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The relationship between maternal lifestyle and children's body mass index: A cross-sectional study in Abadan, Iran

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ABSTRACT

Background & aim: The nutritional status of children is assessed by height, weight and body mass index (BMI). Several factors affecting the child's BMI. Parents act as models for children regarding the consumption of food and nutrition, and their nutrition practices and lifestyle affect a child's diet and weight indirectly. This cross-sectional study was conducted to assess the association between maternal lifestyle and child's body mass index in Abadan, Iran.

Methods: In this cross-sectional study, 500 children within the age range of 3-6 years were selected with their mothers from nine health centers in Abadan, Iran. Data were collected using socio-demographic and lifestyle questionnaire through interviewing with mothers as well as measuring children's height and weight. The BMI of mothers was also measured in this study. Data were analyzed using Kruskal-Wallis, the Chi-square, and logistic regression tests.

Results: The results showed no significant relationship between the total score of mother's lifestyle and children's BMI. However, some aspects of mothers' lifestyle including physical health, weight and nutrition management, as well as disease prevention and mental health of the mothers had significant relationship with children's BMI ($P<0.05$). Also a significant relationship was seen between mothers' lifestyle with children's appetite and mothers' socioeconomic status. The prevalence of underweight, overweight, and obese children were 15.2%, 6.8 %, and 5.8 %, respectively.

Conclusion: Although there was no significant relationship between the total score of the mothers' lifestyle and the children's BMI, a significant relationship was observed between some lifestyle dimensions and the children's BMI. The results of this study confirm the leading role of the mothers' lifestyle in children's growth and health.

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Introduction

Children account for a significant percentage of the world population; therefore, the maintenance and promotion of their health is of utmost health priorities in communities (1). Since children have a rapid growth phase, their nutritional need is very important and any type of diet deficiencies may cause severe damage to their growth (2). Careful examination of the nutritional status of children includes anthropometric measurement, such as measures of height, weight, and body mass index (BMI). The BMI in children is a measure of body size with a combination of weight and height while taking age into consideration.

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It calculates differences in body composition by defining the body fat independently based on the ratio of weight in kilograms divided by the square of height in meters. The BMI is used in children at two years of age and older. Underweight, overweight, and obese children are those who are with BMI below the 50th percentile, between the 85th and 95th percentile, and over 95th percentile, respectively, with the same gender and age (3,6).Several factors affecting the child's BMI include genetic factors and predisposition, metabolic disorders, behavioral factors, nutrition style and amount of physical activity, as well as cultural factors that can be regarded the causes of serious health risks for future generations (7).Parents act as models for children regarding the consumption of food and nutrition, and their nutrition practices and lifestyle affect a child's diet and weight indirectly. Therefore, they play leading roles in shaping children's attitudes and behaviors towards weight. This applies particularly to women who still bear most of the burden of caring for children (8, 9). Lifestyle consists of different people's behavior towards eating and smoking habits,physical activity, behavior style in the workplace, as well as the ways to spend leisure time and the use of health services (10). The effect of parents' lifestyle, including parenting style, nutrition, and behavioral models on the health of children has been widely studied in previous studies (11-14). Whether this influence leads to changes in weight and the child's BMI is an issue that requires more studies. There is a dearth of research investigating the association between the mother's lifestyle and child's BMI in Iran. Therefore, this study aimed to evaluate the relationship between the mother's lifestyle and child's BMI.

Materials and Methods

This cross-sectional study was conducted on 500 children within the age range of 3-6 years from January to May 2015 in Abadan, Iran. The sample size was determined using a pilot study on 20 target populations. Regarding sampling, health centers in Abadan were initially divided into four groups in terms of their location in the regions 1-4 of Abadan municipality. Regions 1 and 2 included two and six centers with populations of 27,140 and 77,680, respectively. In addition, two centers with a population of 8832 were located in region 3 and region 4 included five centers with a population of 65,339. Out of 16 health centers located in these regions, nine centers were selected randomly. Health centers 3 and 4 were selected from region 1 and the health centers 1, 5, and 9 were selected from region 2. Moreover, health center 2 and health centers 6, 7, and 12 were selected from regions 3 and 4, respectively.

