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Perceptions of Body Weight, Anthropometric Characteristics, and Risk of Eating Disorders in Girl Students in Zanjan, Iran: A Cross-Sectional Study

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ABSTRACT

Background: The perception of body weight seems to have an impact on weight-control behaviors and is associated with an increased risk of eating disorders EDs). The study aims to examine the perceptions of body weight, anthropometric characteristics, and the risk of EDs in female students in Zanjan, Iran. **Methods:** Using a cross-sectional design, the data of 359 students aged 16-19 year attending secondary high schools in Zanjan, during the school year 2017-2018 were collected and analyzed. **Results:** The results revealed a significant association between being overweight and having obese body shape, high levels of stress, and the odds of EDs. Additionally, there was a significant inverse relationship between being overweight and obese body mass index (BMI), overweight and obese body shape, and the odds of oral control subscale of EDs. **Conclusion:** The results of this study demonstrated a relationship between BMI, stress level, body shape, and an elevated risk of EDs. Further prospective studies are needed to validate and expand upon these findings.

Introduction

Eating disorders (EDs), like bulimia nervosa , anorexia nervosa (AN), and periodic binge eating disorder , are psychiatric syndromes that are difficult to treat and might affect people's nutritional status, predisposing them to obesity and malnutrition (Hetterich *et al.*, 2019). The perception of body weight seems to have an impact on weight-control behaviors and is associated with an increased risk of eating disorders. These syndromes are characterized by pathological control of body weight, disruptions in body image perception, and disturbed eating behavior (Fortes *et al.*, 2014). Puberty is a complicated biological process, and adolescence is a unique stage of life

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marked by changes in psychological and physiological characteristics and the onset of puberty, doubling the importance of food and nutrition (Badpeyma *et al.*, 2024, Mohammadi *et al.*, 2022, Rasouli *et al.*, 2024). The Prevalence of eating behavior disorders is far higher than clinical EDs (Hay *et al.*, 2023, Mancine *et al.*, 2020) and mainly occurs among adolescent females (Mitchison *et al.*, 2020, Sahlan *et al.*, 2021). During adolescence, individuals are most affected by ongoing body aesthetic patterns and thereby vulnerable to EDs (Kurnik Mesarič *et al.*, 2023). Three treatment options for EDs are psychotherapy, medication, and behavioral weight loss programs (Davis and Attia, 2017, Grenon *et al.*, 2019, Saljoughian, 2021). Lack of treatment of EDs might cause a decrease in social functioning, the appearance of bipolar mood disorder, depression, anxiety, obsessive-compulsive disorder, and alcohol use (Bühren *et al.*, 2014), and even increase the risk of suicide in teenagers (Bodell *et al.*, 2019). Swenne observed that the adolescent growth curves of those who suffered from EDs had a higher weight than those without EDs (Swenne, 2001). Overweight female adolescents are more likely to have restricted eating behaviors, be worried about their weight, and are less likely to be satisfied with their appearance (Sadowska *et al.*, 2020). It can have lasting effects on self-esteem and body image and can lead to an increased risk of EDs (Péter, 2023). Inaccurate body weight perception can put individuals at risk regarding behavioral and psychological problems compared to those without these perceptions. For example, compared to male subjects, female subjects have a greater tendency toward a distorted body image and a lower physical self-perception, which can result in higher rates of binging and body dissatisfaction (Hao *et al.*, 2023, Quittkat *et al.*, 2019).

A study among US college students demonstrated that those who had disturbed body image adopted more wrong weight loss methods compared to students with accurate body image perception (Wharton *et al.*, 2008). Additionally, a longitudinal study predicted EDs caused by obesity and unhealthful weight-control behaviors 5 years later (Neumark-Sztainer *et al.*, 2006). On the other hand, according to a growing number of children and young female adolescents in the population of developing countries, the prevalence of overweight and its side effects, such as EDs, might increase.

