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The impact of familial factors on obesity in Iranian children and adolescents

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A Study Design
B Data Collection
C Statistical Analysis
D Data Interpretation
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Summary

Background: To investigate the relationships between obesity in children and adolescents and some familial factors in Iran.

Material/Methods: A cross-sectional study was performed among 380 obese children and adolescents, aged 2–17, and their biological parents (n=760). The family socioeconomic status (SES) as well as the behavior, attitude, skills and knowledge (BASK) of parents, dietary and physical activity habits were assessed by validated questionnaires.

Results: Among the obese children studied, 37.4% of boys and 28.4% of girls had an obese mother ($p<0.05$), 5.8% of boys and 6.8% of girls had an obese father ($p>0.05$) and both parents of 5.8% of girls and 5.8% of boys were obese (BMI ≥30 kg/m^2). A significant relationship was found between the BMI of daughters and the BMI of their mothers and WHR of their fathers, as well as the BMI of sons with WHR of both parents. In addition, the WHR of children in both gender correlated significantly with the mother's WHR, but this relationship was not significant with father's WHR. A significant inverse relationship was found between the education level of both parents, as well as maternal employment and obesity in their children. 72.3% of mothers and 39.5% of fathers reported that before their children became fat, they believed that an obese child is healthier than low- or normal weight peers; 79.2% of mothers reported a history of using pressure in child feeding. The BMI of mother was associated with food habits of their daughters and sons, and the BMI of fathers had significant association with the frequency of activities of their sons.

Conclusions: Modification of obesogenic environment from early life is needed even in developing countries; culturally relevant family-based interventions, especially focusing on mothers' beliefs and behavior, should be emphasized.

Key words: **obesity • children • parents • socioeconomic status • dietary habits • physical activity**

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BACKGROUND

Childhood obesity is becoming an increasing public health problem of different developed and developing countries [1–2]. Tracking of obesity from childhood to adulthood and its contribution to adult obesity-related morbidity and mortality is of great health significance [3–4]. Given difficulties in changing established eating and exercise behaviors, identifying the modifiable environmental factors is of great concern to prevent obesity during development. Parental obesity is shown to be one of the important predictors for childhood obesity [5]. Familial environment and parental habits can have influence in this regard. Parents provide both the genes and eating environment for their children, familial patterns of adiposity are the result of gene-environment interactions [5–6].

Almost all data concerning the impact of familial factors on childhood obesity are from Western countries, considering differences in lifestyle and parenting skills in different communities. This study was carried out in Isfahan – the second largest city of Iran – to examine the association of selected family factors with childhood obesity in order to help find a useful approach for prevention and control of this escalating problem in our community similar to many other developing countries [7–8].

MATERIAL AND METHODS

This cross-sectional study was performed in 2003 among children and adolescents referred to the Obesity Clinic of Preventive Pediatric Cardiology Department, Isfahan Cardiovascular Research Center, a WHO collaborating center.

The participants were 380 children and adolescents, aged 2–17 years, and both their biological parents (n=760). Based on power calculations, this sample was deemed large enough to test hypothesis herein. The cases were selected by a randomization procedure from among children and adolescents referred from health care centers and schools, taking into consideration the proportion of the different clusters in the city to avoid socioeconomic bias.

The eligibility criteria for children and adolescents' participation included being obese (body mass index (BMI) ≥ age- and gender-specific 95th percentile) and living with both biological parents. Oral information was provided in detail to children and parents and written consent was obtained from the parents. The study was approved by the Ethics Committee of Isfahan Cardiovascular Research Center, Isfahan University of Medical Sciences (ICRC-IUMS).

All children and adolescents were examined by a pediatrician; those subjects with mental retardation, abnormal faces or other signs compatible with genetic syndromes, chronic medical problems or drug use and those with abnormal thyroid function tests (checked from all children) were excluded from the study. Parents were excluded from participation if they were on specific diet and or if they had been treated with any anti-obesity agent. Those mothers who were pregnant or lactating were also excluded. Parental BMI was calculated with the following cut-off points: normal (18< BMI ≤25 kg/m^2), overweight (25< BMI <30kg/m^2) and obesity (BMI≥30kg/m^2) [9].

