevalence of overweight in school children.

Studies have evaluated the relation of infant feeding with overweight and obesity, with varying results.^[23-28] With few exceptions, the studies that demonstrated no association had comparatively smaller sample sizes, were frequently not population based, and restricted to young age groups ranging from 6 to 8-month-old infants. Only two studies have shown an increased duration of breast-feeding as a risk factor for increased weight.^[29,30] In contrast, our study conducted in 800 school children aged 11-13 years revealed a strong and consistent inverse association as demonstrated in other studies^[18,19,31] based on larger samples. Kramer^[18] described a strong protective association of breast-feeding with obesity in two samples (clinic and schools) of more than 600 adolescents of 12 to 18 years old. Similarly, von Kries et al^[19] recently reported a 20% reduction in odds of being overweight associated with breast-feeding in a population-based survey of more than 9000 children of 5 to 6 years old. Our findings in 10 to 13 years old school children are of a similar order of magnitude, and provide insight into the pre-adolescence age group which previously has not been studied and is particularly relevant to obesity in adulthood.^[29,32]

The relation of the duration of breast-feeding with overweight found in our study follows a marked dose-response like pattern, the lowest likelihood of

overweight being found with the longest duration of breast-feeding, consistent with previous findings.^[18,29] It is important to consider, however, that in all comparisons of breast-fed to non breast-fed children, residual confounding factors may play a role, i.e., mothers who chose not to breast feed may differ from those who breast-feed, in ways not ascertained by the study. For example, it is well established that breast-feeding is positively correlated with social class and a lower socio-economic status is associated with a higher prevalence of obesity.^[9] Therefore, our results based on the subgroup of breast fed children showing a continued positive effect of a longer duration of (exclusive) breast-feeding adds credibility to our findings.

Both behavioral and metabolic explanations for the observed association of breast-feeding and obesity have been proposed. Breast milk composition changes during feeding and provides satiety signals for the infant to stop suckling.^[33] In bottle-fed infants, the amount consumed is regulated mainly by volume, which may result in overfeeding. Furthermore, breast fed infants may acquire more control over their feeding behavior than bottle-fed children.^[29]

Bottle-fed infants exhibit significantly higher plasma insulin levels and a prolonged insulin response.^[34] This in turn may stimulate cell glucose uptake and inhibit biolysis, thus contributing to differences in deposition of subcutaneous adipose tissue.^[35] Odeley et al^[36] have shown that fasting insulin is positively associated with increased weight gain, relative weight increase and change in triceps skin fold in a cohort of 5 to 9-year-old Pima Indian children followed over 9 years, a finding since confirmed in young adults of 18-30 years.^[36] The weight and fat gain stimulating effects of insulin in young populations could therefore underlie the observed association of breast-feeding and overweight. This mechanism may also explain the markedly reduced risk of incident diabetes observed in a longitudinal study in Pima Indians aged 10-30 years.^[37] The effects of breast-feeding on insulin metabolism may even extend into adulthood. Ravelli et al^[38] have recently shown that individuals aged 48-53 years who were exclusively breast fed during the first 10 days of life had significantly lower fasting levels of insulin and glucose and post-challenge plasma glucose than those bottle fed. They also exhibited higher BMI, waist circumference and waist-to-hip ratio, which, however, were not statistically significant.^[29]

Our study shows a strong, protective effect of breast-feeding on the prevalence of overweight in children in Yazd. The proportion of ever breast fed children in our samples was higher (97.9%) than the national average of in the United States (65%)^[39] and

Germany.^[29] The prevalence of overweight among school children observed here (13.0%) was higher than the national estimate (10%)^[40] and lower than a Germany study (13.9%).^[29]

The main limitation of our study is that we did not have information on the dietary and physical activity of the adolescents as well as their parents' BMI. These factors might considerably influence overweight. Although the proportion of breast-feeding and overweight are high in Iran but a 4% higher prevalence of overweight may be related to confounding factors such as dietary intake and physical activity. Parental history of obesity is one of the strongest known risk factors for obesity in the offspring, more than doubling the risk.^[32] Breast-feeding among obese women may pose a particular burden^[41] as maternal obesity has been associated with a decreased likelihood of successful breast-feeding initiation and higher discontinuation rates.^[42] Thus, maternal obesity could act as a potential confounder. Kramer,^[18] however, has shown that the strong inverse relationship between breast-feeding and overweight/obesity was observed consistently in adolescents both with and without a parental history of obesity. None of those studies^[23,43] reporting lack of association between breast-feeding and overweight to date reached this conclusion based on adjustment for parental weight or obesity.

Our population study showed high rates of overweight at young ages and also high rates and cultural acceptance of breast-feeding. This suggests that programs that encourage prolonged breast-feeding may be useful tools in the battle against childhood overweight and obesity in this high-risk population.

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Contributors: Fallahzadeh H proposed the study and wrote the first draft. Golestan M analyzed the data. All authors contributed to the design and interpretation of the study and to further drafts. Fallahzadeh H is the guarantor.

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