



Relationship between eating behavior, mental health problems and overweight and obesity in school children

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ABSTRACT

Childhood obesity has been known as a world problem. Many diseases, including mental health problems, have been associated with childhood obesity. This study has shown the association between eating behaviors in obese children and their mental health problems. In this cross-sectional study, 161 students aged 7-12 were selected from Tehran's elementary schools. Eating behaviors of children were obtained using the CEBQ, and mental health problems were obtained by the SDQ completed by parents. Standard methods also measured anthropometric indices. Statistical analysis was performed using chi-square, Pearson coefficient, and stepwise multivariate linear regression to examine the CEBQ, SDQ and BMI z-score relationship. The mean age of participants was 9.4 ± 1.88 years. Out of them, 40.4% were boys and 59.6% were girls. The food approach scales significantly correlated with the child's BMI z-score. The food avoidance scales also showed an inverse and significant correlation with BMI z-score. The hyperactivity score also showed a positive and significant relationship with food avoidance behaviors and a negative and significant relationship with BMI z-score. Our findings suggest that children with mental health problems may exhibit more food approach and avoidance behaviors, which are strongly and directly related to childhood obesity.

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1. Introduction

Obesity is a major threat to public health in industrialized countries associated with cardiovascular diseases, diabetes, and cancer (1, 2). Nutrition transitions in developing countries over the past decades, along with declines in physical activity, have contributed to increasing childhood and adolescent obesity (3, 4). By 2020, non-communicable diseases are projected to account for 60% of diseases and deaths in developing countries, with obesity as a major risk factor for most (5). The prevalence of obesity and overweight in Iran has been reported as 5.1% and 10.8% among children and adolescents (6). According to a 2007-2008 study in the United States, approximately 17% of 2-19-year old American children were obese, and about 22% were overweight (7). Inappropriate eating behaviors are associated with an increased risk of obesity, diabetes, and cardiovascular diseases during childhood and adolescence (8). Numerous studies have shown

links between eating behaviors and childhood obesity. One study showed eating behavior scores were strongly associated with childhood obesity, with a graded relationship across normal-weight, overweight, and obese groups (9). Another found that "food responsiveness" and "desire to drink" subscales of eating behaviors were positively associated with adiposity in primary school children, while "satiety responsiveness", "slowness in eating", and "emotional under-eating" subscales were negatively associated (10). A further study also found all eating behavior sub-scales were significantly associated with BMI z-scores (11). Eating behavior is part of nutrition psychology, encompassing nutritional variables and normative eating patterns (12). Identifying obesity-related eating styles could help inform interventions to reduce overweight. Childhood and adolescent obesity have many negative psychological consequences (13). Obese children and teens face increased risks of mental health problems like stress, depression, and hyperactivity, leading to

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outcomes such as negative self-image and social issues (14, 15). Around 20% of children and adolescents worldwide experience mental disorders (14). Mental health problems negatively impact children's academic performance, social activity, and family quality of life and predict future obesity (14-16). Unhealthy eating behaviors are important in childhood mental health issues, including depression, hyperactivity, stress, and social interactions (17, 18). Preventing and treating psychological problems in children not only improves their lives but also their adult functioning. Associations between eating behavior and psychological difficulties have been demonstrated in children (19). However, research specifically examining these relationships in Iranian children is limited. In this study, we aim to investigate whether relationships exist between eating behavior and mental health problems, eating behavior and BMI status, and mental health problems and BMI status in school children.

2. Materials and methods

2.1. Participants

The research protocol of this study was approved by the ethics committee of Islamic Azad University, Tehran Science and Research Branch (IR.IAU.SRB.REC.1398.017). This study was conducted during the winter of 2019 on 194 primary school children in Tehran. Ten elementary schools were selected by cluster random sampling from Tehran's primary schools, including state and non-governmental boys 'and girls' schools that were equally enrolled. Students were randomly chosen at every school. The research process was explained to parents by a nutritionist, and written consent was obtained. Parents completed questionnaires in the presence of the nutritionist.