Although some studies have been performed on EDs in Iran (Asl *et al.*, 2022, Davodi *et al.*, 2016, Firoozjah *et al.*, 2022, Khajrnoori and Dehghani, 2016, Momeni *et al.*, 2020), a limited number of studies were conducted on the effect of high body mass index (BMI), weight perceptions, and body image on the odds of EDs. Therefore, the authors investigated the relationship between BMI, weight perception, waist circumference (WC), and the likelihood of being at risk of EDs among secondary high school females in Zanjan, Iran.

Materials and Methods

Design and participants

A cross-sectional design was utilized in this study, gathering data from a sample of 359 students aged 16 to 19 attending secondary high schools in Zanjan, located in the northwest region of Iran, during the 2017-2018 academic year. This age group was selected due to its critical developmental stage, where adolescents are particularly vulnerable to various psychological and behavioral issues, including EDs. The sample size was determined using a prevalence rate of 21.6% for ED risk behaviors (Nobakht and Dezhkam, 2000), a 95% confidence interval (CI), and an absolute precision of 5 percentile points. This statistical approach ensured that the findings would be robust and reflective of the broader population. To ensure representative sampling, cluster random sampling was performed using a comprehensive list of all high schools in the area. This method allowed for a more systematic selection process, reducing bias and enhancing the validity of the results. Following this, simple random sampling was used to select students for participation, ensuring that every student had an equal chance of being included in the study. Eligibility criteria for inclusion in the study required participants to have no physical disabilities that would impede anthropometric assessments and

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to not be pregnant. These criteria were established to maintain the data's integrity and ensure that all participants could be accurately assessed. The project was comprehensively presented at a meeting that included teachers and the parents of the students. This meeting served as a crucial platform for fostering stakeholder transparency and trust. After detailing the study's processes and objectives, students interested in participating were invited to participate, with parental consent obtained through signed agreements. This step was vital for ethical compliance and ensuring that parents were fully informed about their children's participation.

Measurements

A questionnaire gathered demographic information, such as educational level, age, and specific diseases. The Eating Attitude Test-26 (EAT-26) questionnaire was applied to assess disordered eating behaviors (Garner *et al.*, 1982). It is a validated self-report questionnaire used to measure symptoms and features of EDs. EAT-26 has 26 items, and responses are scored on a six-point Likert scale, ranging from "always" to "never." The total score of EAT-26 questionnaire ranges from 0 to 78. A cutoff score of ≥ 20 on EAT-26 indicates a risk for disordered eating attitudes and behaviors. The EAT-26 Persian version was validated previously (Gargari *et al.*, 2010, Gargari *et al.*, 2011).

For the assessment of body image perception, the gender-specific accepted Body Image Rating Figures (BIRF) was employed (Ettarh *et al.*, 2013) and presented on an A4-size paper. The participants were asked to select the silhouette most closely resembling their body size (**Figure 1**). The 18 images were categorized into four groups based on the image scheme, according to Madrigal *et al.* (Madrigal *et al.*, 2000).

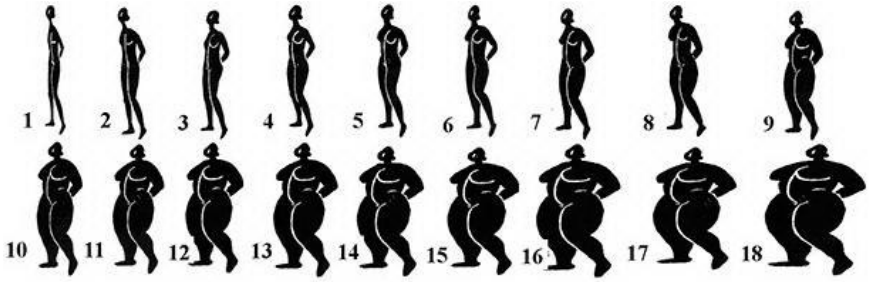

Figure 1. Body image rating scale for women.

Images 1-5 indicate underweight individuals, images 6-9 indicate normal weight, images 10-13 indicate overweight, and images 14 through 18 represent obese participants.