The age, calculated from birth until the interview date, was recorded. Weight(Wt) and height (Ht) were measured with subjects lightly clothed and barefoot to the nearest 0.5cm and 0.1kg, respectively. Based on the recommendations of Lohman et al, three Ht and Wt measurements were collected [10], and their averages were used to compute the body mass index (BMI) as Wt (kg) divided by Ht (m) squared. BMI was converted to percentile by using the Center for Disease Control (CDC) reference data [11]. Obesity was defined as a BMI more than the age- and gender-specific 95th percentile for children and a BMI more than 30 for parents.

Waist circumference (WC) was measured at a point midway between the lower border of the rib cage and the iliac crest at the end of normal expiration, and hip circumference was measured at the widest part of the hip [12]. Waist-to-hip ratio (WHR) was computed by dividing the WC by the hip circumference. All measurements were made by the same trained staff under the supervision of the same pediatrician.

A structured self-administered questionnaire was prepared for parents; the validity of its content was affirmed on the basis of observations by a panel of experts from the Research Method Committee and Research Council of ICRC-IUMS. Item analysis and reliability measures were assessed based on the response of 50 parents. When scales were created, the standard measure of reliability, Cronbach alpha, was calculated to measure internal consistency of the items. A Cronbach alpha above 0.5 was considered an acceptable level of correlation among the items. The behavior, attitude, skills and knowledge (BASK) of parents about factors influencing childhood obesity, as well as detailed information on socioeconomic status (SES) were asked.

Socioeconomic factors that were analyzed included family income, number of family members, parental and maternal occupation and education, type of house (rental or private), and the type of school (public or private) of children and adolescents above 6 years of age. Family income was categorized as low, middle, or high based on data from the National Plan and Budget Organization.

A food frequency questionnaire (FFQ) including commonly consumed food items was completed. The frequency of physical activities and the frequency of TV watching for ≥3 hours/day were recorded on a weekly basis. As the rate of physical activity is very low in our community [13–14], only routine usual activities such as walking and home exercise were asked. Vigorous physical activity was defined as an activity causing perspiration or an increase in breathing or heart rate for at least 30 minutes.

Statistical analysis

The collected data were stored on a computer database. The data were analyzed using the SPSS-XI program (SPSS Inc, Chicago, IL). Significance level was set at $p<0.05$.

Student-t test was used to compare the mean values of descriptive data. Discrete variables were compared with the chi-square test. The Pearson correlation coefficient was used for analysis of the correlation between parent-offspring's

Table 1. Mean (±standard deviation) of body mass index (BMI) and waist-to-hip ratio (WHR) in obese girls and boys and their parents.

	Girls			Boys			Total
Age groups/yr	**2–6**	**7–12**	**13–17**	**2–6**	**7–12**	**13–17**	
n	**21**	**131**	**38**	**21**	**131**	**38**	**380**
	mean ±SD	**mean ±SD**	**mean ±SD**	**mean ±SD**	**mean ±SD**	**mean ±SD**	**mean ±SD**
Children BMI	22.4±4	24.5±4.27	23.4±3	24.4±4.1	23.8±3.5	26.3±4.3	24.2±3.9
ChildrenWHR	1.1±0.05	1.1±0.07	1.1±0.08	1.1±0.1	1.1±0.07	1.1±0.1	1.1±0.07
Mother BMI	30.2±4	29±3.9	29.1±3.9	29.7±4.9	29.9±6.6	30.3±4.9	29.6±5.1
Father BMI	29.9±3.2	28.6±2.3	27.9±2.5	27±3.1	28.8±3.9	28.5±1	28.6±3
Mother WHR	0.79±0.05	0.81±0.06	0.82±0.06	0.83±0.07	0.83±0.09	0.84±0.08	0.82±0.07
Father WHR	0.91±0.04	0.89±0.04	0.89±0.05	0.89±0.02	0.9±0.03	0.9±0.01	0.9±0.03

anthropometric measurements. The Kruskal-Wallis test was used to evaluate the relationship between different aspects of family SES with obesity in children. The relationships between children's BMI and their eating and exercise behavior were assessed with regression models controlled for age. The relationships between parents' BMI and children's behavior were examined in regression models with the children's age and BMI as covariates.