The number of samples for each health center was calculated according to the proportion of the population covered by each center. One of the researchers randomly attended in selected health centers. Eligible participants have been selected according to the last digit of their health record number randomly. Women and their children were asked to attend to the health centers by phone calls. Inclusion criteria were children within the age range of 3-6 years from singleton and full-term pregnancy with normal birth weight. On the other hand, the children who were suffering from any known systemic, metabolic, and autoimmune diseases, diabetes, hypothyroidism, and hyperthyroidism, or those who were under medication with corticosteroids were excluded from the study.

The data were collected using interviews with mothers, socio-demographic forms, and lifestyle questionnaires. Weight and height of children and mothers were measured in the same standing condition with minimum clothing without shoes using the standard portable digital scales (Seca brand) with an accuracy of 100 g and a metal stadiometer (Seca 700) with an accuracy of 1.0 cm. The lifestyle questionnaire consists of 70

items which measure different aspects of lifestyle, including physical health, sports and fitness, weight and nutrition management, disease prevention, mental health, social health,

drug-use prevention and drug use, accident prevention, and environmental health assessment.

The scoring was performed utilizing a 6-point Likert-type scale ranged from 1 to 6. The total score for each dimension of the scale was obtained in this study. Factor-validity constraint was employed in order to investigate the validity and

reliability of the questionnaire in a study conducted by Lalie et al. (2012). Accordingly, the utilization of a lifestyle questionnaire was approved as a multidimensional tool for assessing lifestyle.

Furthermore, the reliability of the questionnaire was calculated at 0.87 using Cronbach's alpha. The BMI was calculated for each mother and child using the ratio of weight in kilograms divided by the square of height in meters (15). According to the US center for disease control and prevention guideline, the BMI of children based on their age and gender were classified into four groups. These groups included underweight, normal, and overweight children with BMIs less than the 50th percentile, between 50th-85th percentile, and between 85th-95th percentiles, respectively. In addition, obese children had a BMI above the 95th percentile.

Data were analyzed in SPSS software (version 22) through the Chi-square, Kruskal-Wallis, and logistic regression tests. P-value less than 0.05 was considered statistically significant.

Results

This cross-sectional study included 500 children with the age range of 3-6 years who were referred to health centers in Abadan, Iran. This study aimed to assess the association between the maternal lifestyle and child's BMI. Table 1 displays the basic characteristics of mothers and children under study. According to the results, 281 (56%) children were males and mean values of children, mothers, and fathers' age were 4.4±1.1, 31.3±5.6, and 34.8±6.1 years, respectively. Regarding income, the majority of cases had a high income (56.6%), and the majority of mothers had an elementary school degree (41.6%). Moreover, in terms of occupational status, 87.6% of mothers were housewives and 1.4% and 16.2% of mothers and fathers were smokers, respectively.

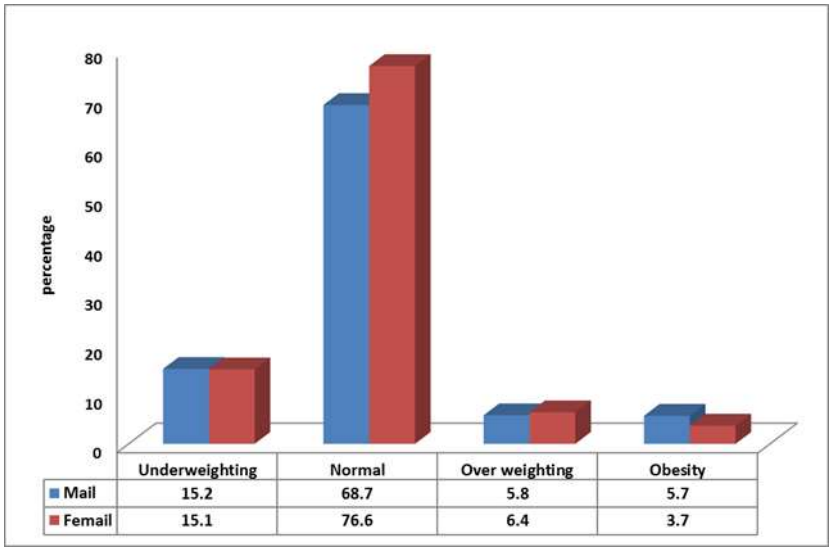

Figure 1: Distribution of *BMI in children within the age range of 3-6 years by gender