Trained measurers conducted weight and height measurements. Weight was measured with light and minimal clothing, with no shoes, and was recorded to the nearest 0.1 kg by a calibrated electronic balance (capacity: max 200 kg, Seca 813 scale, Germany). Participants' height was measured in a standing position, with no shoes, hats, or hair accessories, and with their shoulders in a normal position, noted to the nearest 0.1 cm using a stadiometer. Using a non-stretchable tape measure, WC was determined around the waist at one-third of the distance between the umbilicus and the xiphoid process (Krotkiewski *et al.*, 1983). Finally, BMI was determined by dividing the weight (kg) by the square of height (m). The students were grouped as normal, underweight, obese, or overweight, considering international age and gender-specific cutoff points (Onis *et al.*, 2007).

Ethical considerations

The research protocol received approval from the Ethics Committee of Qazvin University of Medical Sciences under code IR.QUMS.REC.1396, 380. This approval underscored commitment to conducting research ethically and responsibly. Additionally, this study adhered to the principles

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outlined in the Helsinki Declaration, ensuring that ethical standards were maintained throughout the research process.

Data analysis

The data were analyzed using SPSS software version 16 (SPSS, USA), which used descriptive and inferential statistics. Descriptive analysis was performed, calculating the proportions for categorical variables and mean and standard deviation (SD) for continuous variables. The data was analyzed using independent t-tests, Chi-square tests of independence, and Spearman and Pearson correlations. Additionally, logistic regression models were employed to examine the association between binary EDs and independent variables. Due to the non-normal distribution of ED subscales, median regression models were used to investigate the association between ED subscales and independent variables. All analyses were conducted in the R 6.3.2 environment at 0.05. The P-values <0.05 were inferred as significant.

Results

Characteristics of the study population and correlations among variables

After exclusion, 355 participants were included in the study sample. The participants' ages ranged from 16-18, with a mean±SD age of 16.04±0.646 year. As expected, WC was significantly correlated with BMI (r=0.88, *P*<0.001). The eating attitude test (EAT) score showed significant correlations with weight (r=0.11, *P*=0.02) and BMI (r=0.143, *P*=0.007). **Table 1** indicates the characteristics of the participants and correlations among variables.

Table 1. Means, standard deviations, and Pearson correlations for study variables (N = 359).

Variable	Mean±SD	Age	Weight	Body mass index	Waist circumference	Body image
Age (y)	16.04±0.64					
Weight (kg)	55.63±10.28	0.05				
Body mass index (kg/m^2)	21.56±3.67	0.051	0.92[a]			
Waist circumference (cm)	76.23±7.84	0.055	0.881[b]	0.880[b]		
Body image	6.26±2.58	0.025	0.682[b]	0.716[b]	0.663[b]	
Eating attitude test scpre-26	14.50±8.89	0.012	0.11[a]	0.143[b]	0.091	0.086

[a]: P<0.05; [b]: P<0.01.

Most students (80%) had a BMI within the normal range category, and 5.1, 10.01, and 4.8% were underweight, overweight, and obese, respectively. Additionally, 51.3% perceived themselves to be of normal weight. Moreover, 47.2% of overweight and 23.5% of obese students perceived themselves to be in the normal weight range. Most obese and overweight female students selected silhouettes that were smaller compared to those equivalent to their actual weight, believing they were normal or moderately overweight. The percentages of underweight, normal weight, and obese students based on BMI indices and body image perception are presented in **Table 2**.

Table 2. Percentages of students categorized by weight status and Body Image Perception.

Body weight status	Body weight image				Total	P-value[b]
	Underweight	Normal	Overweight	Obese		
Underweight	17 (94.4)[a]	1 (5.6)	0 (0.0)	0 (0.0)	18 (5.1)	
Normal	116 (40.8)	160 (56.3)	7 (2.5)	1 (0.4)	284 (80.0)	<0.001
Overweight	1 (2.8)	17 (47.2)	17 (47.2)	1(2.8)	36 (10.1)	
Obese	1 (5.9)	4 (23.5)	11 (64.7)	1(5.9)	17(4.8)	
Total	135 (38.0)	182 (51.3)	35 (9.9)	3 (0.8)	355(100)	

[a]: n (%); [b]: Chi-square test.