Results

The average age of the subjects was 13.1 years for children, 35.7 years for mothers and 41.2 years for fathers. Among the subjects studied, 37.4% of boys and 28.4% of girls had an obese mother ($p<0.05$), 5.8% of boys and 6.8% of girls had an obese father ($p>0.05$) and both parents of 5.8% of girls and 5.8% of boys were obese (BMI ≥30 kg/m^2).

The mean (±standard deviation) of the BMI and WHR of children and parents are presented in Table 1.

The prevalence of generalized and abdominal obesity of parents is presented in Table 2, and shows that the prevalence of abdominal obesity was significantly higher in mothers of boys than mothers of girls (37.9% vs. 25.8%, respectively, $p=0.01$).

A significant correlation was found between the BMI of daughters and the BMI of their mothers and WHR of their fathers, as well as the BMI of sons with WHR of both parents. In addition, the WHR of children in both genders correlated significantly with the mother's WHR, but this relationship was not significant with the father's WHR (Table 3).

The average education was 11.7 years for mothers and 14.8 years for fathers. A significant inverse relationship was found between the education level of both parents, as well as maternal employment, and obesity in their children.

72.3% of mothers and 39.5% of fathers reported that before their children became fat they believed that an obese child was healthier than low or normal weight peers; in addition, 79.2% of mothers reported a history of using pressure in child feeding.

Linear correlations between eating and exercise behaviors and parents' and children's BMI in girls and boys are presented in Tables 4 and 5. The consumption frequency of foods associated with BMI in girls and boys were rice, bread, deep fried foods, fried potatoes, fast foods, soft drinks and cookies. BMIs of girls and boys were inversely related to frequency of vigorous exercise and brisk walk, and positively correlated with the frequency of TV watching. The BMI of mother was associated with food habits of their daughters and sons, and the BMI of fathers had significant association with the frequency of activities of their sons.

Discussion

The present study found a significant association between both generalized and abdominal obesity of children and abdominal obesity of mothers. An inverse association was shown between education level of both parents, as well as maternal employment, and children's obesity. In addition, the BMI of mothers correlated with food habits of their children.

Different studies in Western countries have shown various associations between anthropometric measurements in children and their parents; however, such data are limited in developing countries. The findings of the present study are in line with the work of Davison and Birch evaluating predictors of change in girls' BMI and familial aggregation of risk factors associated with childhood overweight which highlighted the centrality of the family in the etiology of childhood overweight and the necessity of incorporating parents in the treatment of childhood overweight [15]. The findings of the present survey are also consistent with the Minneapolis Children's Blood Pressure Study, both indicating significant familial aggregation of body fat distribution [16].

The findings of the current study revealed significant associations between anthropometric measurements of children and their parents, especially their mothers. In a study performed in south Italy, the children's BMI correlated with fathers' and mothers' BMI, the children WHR correlated with the fathers' BMI and the children's BMI correlated with the fathers' WHR [17].

Table 2. Prevalence of generalized-and abdominal obesity in parents of obese children.

	Girls	Boys	P value
	n (%)	n (%)	n (%)
BMI ≥30 in mother	65 (34.2)	82 (43.2)	0.073
BMI ≥30 in father	24 (12.6)	22 (11.6)	0.75
WHR ≥0.8 in mother	49 (25.8)	72 (37.9)	0.01
WHR ≥1 in father	5 (2.6)	3 (1.6)	0.47

Table 3. Correlation of obesity indices in children and parents.