*Body Mass Index
Underweighting
Over weighting
Obesity

Table 1. Socio-demographic characteristics of children and their parents

Variable	Number (%) Mean ± SD	P-Value
Child's age(year)	4.4±1.1	
Mode of delivery		0.475
Normal vaginal delivery	239(4.7)	
Cesarean section	264(52.8)	
Birth weight(g)	3200±500	
Breastfeeding in the first 6 months		0.935
Yes	411(82.2)	
No	89(17.8)	
Infants' appetite status		
Poor	63(12.6)	
Fair	247(49.4)	
Good	190(38)	
Child's *BMI (kg/m^2)	14.94±2.07	
Gender		0.07
Male	281(56)	
Female	219(44)	
Mother's age(y)	31.37±5.67	
Mother's height (cm)	161.37±6.3	
Mother's weight (kg)	68.63±12.2	
Mother's *BMI (kg/m^2)	26.17±4.7	0.74
Mother's educational status		0.123
Illiterate	75(15)	
Elementary school	133(26.6)	
Secondary school	190(38)	
University	102(20.4)	
Smoking of mothers		0.134
Yes	7(1.4)	
No	493(98.6)	
Smoking of fathers		0.323
Yes	81(16.2)	
No	419(83.8)	
Type of Accommodation		0.552
Leased	263(52.9)	
Possessive	237(47.4)	
Socio-economic status		<0.001
Low class	136(27.2)	
Middle class	281(56.2)	
High class	83(16.6)	
Mother's occupational status		0.77
Employed	62(12.4)	
Housewife	438(87.6)	
Father's occupational status		0.77
Employee	118(23.6)	
Unemployed	54(10.8)	
Self-employed	222(44.4)	0.02
Worker	106(21.2)	

The prevalence of underweight was 15.2 % in female (15.1%) and male (15.3 %) children. In addition, the total prevalence of overweight was found to be 6.8% in female (4.6%) and male (8.5%) children. Furthermore, the prevalence of obesity was 5.8% in female (3.7 %) and male (7.5%) children. Table 1 depicts that most of the children (72.2%) were in the normal range of weight (females: 67.7%, males: 68.7%).

Table2. The relationship between the mother's lifestyle and children's body mass index

	N= 500				
Classification of *BMI	**Underweight**	**Normal**	**Overweight**	**Obese**	
	>%50	***%50-85***	***%85-95***	***>%95***	**P value**
The dimensions of the mother's lifestyle	**N=76 Means± SD**	**N= 361 Means± SD**	**N= 34 Means± SD**	**N= 29 Means± SD**	
Physical Health	38.6±5.7	39.96±4.7	37.44±5.9	39.31±5.2	0.024
Sports and fitness	31.51±6.8	31.96±7.1	28.08±9.7	30.69±8.7	0.2
Weight and nutrition management	33.1±6.5	35.54±5.2	22.35±8.6	33.06±7.7	0.01
Disease prevention	35.78±5.2	37.31±3.9	34.73±4.4	36.03±6.3	0.002
Mental health	35.43±5.2	36.27±4.8	33.97±5.8	34.27±3.9	0.023
Social Health	35.53±6.5	36.69±4.7	32.67±9.1	35.13±6.3	0.183
Spiritual health	30.84±5.3	31.37±4	29.69±5.7	31.03±4.1	0.635
Drug prevention	33.39±5.4	33.82±3.9	31.97±7.1	33.31±6.3	0.568
Accident Prevention	42.49±5.8	42.74±5.4	38±11.3	39.03±8.8	0.06
Environmental Health	33.9±5.9	33.87±5.5	31.61±7	33/03±7.4	0.378
Total score	351.09±45.8	359.57±33.37	330.76±57.2	345.65±46.6	0.07

- Anova Test.
- Body Mass Index

According to the results of the study, the mother's lifestyle score was obtained at 355.52±38.9. Additionally, the highest and lowest mean scores were estimated at 42.23±6.47 and 31/.17±4.43 for accident prevention and spiritual health, respectively. Based on the results obtained form Kruskal-Wallis Test, there was no significant relationship between the mother's lifestyle and child's BMI in four groups (P>0.05). However, a significant relationship was observed between the child's BMI and some aspects of the mother's lifestyle, such as physical health, weight and nutrition management, prevention of disease, and mental health status (P<0.05).