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Among all participants studied, 80 pf them (22.3%) obtained scores of 20 or above on the EAT-26 questionnaire. **Table 3** compares the weight, BMI, body image, and WC between individuals with disordered eating attitudes and healthy participants. Statistically significant differences were observed in BMI and mean weight between those with disordered eating attitudes and healthy participants. However, no significant difference was detected in the mean WC and body perception between the two groups.

Table 3. Comparison (mean±SD) of weight, body mass index, body image, and waist circumference by eating attitude score.

Variable	Eating attitude score		P-value[a]
	< 20	≥ 20	
Weight (kg)	57.94±20.5	54.97±10.14	0.023
Body mass index (kg/m^2)	22.46±3.95	21.03±3.55	0.012
Body perception	6.11±2.36	6.78±3.2	0.087
Waist circumference (cm)	75.88±7.76	77.44±8.04	0.118

[a]: *Independent t-test.*

Eating disorders and independent variables

Statistically, no significant relationship was observed between EDs and age, grade at birth, number of family members, and parental job variables (P>0.05). **Figure 2** illustrated the comparison of anthropometric characteristics between the two groups. Additionally, **Figure 3** depicts the association between the correlation matrix and EDs and anthropometric indices.

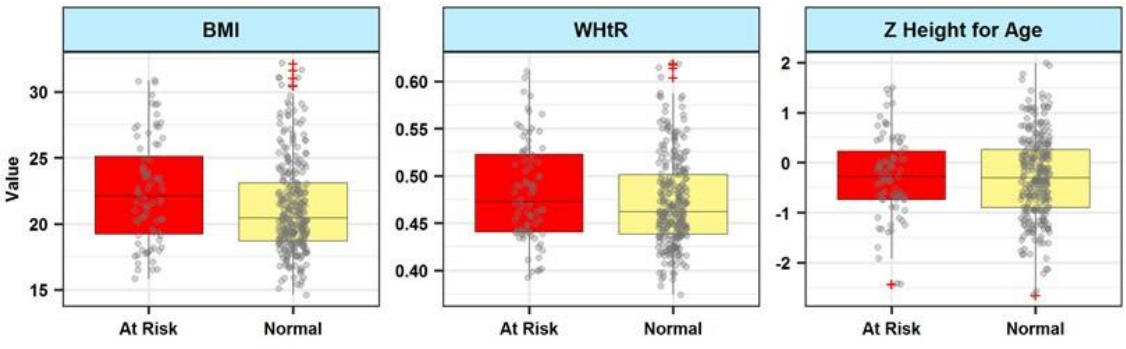

Figure 2. The distribution of anthropometric factors by eating disorders. **BMI**: Body mass index; **WHtR**: Waist to hip ratio.

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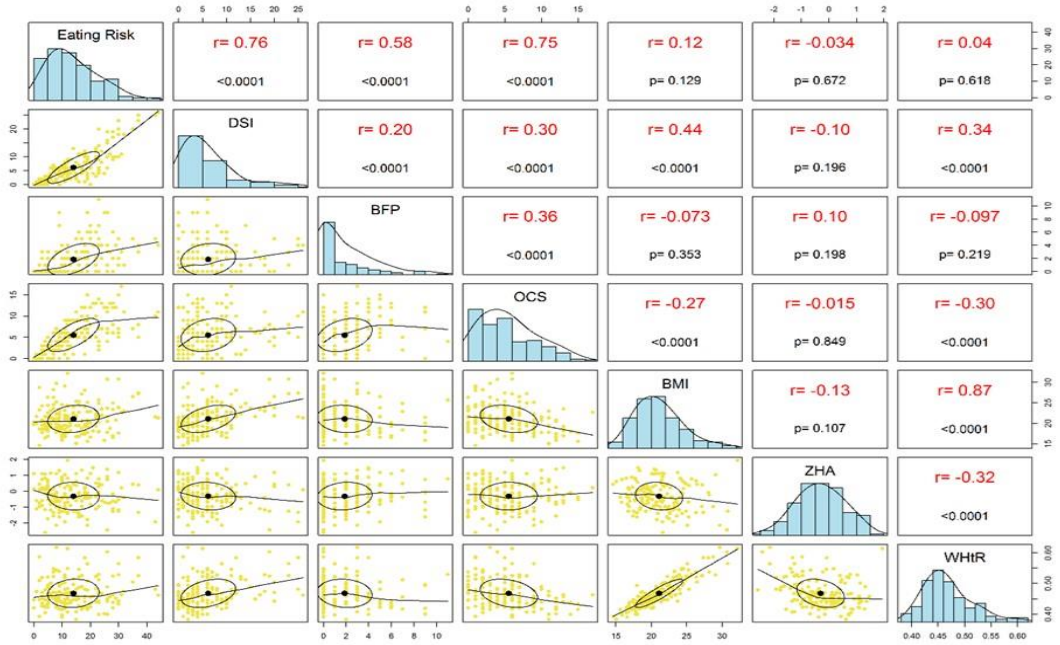