		ChildrenWHR	Mother BMI	Father BMI	Mother WHR	Father WHR
Children BMI	Girls	r=0.16 p=0.027	r=0.51 p=0.007	r=0.008 p=0.9	r=0.065 p=0.37	r=0.42 p=0.02
	Boys	r=0.22 p=0.002	r=0.053 p=0.46	r=0.064 p=0.3	r=0.49 p=0.001	r=0.47 p=0.02
	Total	r=0.19 p=0.0001	r=0.11 p=0.031	r=0.039 p=0.44	r=0.47 p=0.001	r=0.46 p=0.002
ChildrenWHR	Girls		r=0.006 p=0.9	r=0.032 p=0.6	r=–0.54 p=0.0001	r=0.49 p=0.03
	Boys		r=0.061 p=0.4	r=0.026 p=0.7	r=–0.57 p=0.0001	r=–0.51 p=0.04
	Total		r=–0.04 p=0.43	r=0.028 p=0.58	r=0.3 p=0.0001	r=0.08 p=0.1
Mother BMI	Girls			r=0.073 p=0.3	r=0.36 p=0.0001	r=0.07 p=0.2
	Boys			r=0.11 p=0.1	r=0.09 p=0.2	r=0.022 p=0.76
	Total			r=0.099 p=0.053	r=0.057 p=0.26	r=0.049 p=0.34
Father BMI	Girls				r=-0.026 p=0.72	r=0.53 p=0.0001
	Boys				r=0.098 p=0.18	r=0.17 p=0.014
	Total				r=0.056 p=0.27	r=0.34 p=0.0001
Mother WHR	Girls					r=0.026 p=0.72
	Boys					r=0.22 p=0.002
	Total					r=0.11 p=0.023

The study of Safer et al. supports the hypothesis that familial factors (biological and/or environmental) affecting the development of adiposity emerge at specific ages and are related to the adiposity of both parents. In their study, they found significant correlations between both maternal and parental BMI and the BMI of their children. Children with two overweight parents had consistently elevated BMI compared to children with either no overweight parents or one overweight parent [18]. The study of Birch and colleagues found significant relationship between the BMI of mothers and daughters [19]. In the study of Danielzik et al, children's BMI showed closer associations with maternal than with parental BMI. However,

Table 4. Linear associations between eating and exercise behaviors and parents' and children's body mass index (BMI) in girls.

	Daughter BMI		Mother BMI		Father BMI	
Variables	**β**	**P**	**β**	**P**	**β**	**P**
Foods (time/week)						
Rice	0.04	0.01	0.03	0.02	0.04	0.02
Bread	0.02	0.03	0.01	0.06	0.02	0.2
Deep fried foods	0.04	0.01	0.04	0.02	0.05	0.03
Fried potatoes	0.03	0.04	0.02	0.04	0.02	0.1
Fast foods	0.04	0.02	0.03	0.01	0.01	0.2
Soft drinks (non diet)	0.03	0.02	0.02	0.1	0.02	0.1
Mayonnaise	0.02	0.05	0.01	0.4	0.02	0.5
Cookies	0.04	0.02	0.03	0.02	0.03	0.2
Activities (number of sessions/week)						
Vigorous exercise*	–0.03	0.01	–0.02	0.1	–0.03	0.1
Non vigorous home exercise	–0.02	0.4	–0.01	0.1	–0.02	0.2
Walking	–0.01	0.2	–0.01	0.3	–0.02	0.01
Brisk walk	–0.03	0.01	–0.02	0.2	–0.01	0.2
TV watching**	0.04	0.01	0.03	0.01	0.03	0.02

* activity causing perspiration or an increase in breathing or heart rate for at least 30 minutes;
** TV watching for at least 3 hours/day.

Table 5. Linear associations between eating and exercise behaviors and parents' and children's body mass index (BMI) in boys.