2.2. Demographic information

A demographic questionnaire was used to collect information on age, gender, parents' education, time of sleeping and waking up, physical activity, and economic status. Interviews with the parents of the students obtained all the data. Parents were asked to report their child's physical activity, walking and running as minute per day to assess children's physical activity. Household economic status was determined using a questionnaire including 9-item home appliances and was classified as owning less than 3 items as poor economic level, 4 to 6 items as moderate economic level, and more than 7 items as wealthy economic level.

2.3. Anthropometric assessments

Weight was measured with light clothes and without shoes to the nearest 0.1 kg and height to the nearest 0.1 cm. BMI was calculated as weight (kg) divided by height (m²).

2.4. Child BMI z-score:

Gender- and age-adjusted child BMI z score at 7-12 years of

age was calculated using WHO Anthro plus software (20). BMI z-score ≤ -1 as underweight, $-1 < \text{BMI z-score} < +1$ as normal, and BMI z-score $\geq +1$ were considered overweight and obese in this study.

2.5. Assessment of mental problems

Mental problems were assessed by the Strengths and Difficulties Questionnaires (SDQ), a brief screening questionnaire for psychological problems of children and adolescents. The validity and reliability of this questionnaire's Persian version have been assessed (21). SDQ questionnaire was a structured questionnaire to screen psychiatric problems of youths containing 25 questions and 5 subscales, including emotional, hyperactivity, peer relationship, conduct problems, and prosocial behaviors. There were 5 items for each subscale. Each item was given a score (0-2), and the total score of each subscale was considered from 0 to 10 and classified as normal, borderline, and abnormal.

2.6. Assessment of eating behaviors

Eating behaviors were assessed by the Child Eating Behaviour Questionnaire (CEBQ). This widely used 35-item tool measures food approach (food responsiveness, enjoyment of food, emotional over-eating, and desire to drink) and food avoidance (satiety responsiveness, slowness in eating, emotional under-eating, fussiness). Items are scored on a Likert-style scale from 1 to 5. Mean scores for each scale are calculated, with higher mean scores representing a higher expression of that behavior. The validity and reliability of this questionnaire's Persian version have been assessed (22).

2.7. Statistical analysis

Statistical analyses were conducted using SPSSVR Statistics Version 22. ANOVA was used to explore the association between SDQ and CEBQ mean scale scores and other quantitative variables by children's weight status. Pearson's correlations were used to assess relationships between mean scale scores on the SDQ and CEBQ and between mean scale scores on both tools and child BMI z-score. The chi-square test was used to determine the relationship between the qualitative variables and children's weight status. Stepwise linear regression was used to investigate the relationship between confounding variables (age, sex, physical activity, economic status, parental education, medication and supplement use, duration of watching television and computer games) and the mean scores of SDQ, CEBQ, and BMI z-score. P-value < 0.05 was considered statistically significant.

3. Results

A total of 161 students (40.4% boy and 59.6% girl) with a mean age of 9.4 ± 1.88 years completed all stages. Participants' characteristics are shown in Table 1. A comparison of participant characteristics by weight status is

shown in Table 1. Demographically, the mean waking time during weekday mornings was significantly lower in children with overweight/obesity compared to normal-weight children ($p<0.05$). Height z-scores increased significantly from normal weight to overweight/obese groups ($p<0.05$). Lifestyle factors like physical activity time and bedtimes did not significantly differ between weight groups. Parental education levels also did not vary substantially with the child's BMI. Most comparisons between characteristics and weight status were non-significant, suggesting groups were relatively well-matched demographically. Table 2 compares mental health and eating behavior scores across BMI z-score groups. On the

SDQ, hyperactivity scores were significantly lower in the overweight/obese group compared to normal weight ($p=0.04$). On the CEBQ, food responsiveness ($p<0.05$), enjoyment of food ($p<0.000$), and emotional overeating scores were significantly lower in the overweight/obese group. Slowness in eating, a food avoidance scale, was also significantly lower in overweight/obese children ($p<0.05$), indicating faster eating speeds. Generally, food avoidance scores were higher in underweight versus overweight/obese children. No other SDQ or CEBQ subscales, including desire to drink, emotional under-eating, and food fussiness, differed significantly across BMI groups.

Table 1. Demographic characteristics of children.