Figure 3. The association between matrix correlation and ED and anthropometric index. **DSI**: Dieting Scale; **BFP**: Bulimia & Food Preoccupation Scale; **OCS**: Oral Control Subscale.

Table 4 presents multivariable odds ratios (OR) and 95% CI for EDs and some independent variables. There was a significant association between overweight and obese body shape, high levels of stress and the odds of EDs. In other words, individuals with high levels of stress had a significantly increased risk of EDs (OR: 4.4; 95% CI: 1.55-12.49, *P*=0.005). Moreover, the participants with very high levels of stress were about 10 times more likely to be at risk of EDs than those without Stress (OR: 10.16; 95% CI: 3.45-29.93, *P*<0.0001). Additionally, this table shows that individuals with overweight and obese body might have more than 2 times the odds of EDs compared with individuals with a normal body shape (OR: 2.28; 95% CI: 1.06-4.91, *P*=0.035).

Dieting scale

The association between some independent variables and the odds of ED subscales is shown in **Table 5**. As shown, overweight (OR: 8; 95% CI: 4.97-11.03, *P*<0.0001) obese (OR: 7; 95% CI: 1.71-12.29, *P*=0.01) significantly increased the risk for the dieting scale more than normal weight. Furthermore, individuals with a high stress level increased the odds of the dieting scale by about 2 times (OR: 2; 95% CI: 0.15-3.85, *P*=0.034)

Bulimia and food preoccupation scale

It was observed that participants with very high levels of stress faced increased odds of the bulimia and food preoccupation scale by about two times compared to those with low levels of stress (OR: 2; 95% CI: 0.75-3.25, *P*=0.002). However, the results of the other variables were insignificant (*P*>0.05).

Oral control subscale

Table 5 shows a significant inverse association between overweight (OR: -6; 95% CI: -9.28--2.72, *P*<0.0001) and obese (OR: -5; 95% CI: -8.32--1.68, *P*=0.003), overweight and obese body shape (OR: -3; 95% CI: -4.49--1.51, *P*<0.0001), and the odds of the oral control subscale. Furthermore, the findings indicated a significant positive relationship between very high levels of stress and the risk of the oral control subscale (OR: 2; 95% CI: 0.52-3.48, *P*=0.008).

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Table 4. Logistic regression results for association between eating risk and independent variables.

Eating risk	OR	SE	t	P-value	95 % CI for OR
Weight status (Underweight[a])					
Normal	2.54	0.418	-0.88	0.38	0.32-20.24
Overweight	4.52	0.24	-1.39	0.16	0.54-37.91
Obese	5	0.232	-1.39	0.16	0.51-48.75
Waist to Height Ratio (Low[a])					
Ideal	0.54	1.149	0.99	0.32	0.16-1.83
High	0.94	0.701	0.1	0.92	0.26-3.40
Too high	1.13	0.695	-0.15	0.88	0.24-5.21
Body shape (Underweight[a])					
Normal	0.83	0.336	0.65	0.51	0.48-1.44
Overweight & Obese	2.28	0.171	-2.11	0.03	1.06-4.91
Stress (Too low[a])					
Low	1.14	0.559	-0.2	0.84	0.33-3.94
Moderate	2.77	0.188	-1.95	0.05	1.00-7.68
High	4.4	0.121	-2.78	0.005	1.55-12.49
Too high	10.16	0.054	-4.2	<0.0001	3.45-29.93