	Daughter BMI		Mother BMI		Father BMI	
Variables	**β**	**P**	**β**	**P**	**β**	**P**
Foods (time/week)						
Rice	0.03	0.01	0.04	0.03	0.03	0.01
Bread	0.02	0.1	0.03	0.08	0.02	0.1
Deep fried foods	0.04	0.02	0.05	0.02	0.04	0.01
Fried potatoes	0.02	0.01	0.03	0.1	0.02	0.07
Fast foods	0.03	0.04	0.04	0.01	0.01	0.5
Soft drinks (non diet)	0.02	0.04	0.04	0.02	0.02	0.3
Mayonnaise	0.02	0.07	0.02	0.4	0.01	0.2
Cookies	0.03	0.04	0.05	0.01	0.01	0.4
Activities (number of sessions/week)						
Vigorous exercise*	–0.04	0.01	–0.01	0.2	–0.03	0.04
Non vigorous home exercise	–0.02	0.1	–0.02	0.4	–0.02	0.04
Walking	–0.02	0.08	–0.01	0.5	–0.03	0.02
Brisk walk	–0.04	0.02	–0.02	0.1	–0.04	0.01
TV watching**	0.05	0.04	0.04	0.02	0.04	0.01

* activity causing perspiration or an increase in breathing or heart rate for at least 30 minutes;
** TV watching for at least 3 hours/day.

in their study a weak correlation was found between the BMI of children and their parents. Parental BMI explained 7.6% of the variance in children's BMI. Children's risk of becoming overweight increased with parental overweight and obesity [20]. Consistent with their findings, a close correlation was found in the current study between the BMI and WHR of both daughters and sons and the WHR of mothers. These finding suggest the need of determining the WHR as a matter of abdominal obesity and also the familial pattern of obesity in children as well as adults.

Although such cross-sectional studies have limitation in showing an association between the body shape of children and parents, their findings are consistent with long-term prospective studies performed in this regard. The longitudinal study of Burke and colleagues in Australia found that obesity in fathers was associated with a four-fold increase in the risk of obesity at the age of 18 in both sons and daughters with an independent eight-fold increase in risk for daughters if mothers were obese [21]. In addition, in the 4-year longitudinal study of Maffeis and colleagues on the relationship between parents' obesity and adiposity in children, the parents' obesity was the main risk factor for obesity [22]. In the prospective cohort study of Strauss and colleagues, maternal obesity was the most significant predictor of childhood obesity [23].

The importance of SES in the development of childhood obesity remains controversial. Different indicators have been selected as the measures of SES. According to Turrell et al., the income, education levels and parental occupation are suitable indicators for measuring SES [24], and these indicators were evaluated in the current study.

In different surveys, significant associations are found between childhood obesity and the family SES. In many industrialized countries, lower social class position is shown to be associated with childhood overweight [15]. The study of Power et al. showed a significant relationship between social class in childhood and developing obesity later in life [25]. However a US study did not find a relationship between overweight prevalence and social status or education in American children and adolescents [26]. Wang et al. studied school children aged 7–15 years in Australia and found that the odds ratio of overweight or obese boys with highest household income was significantly smaller than those with the lowest household income. In their study, having parents, especially mothers, who were overweight or obese increased the probability of children being overweight or obese [27]. Many other studies in developing countries revealed a higher prevalence of obesity among children of families with higher SES [28]. Such association was not found in the present study, however, our previous population-based study revealed a higher prevalence of overweight and obesity in children of moderate-income families [8]. Longitudinal studies can evaluate this association in a more precise manner, for instance a study in Belgium revealed that children of low SES are at higher risk for incidence and permanence of obesity [29]. A longitudinal study performed by Wannamethee et al. showed that socioeconomic status early in life has some persisting influence on ischemic heart disease risk in adult life [30].

Many surveys have shown an effect of parental educational level on BMI of their children. In the present study, an inverse relation was found between the educational level of both parents and the obesity of their children.