Parameters	Underweight (BMI Z-Score<-1) N=24	Normal (-1≤ BMI Z-Score<+1) N=60	Overweight/obese (BMI Z-Score≥+1) N= 77	Total	P-value*
Weight(kg)	24.6±4.90	30.7±7.20	44.8±12.70	36.5±12.9	0.000
Height(cm)	132.6±10.70	135.3±11.80	140.7±13.10	137.5±12.6	0.005
HAZ	-0.06±0.80	0.15±1.00	0.65±1.15	0.3±1.08	0.003
Age(year)	9.08±1.81	9.2±1.75	9.7±2.00	9.4±1.88	0.268
Gender:					
Boy	17	32.3	50.8	40.4	0.545
Girl	13.5	40.6	46	59.6	
Sleeping time (h/min)	10.8±1.00	10.3±1.60	10.0±1.70	10.2±1.62	0.069
Waking time (h/min)	7.4±1.35	7.5±1.50	6.9±1.07	7.2±1.32	0.033
Physical activity (min/day)	77.08±76.80	79.75±64.20	56.0±72.00	67.9±70.41	0.114
Father's education:					
Diploma or less	20.5	35.5	44	54	0.501
University	14.1	41.1	44.4	46	
Mother's education:					
Diploma or less	17.5	34.15	48.35	55	0.81
University	16.65	36.15	47.2	45	
Economic status					
Poor	2.5	3.7	4.3	10.6	0.77
Moderate	5.6	13.7	15.5	34.8	
Wealthy	6.8	20	28	55	

Abbreviation: HAZ, height -for- age z-score. Data are expressed as mean±SD for quantitative variables and as % for qualitative variables.

* χ^2 test for quantitative variables and ANOVA for qualitative variables.

Table 2. Mean score of eating behaviors and mental problems of children by weight status.

SDQ scales	Underweight (BMI Z-Score <-1) N=24	Normal (-1≤ BMI Z-Score< +1) N=60	Overweight/obese (BMI Z-Score≥+1) N=77	P-Value*
Hyperactivity	1.2±0.34	1.1±0.30	1.0±0.35	0.04
Pro-social behavior	1.5±0.36	1.73±0.30	1.6±0.35	0.05
Emotional symptoms	0.47±0.30	0.35±0.31	0.4±0.40	0.41
Conduct problems	0.6±0.30	0.53±0.22	0.52±0.21	0.45
Peer problems	1.1±0.34	0.94±0.32	1.0±0.30	0.13
CEBQ scales				
FR	2.15±0.10	2.11±0.90	2.6±1.10	0.013
EOE	1.77±0.86	1.76±0.72	2.03±0.95	0.16
EF	2.9±1.00	3.0±0.93	3.7±1.00	0.000
DD	2.6±1.30	2.6±1.15	2.5±1.22	0.81
SR	3.07±0.73	3.00±0.61	2.8±0.56	0.054
SE	3.17±0.70	3.0±0.66	2.8±0.65	0.02
EUE	3.15±0.61	2.7±0.81	2.8±0.81	0.07
FF	2.8±0.60	2.91±0.47	2.89±0.51	0.56

*ANOVA test. Abbreviations: FR, Food responsiveness; EOE, Emotional over-eating; EF, Enjoyment of food; DD, Desire to drink; SR, Satiety responsiveness; SE, Slowness in eating; EUE, Emotional under-eating; FF, Food fussiness. Data are expressed as mean±SD.

Table 3 displays Pearson's correlations between the SDQ and CEBQ subscales and the child's BMI z-score for age. It reveals a significant inverse association between the hyperactivity score and the BMI z-score, suggesting that an

increase in a child's BMI is associated with a decrease in the hyperactivity score ($p<0.05$). The table also uncovers significant relationships between various eating behavior scales and childhood obesity. Food approach subscales, such

as food responsiveness, emotional overeating, and enjoyment of food, exhibit a positive and significant correlation with childhood obesity. This suggests that a higher expression of these behaviors corresponds to an increase in the child's BMI ($p < 0.05$). Conversely, food avoidance behaviors, including satiety responsiveness and slowness in eating, show a significant negative correlation with the child's BMI z-score. This implies that as a child's BMI increases, the incidence of food avoidance behaviors diminishes ($p < 0.05$).

Table 3. Pearson's correlations between scores of SDQ and CEBQ scales and child BMI z-score.