[a]: *Reference group.*

Table 5. Median regression results for eating risk subscales and independent variables

Eating subscales	Beta	SE	t	P-value	95 % CI for Beta
Dieting scale					
Weight status (underweight[a])					
Normal	3.5	1.307	2.68	0.008	0.93-6.07
Overweight	8	1.54	5.2	<0.0001	4.97-11.03
Obese	7	2.691	2.6	0.01	1.71-12.29
Waist to height ratio (Low[a])					
Ideal	-0.5	1.203	-0.42	0.678	-2.87-1.87
High	0.5	2.055	0.24	0.808	-3.54-4.54
Too high	-1	2.516	-0.4	0.691	-5.95-3.95
Body Shape (underweight[a])					
Normal	-1	0.817	-1.22	0.222	-2.61-0.61
Overweight& Obese	-1	1.859	-0.54	0.591	-4.66-2.66
Stress (Too low[a])					
Low	-0.5	1.23	-0.41	0.685	-2.92-1.92
Moderate	0	1.125	0	>0.999	-2.21-2.21
High	2	0.939	2.13	0.034	0.15-3.85
Too high	-0.5	1.23	-0.41	0.685	-2.92-1.92
Bulimia & food preoccupation scale					
Weight status (underweight[a])					
Normal	-1	2.094	-0.48	0.633	-5.12-3.12
Overweight	-1	2.175	-0.46	0.646	-5.28-3.28
Obese	-1	2.228	-0.45	0.654	-5.38-3.38
Waist to height ratio (Low[a])					
Ideal	-1	1.722	-0.58	0.562	-4.39-2.39
High	-2	1.781	-1.12	0.262	-5.50-1.50
Too high	-2	1.808	-1.11	0.269	-5.56-1.56
Body shape (underweight[a])					
Normal	1	0.568	1.76	0.079	-0.12-2.12
Overweight and obese	1	0.743	1.35	0.179	-0.46-2.46

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Stress (too low[a])					
Low	0	0.719	0	>0.999	-1.41-1.41
Moderate	0	0.709	0	>0.999	-1.39-1.39
High	1	0.644	1.55	0.121	-0.27-2.27
Too high	2	0.634	3.15	0.002	0.75-3.25
Oral control subscale					
Weight status (underweight[a])					
Normal	-3	1.761	-1.7	0.089	-6.46-0.46
Overweight	-6	1.667	-3.6	<0.0001	-9.28--2.72
Obese	-5	1.689	-2.96	0.003	-8.32--1.68
Waist to height ratio (Low[a])					
Ideal	-2	2.164	-0.92	0.356	-6.26-2.26
High	-3	2.125	-1.41	0.159	-7.18-1.18
Too high	-4	2.458	-1.63	0.105	-8.83-0.83
Body shape (underweight[a])					
Normal	-1	0.768	-1.3	0.194	-2.51-0.51
Overweight and obese	-3	0.759	-3.95	<0.0001	-4.49--1.51
Stress (Too low[a])					
Low	1	0.733	1.36	0.173	-0.44-2.44
Moderate	2	0.821	2.44	0.015	0.39-3.61
High	1	0.923	1.08	0.28	-0.82-2.82
Too high	2	0.754	2.65	0.008	0.52-3.48

[a]: *Reference group.*

Discussion

In this study, 22.3% of the participants were at risk of disordered eating behaviors. Similar results have been reported in other studies regarding the prevalence of ED behaviors (D'Souza *et al.*, 2005, Graber *et al.*, 2003, Nobakht and Dezhkam, 2000). However, the Prevalence of ED risk in the present study was higher than in some previous studies in Iran and other countries (Cheah *et al.*, 2017, Gargari *et al.*, 2011, Mozaffari-Khosravi *et al.*, 2011, Pike and Dunne, 2015, Qomi *et al.*, 2023). The results of this study supported the relationship between high BMI, overweight and obese body shape, and the odds of EDs. However, no significant relationships were observed between WC and the risk of EDs.