Furthermore, there was a significant difference between the prevalence of different child's BMI and economic status of families (P<0.001, Table3). The highest prevalence of childhood malnutrition was among low-income families (43.4%), and high-income families obtained the lowest prevalence of malnutrition (Table 3).

Moreover, a significant association was found between the child's BMI and father's occupational status (P<0.001). On the contrary, ANOVA test results showed that malnutrition did not correlate significantly with the child's age and gender, parent's educational status, mode of delivery, smoking, and family size (P>0.05).

Logistic regression analyses were carried out to check the relationship between the father's occupational status and family income with a child's BMI as a dependent variable adjusting for maternal lifestyle. According to the result, the higher perseverance of underweight was in children with fathers who were unemployed (36.8%) and worker (35.5%). However, children with self-employed fathers obtained higher perseverance of normal weight (51.2%).

Accordingly, there was an association between thefather's occupational status and children's weight (OR=0.6, CI 95%=0.5-1.2, Table3) and the ability to afford a nutritious diet was correlated with the father's occupation after samples collection the highest percentage in our community was self-employed.

Table3. The relationship among demographic characteristics based on logistic regression in two groups of child's *BMI (normal, abnormal)

BMI status		Normal BMI	Abnormal BMI					CI	
Variable			Underweight	Overweight	Obese	P-Value	Odd Ratio	Lower	Upper
			Prevalence (Percentage)						
Family's income	Less than enough	76(21)	33(43.4)	15(44.1)	12(41.4)	<0.001	0.2	0.13	0.5
	Enough	218(60.4)	32(42.1)	16(47.1)	15(51.7)	<0.001	0.5	0.27	0.96
	More than enough	67(18.6)	11(14.5)	3(8.8)	2(6.9)				
Father 's occupational status	Employee	83(23)	14(20)	4(11.8)	5(17.3)	0.968	1	0.5	1.7
	Unemployed	17(4.7)	28(40)	2(5.9)	1(3.4)	0.379	0.6	0.2	1.6
	Self-employed	185(51.2)	1(1.4)	19(55.8)	17(58.6)	0.02	0.6	0.5	1
	Worker	76(21.1)	27(38.5)	9(26.5)	6(20.7)	0.762	0.7	0.4	1.2

After reviewing and modifying the meaningful variables considering other risk factors, the variables retained their significance and it was found that they had a distorted effect on each other. According to the results of Table 4, after adjusting the lifestyle variable using the logistic regression test for each lifestyle increment, the chances of having an ideal BMI in the child increased by 0.9%. Moreover, the chances of having an optimal BMI in the child increased by 3.5% after adjusting the variable of physical health of life using logistic regression test for each unit with increasing the score of physical health.

Table 4. The Relationship between the mother's lifestyle and the desired and unfavorable child's BMI based on logistic regression

	N=500						
BMI Calcification	Non-normal BMI	Normal BMI	P-value	B	OR	CI (95%)	
Dimensions of the mother's lifestyle	Mean±SD					Lower	Upper
Physical Health	38.8±5.6	39.96±4.6	0.008	0.052	1.053	1.013	1.094
Sports and fitness	31.04±7.8	31.96±7.1	0.243	0.016	1.016	0.989	1.043
Weight and nutrition control	33.4±6.9	35.54±5.5	<0.001	0.059	1.061	1.027	1.096
Disease prevention	35.77±4.8	37.31±4	<0.001	0.086	1.09	1.043	1.14
Mental health	35.15±5	36.27±4.8	0.364	0.038	1.039	0.0999	1.081
Spiritual health	30.56±4.9	31.37±4	0.54	0.043	1.043	0.999	1.090
Social Health	35.15±6.6	36.69±4.7	0.008	0.046	1.047	1.012	1.083
Drug prevention	32.86±5.7	34.01±3.4	0.007	0.06	1.061	1.016	1.108
Accident Prevention	41.11±7.9	42.74±5.4	0.005	0.044	1.045	1.014	1.078
Environmental Health	44.33±6.2	33.87±5.5	0.303	0.017	1.017	0.984	1.051
Lifestyle	347.32±46.4	360.08±33.34	0.003	0.09	1.009	1.004	1.014

After adjusting the variables of exercise and health using logistic regression test for each unit, the increase in the score of exercise and health led to an increase in chances of having an optimal BMI by 1.6% in the child. Following that, the increase in the weight and nutrition control score increased the chances of having an optimal BMI in the child by 1.6% after adjusting the weight and weight control variable using logistic regression test for each unit.