SDQ scales	X±SD	BAZ
Hyperactive	1.06±0.33	-0.158*
Pro-social behavior	1.6±0.34	-0.017
Emotional symptoms	0.4±0.35	0.027
Conduct problems	0.54±0.22	0.00
Peer problems	1.0±0.32	0.031
CEBQ scales		
Food responsiveness	2.3±1.03	0.216*
Emotional over-eating	1.9±0.86	0.198*
Enjoyment of food	3.3±1.04	0.407*
Desire to drink	2.6±1.20	0.042
Satiety responsiveness	2.9±0.62	-0.185*
Slowness in eating	2.9±0.67	-0.195*
Emotional under-eating	2.8±0.80	-0.127
Food fussiness	2.9±0.51	0.006

*P-value<0.05.

Table 4 further illustrates the relationship between SDQ and CEBQ scales, age, and wake-up time in children. The emotional symptom score generally displayed a positive correlation with all eating behaviors, which was significant for "food-approach" CEBQ subscales, including Food Responsiveness (FR) ($p < 0.001$), Emotional Overeating (EOE) ($p < 0.001$), and Desire to Drink (DD) ($p = 0.002$). The hyperactivity score exhibited a positive and significant correlation with "food-avoidant" CEBQ subscales, including Food Fussiness (FF) ($p = 0.011$) and Satiety Responsiveness (SR) ($P = 0.009$). This suggests that the more active a child is, the quicker they feel satiated, leading to a diminished desire to eat and less appetite. Interestingly, peer problems showed a positive and significant relationship between food-approach behaviors (FR and EOE) and food-avoidance behaviors (FF and SR). The stepwise linear regression analysis results on the 10 quantitative variables associated with BMI z-score revealed that only four variables were significantly associated with BMI z-score. These include Enjoyment of Food, Height for Age Z-score, Sleeping Time, and Satiety Responsiveness ($R^2 = 0.27$; $p < 0.05$). Other variables such as Food Responsiveness (FR), Emotional Overeating (EOE), Slowness in Eating (SE), Pro-social Behavior, Hyperactivity, and Waking Time were not found to be significantly associated with BMI z-score. The data for these variables are not shown.

Table 4. Pearson's correlations between scale SDQ, CEBQ scores, age, waking time in children (N=161).

	Hyperactive	Pro-social behavior	Emotional symptoms	Conduct problems	Peer problems	Age	Waking time
FR	0.056	-0.189*	0.276**	0.179*	0.192*	0.265**	-0.078
EOE	0.011	-0.137	0.327**	0.145	0.174*	0.278**	-0.091
EF	-0.104	0.004	0.104	-0.018	0.107	0.234**	-0.207**
DD	0.138	-0.075	0.240**	0.184*	0.151	-0.034	0.114
SR	0.205**	0.225**	0.135	0.101	0.204*	-0.138	0.062
SE	0.126	0.045	0.130	0.108	0.084	-0.071	0.003
EUE	0.086	0.063	0.154	0.083	0.054	-0.121	-0.071
FF	0.200*	0.150	0.052	0.146	0.200*	-0.03	-0.042

FR, Food responsiveness; EOE, Emotional over-eating; EF, Enjoyment of food; DD, Desire to drink; SR, Satiety responsiveness; SE, slowness in eating; EUE, Emotional under-eating; FF, Food fussiness. ** $P < 0.01$. * $P < 0.05$.

4. Discussion

In this study, the relationship between psychological problems and childhood obesity was investigated. The results indicated a negative and significant correlation between the hyperactivity score and BMI z-score. As a child's weight and age increased, the rate of restlessness and distraction decreased. Numerous studies have explored the relationship between psychological problems and weight status in children (23-25). These studies typically utilized the Child Behavior Checklist (CBCL) and DASS Questionnaire to assess psychological problems. However, few studies have employed the SDQ questionnaire for this purpose. The SDQ questionnaire offers several advantages, such as brevity and reliability (26-29). An Australian study on children aged 3.5 - 4.5 years found a significant relationship between peer problems, social behaviors, and BMI z-score (19). Similarly, significant correlations between the peer problems scale and BMI z-score were observed in studies on Australian children