Additionally, the researchers showed a reverse association between higher BMI and the oral control subscale of eating risks. The present study's results were aligned with those of previous authors who examined the association between EDs and student BMI. A survey of 329 female participants aged 12-18 investigated the relationships between overweight, anthropometric factors (including WC), and risk of EDs; except for BMI, the other anthropometric measurements were not significantly correlated with EAT score (Babio *et al.*, 2009). Another student study observed a significant positive correlation between EAT-40 score and body weight and BMI and WC (Şanlier *et al.*, 2008).

Rouzitalab *et al*. showed that in females, WC was positively associated with the EAT-26 score, which was not in line with the current study's findings (Rouzitalab *et al.*, 2015). Other authors also suggested that overweight adolescents are more prone to develop a full manifestation of EDs compared to cases with a normal weight (Flament *et al.*, 2015, Veses *et al.*, 2011). The possible reason is that overweight/obese adolescents have higher levels of weight-associated teasing and other behaviors with a negative impact on their self-esteem. Weight-associated teasing is related to disordered eating attitudes, proposing that it might have potential relevance in developing both EDs and obesity (Lampard *et al.*, 2014).

In the present study, most obese students chose silhouettes with a lower BMI than their actual BMI, believing they were normal or moderately overweight. However, the findings of this study showed no significant relationship between body image perception and risk of EDs. In contrast to

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the present study, frequent dieting was reported to be associated with body size perception and body dissatisfaction in addition to ED symptoms in young adults (Jáuregui-Lobera *et al.*, 2013). The findings of another study among US college students demonstrated that those suffering from disordered body image were more prone to take part in invalid and unhealthy weight loss methods compared to those with a correct body image perception (Wharton *et al.*, 2008). Additionally, in another study, females with a distended body weight perception were more likely to engage in unhealthy weight-controlling methods, like taking diet pills and vomiting, to lose weight. Furthermore, overweight women with normal weight were more likely to take diet pills to lose weight (Harring *et al.*, 2010).

Additionally, the present study showed that individuals with high levels of stress might increase up to 10 times the odds of EDs in comparison to those who had low stress. In this regard, previous studies have stated that stress and psychological symptoms have a positive effect on EDs (Brewerton, 2015), and stress plays a vital role in the expansion of night-eating syndrome (Gan *et al.*, 2019). Another study supporting these findings suggested that stress might increase the risk of EDs in a predisposed personality (Pitt, 2017).

Moreover, a review study indicated the significant relationships between stress, hypothalamic-pituitary-adrenal (HPA) axis functioning, and EDs (Marciello *et al.*, 2020) and mentioned the stimulus role of stress in the onset and maintenance of BN (Westwater *et al.*, 2021). The possible mechanism for this finding might be individuals' dissatisfaction with body shape in response to the increasing prevalence of obesity. Therefore, the stress level increases due to dissatisfaction with body shape and, as a result, weight-control behaviors and then restricted eating behaviors, such as EDs (Naumann *et al.*, 2018). In addition, the effect of stress on HPA axis dysfunctions and its relation with physical and behavioral symptoms, such as the pathophysiology of EDs, has been mentioned in previous studies (Sauro *et al.*, 2008). It has been found that aromatherapy improves infant feeding behavior; it seems effective in adolescents suffering from EDs, and it is suggested that future research consider this point (Esmaeeli *et al.*, 2019).

The main limitation of present study was the cross-sectional method of the study; thus, causal relationships were not established. Also, the small sample size compromised the generalizability of the results.

Conclusion

The high prevalence of adolescent obesity, the resulting stress, and the growing prevalence of EDs necessitates the development of methods to prevent, determine, and treat these health issues from a broad perspective.

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Authors' contribution

Conceptualization was done by A Rasouli and S Mohiti; Data curation by A Rasouli; formal analysis by S Arsang-Jang; investigation by S Mohiti. and S Arsang-Jang; Methodology by A Rasouli and S Mohiti; software by S Mohiti; project administration by A Rasouli and S Mohiti; supervision by A Rasouli; writing original draft by S Sefidgari-abras, S Mohiti M and S Arsang-Jang; Writing review and editing by S Mohiti and A Rasouli. All authors read and agreed to the published version of the manuscript.

Conflicts of interest

The authors declared no conflict of interests.

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