In the same line after modifying the variables of prevention of diseases using a logistic regression test for each unit, an increase in the disease prevention rate raised the chances of having an optimal BMI by 9% in the child. Subsequently, after adjusting the variables of psychological health using logistic regression test for each unit, an increase in the psychological health score increased the chances of having an ideal child's BMI by 3.9%. In addition, the spiritual health score increased the chances of having an optimal BMI of 4.3% in the child after modifying the spiritual health variable using the logistic regression test for each unit.

After adjusting the social health variable using the logistic regression test, it was determined that increased level of each unit in the spiritual health score raised the chances of having an optimal BMI of 4.7% in the child. Furthermore, the chances of having an optimal BMI of 6.1% per child increased after adjusting the variables for the administration of drugs using logistic regression test for increasing the health scores, drug-use prevention and drugs.

After adjusting the variables for prevention of accidents using logistic regression test for each unit, increased scores of prevention of events led to an increase in the chances of having an optimal BMI of 4.5% in the child. Eventually, a logistic regression test determined that an increase in each unit of the environmental health score raised the chances of having an optimal BMI of 1.7% after adjusting the environmental health variable. Pearson's correlation coefficient test was used to determine the correlation between the mother's lifestyle and BMI. According to the results, no significant correlation was found between these two variables (Table5).

Table5. The correlation between mother's lifestyle and child's *BMI

BMI Calcification	Correlations	
The dimensions of mothers lifestyle	**P**	**Sig**
Physical Health	-.066	0.140
Sports and fitness	0.018	0.681
Weight and nutrition control	-0.049	0.277
Disease prevention	-0.10	0.826
Mental health	-0.036	0.417
Spiritual health	-0.109	0.015
Social Health	0.008	0.858
Drug prevention	0.006	0.889
Accident prevention	-.019	0.666
Environmental Health	-.003	0.955
Life Style	-.033	0.467

Discussion

This study aimed to investigate the relationship between the mother's lifestyle and BMI among 3-6-year-old children. Among the children under study, 15.2%, 6.8%, and 5.8% of children were underweight, overweight, and obese, respectively, based on BMI while taking age and gender into account. Our results showed that accident prevention and spiritual health obtained the highest and lowest mean scores, respectively. In addition, no significant correlation was observed between the total score of the mother's lifestyle and child's BMI.

However, considering mother's aspects of lifestyle and child's BMI, there was a significant relationship between child's BMI and some aspects of lifestyle, such as physical health, weight and nutrition management, prevention of disease,

and mental health. After adjusting the lifestyle variable, a significant correlation was found between the mother's lifestyle and child's BMI. The results of logistic regression and BMI of the children in both normal and non-normal groups showed that lifestyle increased the chances of having desirable BMI by 0.09% (1.004-1.014:95% CI; OR: 1.009) among children (Table 4).

Moreover, the results obtained form Kruskal-Wallis test on the dimensions of mother's lifestyle and BMI showed a significant relationship between child's BMI and some aspects of lifestyle, such as physical aspect, weight and nutrition control, disease prevention, and psychological health (P>0.05).Burke et al., in their study (2001) in Australia similarly showed that a child's BMI directly correlated with parents' health and fitness status (16). In the present study, after the adjustment of physical health variable by logistic regression, it was determined that an increase in physical health increased the BMI by 5.3% in children.

Similar to this study, many interventional studies have shown that dietary and physical activity behaviors of parents affect nutrition and children's activities and consequently lead to weight gain (13, 17,21). Moreover, according to the results of Tables 4,7 after adjusting the physical health using the logistic regression test for each unit, an increase in the physical health score was found to have an effect on BMI to reach an optimal level by 3.5% (1.03-1.954: CI 95%; OR: 3.5).

Rogers (2013) showed that mothers' feeding style was directly related to weight gain and nutritional behaviors of children, and it was associated with an upward change in child's BMI scores (22). In our study, after the adjustment of weight and nutrition variables by logistic regression, it was found that every unit increase in the weight and nutrition management led to an increase in BMI by 6.1% among children**.** In the same line, Johannsen (2007) showed that mothers had a strong influence on their children's weight and they seemed to be concerned about their children's eating habits (23).