In addition, a significant association was found between having a housewife mother and obesity in children. Our findings are in line with the study of Krassas et al. in Greece revealing that childhood overweight was influenced positively by parental obesity and negatively by a high parental educational level [31].

Contrary to our findings, in the study of Anderson and colleagues, the causal relationship between maternal employment and childhood weight problems was evaluated and indicated that a child is more likely to be overweight if his/her mother worked more hours per week. They found that the higher socioeconomic status of mothers was particularly deleterious for their children's overweight status [32]. In the study by Salces et al, a higher correlation was shown between working of mothers and obesity of their children [33].Such differences are suggested to be due to cultural differences.

Different studies have revealed that mothers are critical mediators of obesity prevention efforts for children and adolescents because mothers play a large role in shaping the diet and activity patterns of their children [19,34].

In the current study, most mothers believed that an obese child was healthier than the low or normal weight peers and most of them reported using pressure in child feeding before their children became fat. These findings confirm that in addition to a medical problem, obesity is also a cultural problem: historically in our community a fat child meant a healthy child who was likely to survive the rigors of different diseases.

However, the findings of the study by Saelens et al. failed to support the hypothesis that maternal control over child feeding is related to childhood obesity, but showed the impact of maternal weight history and eating habits on her impression of children's future weight [35].

The study of Fisher and Birch found an association of children's fat preferences and intake with parental adiposity and suggests that dietary influences may mediate familial patterns of obesity [36]. Hood et al. investigated the extent to which the parent's degree of dietary self-control affected the development of excess body fat in the child. They found that dietary restraint adversely affected the child's body fat only when associated with high parental disinhibition which was suggested to be mediated by eating behaviors, or through behavioral consequences such as the suppression of the child's innate regulation of dietary intake [37].

Parents also serve as role models for exercise, their support of their child's participation in physical activity can have impact on the activity level of their children. Studies that evaluated the self-reported physical activity characteristics from both parents and adolescents provided mixed results [38]. In the current study, this relationship was significant between fathers and sons.

Different studies in developed countries found a familial aggregation in physical activity [34,39–40]. The study of Davison et al. indicates the positive contribution that parents can have

on activity practices of their young daughters [41]. A longitudinal study found that parents in the obesigenic cluster reported high levels of dietary intake and low levels of physical activity; this could predict children's risk of obesity [42]. On the other hand, the study of Fogelholm et al. underscores the parents' role in childhood activity patterns and obesity. They found that the parent-child relationship of inactivity appeared to be stronger than that of vigorous activity [43]. The results of the study by Mc Murray et al. suggest that factors other than parental attitudes and exercise habits are more influential in determining the fitness and activity levels of children [44]. In the study of Trost and colleagues, a strong correlation was found between childhood overweight status and parental obesity, but no significant differences were observed for the parental influences on physical activity behavior [45]. However, considering the role of continued physical activity from childhood to adulthood in the prevention and treatment of obesity, increasing physical activity should be emphasized particularly in obesogenic families [46].

Limitation of study

Such cross-sectional study showing associations between family environment and childhood obesity cannot establish a causal relationship. In addition, the findings come from a small sample of children referred to our clinic. However, considering that the findings are in agreement with previous population-based studies in the same community and considering that this clinic is the only referral childhood obesity clinic in the province, the findings can be used for future study in larger samples. Larger prospective studies in more diverse population of obese children are needed.

CONCLUSIONS

Culturally relevant family-based interventions especially focusing on mothers' beliefs and behavior are needed to prevent and/or to treat childhood obesity and its long-term consequences; special emphasis should be directed at families that are affected and/or concerned with obesity. As suggested by the review of published data, effective interventions for prevention and treatment of overweight should be approached from a health-centered rather than a weight-centered perspective, with the parents as central agents of change [47]. This can help to prevent the emerging epidemic of childhood obesity in developing countries.

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