aged 4-11 years (30) and French children aged 6-11 years (31). The absence of a relationship between BMI z-score and the peer problems scale and social behavior score in this study could be attributed to residence area, culture, and educational level variations. Additionally, parental reluctance to report their children's social, emotional, and behavioral issues may also be a factor. This study also examined the relationship between eating behavior and childhood obesity. A positive relationship was found between food approach scales and weight, while a negative association was observed between food avoidance scales and weight. Lower scores on food avoidance scales suggest that the child has less ability to regulate food intake, which can lead to overeating and obesity. In other words, children with obesity have a strong affinity for food, finding eating attractive. These children also prefer always to have food in their mouths. Even when they are anxious or upset, they tend to eat. Several studies have explored the relationship between eating behavior and weight status in children using different questionnaires such as DEBQ

and TEFQ (24, 31, 32) and CEBQ (9, 11, 19, 33). A clear and graded association between CEBQ scores and BMI has been reported in previous studies (11, 34, 35). In a study of Chilean children, similar results were found indicating that childhood obesity has a direct relationship with food approach scales, including Enjoyment of Food (EF), Food Responsiveness (FR), Emotional Overeating (EOE), and an inverse association with food avoidance scales, including Satiety Responsiveness (SR) and Slowness in Eating (SE). Lower scores on food avoidance scales, such as Food Fussiness (FF) and Slowness in Eating (SE), in obese children suggest that they have less restriction on food choices and consume food faster (35, 36). In our study, no association was found between the subscales Desire to Drink (DD), Food Fussiness (FF), and Emotional Undereating (EUE) with BMI z-score. This is similar to studies conducted on Dutch children aged 6-7 years and Portuguese children aged 3-13 years (11, 35). In this study, a negative correlation was found between the time of waking up in the morning and the Enjoyment of Food (EF) scale. Interestingly, it was observed that children with obesity tend to wake up earlier in the morning. This could suggest that a child who wakes up earlier may enjoy eating more than others, potentially leading to weight gain. The relationship between mental health problems and eating behaviors was also examined in this study. The social behavior scale was found to be negatively correlated with the Food Responsiveness (FR) scale and positively correlated with the Satiety Responsiveness (SR) scale. This implies that a child with stronger social relationships, such as helping others, sharing things with friends, and being kind to others, may not have a strong inclination to eat excessively. The hyperactivity scale showed a positive correlation with both food avoidance (Food Fussiness - FF) and food-approach behavior (Desire to Drink - DD). This suggests that hyperactive children may not be interested in trying unknown foods, but they may frequently desire sweet drinks. The Peer Problems scale was positively correlated with both food-approach behaviors (FR and EOE) and food-avoidance behaviors (FF and SR). This shows that a dissociable child, depending on the circumstances, could be interested in food or avoid eating. An Australian study on children aged 3.5 to 4.5 years showed that peer problems were associated with both higher food responsiveness and emotional overeating and directly with a higher BMI z-score. This relationship was partially mediated by emotional overeating. Both emotional overeating and food responsiveness fully mediated the association between emotional problems and BMI z-score, while food responsiveness fully mediated the association between conduct problems and BMI z-score (19).

5. Conclusion

This study stands unique in examining the relationship between eating behavior, mental health problems, and weight status in children using a questionnaire similar to the one employed in the present study. A stepwise linear regression analysis revealed that the EF scale was the most potent predictor of children's weight status, followed by HAZ, nighttime sleep duration, and the SR scale. However, this study is

not without limitations. The cross-sectional nature of this research prevents the determination of causality. Furthermore, the lack of assessment of children's food intake could have provided a more comprehensive understanding of the relationships. Our findings underscore a robust association between eating behavior and childhood obesity. Food approach scales (food responsiveness, emotional over-eating, enjoyment of food) are heightened, while food avoidance scales (slowness in eating, satiety responsiveness) are diminished in obese children. Interestingly, certain scales of mental health problems, including hyperactivity, were found to be inversely associated with body weight. The hyperactivity scale exhibited a direct relationship with both age and physical activity. Moreover, our study reveals a strong correlation between specific eating behavior scores and mental health problems with childhood obesity in Iran. By closely monitoring a child's actions and dietary behaviors, we can potentially prevent or even control mental problems. Furthermore, by modifying dietary behaviors, we can play a pivotal role in preventing overweight and obesity in children, thereby contributing significantly to community health improvement.

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