Stephanie et al. (2013) examined long-term side effects of diarrhea, such as growth retardation on 7 systematic cohort review studies from 1985 to 1996 and concluded that diarrhea was associated with underweight; however, diarrhea had no significant relationship with stunting (24). Considering the prevalence of diarrhea and respiratory infections as the most common infectious diseases in children, it seems logical to take the prevention of diseases aspect into an account to deal with problems which cause weight complications in children.

In the present study, after the adjustment of disease prevention variable by logistic regression, it was determined that each unit increase in disease prevention led to an increase in the scores of favorable BMI by 9%. McCurdy et al. (2014) in their study conducted on low-income communities, found a significant relationship between maternal depression and mother's reduced physical presence with children nutrition time and skills to use different food sources which resulted in non-normal BMI among children (25).

In this study, after adjustment for psychological health by logistic regression, it was determined that per unit increase in psychological health scores increased the BMI of children by 3.9%. In this study, the child's BMI did not correlate with sports and fitness, social health, spiritual aspects, avoiding smoking and drugs, accident prevention, and environmental health.

In a study conducted by Jansen et al. (2013) in Australia, a positive relationship was observed between higher socio-economic levels and better BMI in children. In their study, families with low social class, abnormal BMI, and weight complications were 2.5 times higher than those without these factors (26).

In our study, there was no significant relationship between spiritual health and weight. In the same line, Reeves (2011) in the African-American communities found no significant relationships between weight and spiritual, religious, and behavioral health dimensions (27). However, in a study performed by Limbers (2015), paying more attention to religious beliefs in families associated with lower BMI in children.

Nevertheless, the participation of families in religious ceremonies was correlated with better BMI, which indicated the importance of church-based interventions to modify the lifestyle of the family (28).

In this study a low prevalence of smoker women (1.4%) may be obstacle to the scrutiny of this relationship, statistically. Similarly, a study on the risk factors of obesity in Hong Kong in 2003 showed that the prevalence of smoking among mothers and fathers was 7% and 46.9%, respectively. Moreover, no significant relationship was found between smoking of mother and childhood obesity (29), whereas remarkable association was found between BMI and smoking of father. In a 10-year cohort study performed by Hill et al. (2005), a significant relationship was reported between mother's lifestyle and child's BMI (6-11 years old) (30); however, the results are not consistent with the findings of this study.

This discrepancy may be attributed to the differences in methodology, the pursuit of samples in high-risk and no risk groups, as well as the higher age of participants. On the contrary, the relationship between smoking during pregnancy and child obesity in adulthood has been shown in previous studies (31,3). Jenkins et al. conducted a study (2015) on the impact of the environment on behaviors related to weight and child's BMI. The results revealed that access to the green living environment had a protective effect on drinking sugary foods and living in neighborhood deprived of green areas correlated with three unhealthy behavior, such as consumption of sweets and fast foods, as well as watching television.

Consistent with our results, they found that only one environmental variable associated with BMI in children. In contrast with this study, other evidence suggests that associations between the environment and weight status are more consistent with each other than those found between the environment and dietary behaviors (34, 35). Furthermore, in the current study, father's occupational status and family income were positively associated with the nutritional status of children. Therefore, the highest and lowest prevalence levels of underweight were in low- and high-income families, respectively. It seems logical since poverty and malnutrition together create a defective cycle and people with higher incomes have purchasing power leading to the improvement of the family nutrition status. The results of this study were consistent with the findings of the studies conducted by Jessica and Wong in Nigeria and Malaysia, respectively (36, 37).

Conclusion

Although a significant relationship was not observed between the mother's lifestyle and child's BMI, the results of this study showed that a child's BMI correlated significantly with some dimensions of mother's lifestyle. This confirms the effect of mothers' lifestyle on the child's health and growth. It is worth noting that the novelty of the research and the lack of studies that include all aspects of the mother's lifestyle and child's BMI are among the strengths of this study. However, this study suffers from some limitations. The cross-sectional nature of this study did not allow the authors to find casual relationships among the variables. It is suggested that more studies and case studies be conducted to assess the relationship between the mother's lifestyle and demographic characteristics with the child's BMI.

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Conflict of interest

The authors declare no conflicts of interest.

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