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Eating behaviors mediate the relationship between perceived stress and anthropometric measurements related to obesity in young adults

Comportamentos alimentares medeiam a relação entre estresse percebido e medidas antropométricas relacionadas à obesidade em adultos jovens

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ABSTRACT

Objective
The aim of the present study was to investigate the association of perceived stress, eating behaviors and anthropometric measurements related to obesity in the university students.

Methods
A cross-sectional study was carried out with 658 university students (128 males, 530 females). A questionnaire comprising socio-demographic characteristics, eating habits, perceived stress using the Perceived Stress Scale-14, eating behaviors assessed with the Dutch Eating Behavior Questionnaire and measured anthropometric parameters was administered by researchers.

Results
Perceived stress was higher in pre-obesity/obese participants compared to those were underweight and had normal weight (p<0.001). Emotional and external eating behaviors were higher in pre-obesity/obese participants compared to others (p<0.001). The total score of the Perceived Stress Scale-14 showed significant correlations with body mass index (r=0.245, p<0.001), hip circumference (r=0.223, p<0.001), mid-upper arm circumference (r=0.248, p<0.001) and triceps skinfold thickness (r=0.178, p<0.001). In addition, after adjusting for mediators, a positive association was detected between the perceived stress score and body mass index (β=0.358, 95% CI [0.185, 0.531], p<0.001). Increased Dutch Eating Behavior Questionnaire score showed a mediating effect in this relationship (β=0.073, 95% CI [0.056, 0.091], p<0.001).

Conclusion
The findings of this study suggest a notable correlation between perceived stress, eating behaviors, and anthropometric measurements associated with obesity in university students. Enhancing stress coping strategies for individuals could potentially lead to improvements in eating behaviors and reduce risk of obesity.

Keywords: Anthropometric measurements. Eating behavior. Obesity. Perceived stress. University students.

RESUMO

Objetivo
O objetivo do presente estudo foi investigar a associação do estresse percebido, dos comportamentos alimentares e das medidas antropométricas relacionadas à obesidade em universitários.

Métodos
Um estudo transversal foi realizado com 658 estudantes universitários (128 homens, 530 mulheres). Por meio de um questionário, indagou-se sobre as características sociodemográficas, alguns hábitos alimentares, estresse percebido com Perceived Stress Scale-14, comportamentos alimentares com o Dutch Eating Behavior Questionnaire e medidas antropométricas e medidas por pesquisadores.

Resultados
O estresse percebido foi maior em participantes pré-obesos/obesos em comparação ao baixo peso e normais (p<0.001). A alimentação emocional e externa foi maior nos participantes pré-obesos/obesos em relação aos demais (p<0.001). Além disso, a pontuação total Perceived Stress Scale-14 foi determinada significativamente correlacionada ao índice de massa corporal (r=0.245, p<0.001), circunferência do quadril (r=0.223, p<0.001), circunferência do braço (r=0.248, p<0.001), e dobra cutânea tricipital (r=0.178, p<0.001). Ademais, quando o efeito dos mediadores foi levado em consideração, a relação positiva entre o escore de estresse percebido e o índice de massa corporal foi mantida (β=0.358, IC 95% [0.185, 0.531], p <0.001). O aumento do escore Dutch Eating Behavior Questionnaire teve um efeito mediado nessa relação (β=0.073, IC 95% [0.056, 0.091], p<0.001).

Conclusão
Os resultados deste estudo indicam que há uma relação significativa entre estresse percebido, comportamentos alimentares e medidas antropométricas relacionadas à obesidade em estudantes universitários. Melhorar as estratégias de enfrentamento do estresse para os indivíduos pode acurar os comportamentos alimentares e reduzir o risco de obesidade.

***Palavras-chave**: Medidas antropométricas. Comportamento alimentar. Obesidade. Estresse percebido. Estudantes universitários.*

INTRODUCTION

Obesity is one of the most important health issues posing a serious threat public health today [1,2]. Its prevalence characterized by an accumulation of body fat that compromises overall health, is escalating across all age groups from childhood to old ages, both in Türkiye and the worldwide [3,4]. Obesity leads to a myriad of sociological, psychological and physiological health problems [5,6]. Globally, the rate of pre-obesity in adults is 39.0% (39% of men and 40% of women), while the rate of obesity is 13.0% (11% of men and 15% of women) [7]. In the USA, the obesity rate stands at 42.4% [8], while pre-obesity rates range between 30-70% and obesity rates between 10-30% in European countries [9]. In our country, according to the Türkiye Nutrition and Health Research study, 43.4% of men and 29.2% of women were found to pre-obese, while the obesity rates were reported as 24.9% and 35.6%, respectively in those over 19 years of age [10].

The level of stress is influenced by both individual and environmental factors. Physiological issues related to any disease in an individual can increase stress levels, while social factors such as work life, family and social relationships, and economic status can also contribute to increased stress levels [11-13]. It is common for unhealthy eating habits to emerge when stress levels increase, resulting

in higher consumption of energy, saturated fat and refined sugar. Consequently, diet quality tends to deteriorate due to obesogenic environmental factors [14-16]. In addition, independent of dietary influences, stress can also increase physiological responses. For instance, increased cortisol levels during periods of stress can promote fat storage by enhancing lipogenesis [17]. Furthermore, according to the results of studies determined together with the negative feedback mechanism for such reasons, it shows that the increased body weight may also increase the perceived stress level [18-20].

Stress level has negative effects on eating behaviors. Studies have shown that higher than normal perceived stress may result in lower diet quality, increased consumption of snack food and reduced intake of fruit and vegetable, and increased disinhibition or binge eating behaviors [16,21,22]. This unhealthy behavior contribute to an unhealthy increase in body weight [23]. Restraint refers to the deliberate restriction of food intake to control body weight, whereas disinhibition is the tendency to overeat in response to various stimuli, such as highly palatable foods, under emotional stress. According to some researches in this subject, it is thought that high levels of stress can lead to impaired cognitive restraint, which in turn can lead to unhealthy eating behaviors [24,25]. Another hypothesis suggests that these behaviors may be sustained by stress, leading to increased consumption of more pleasing and delicious foods (increased snack foods intake and low fruit-vegetable intake) as well as stimulation of the brain's reward center [26,27]. Stress-induced negative eating behaviours can be managed and stress levels can be reduced or eliminated with appropriate interventions [28,29].

The aim of this study was to investigate the relationship between perceived stress, eating behaviors and anthropometric measurements related to obesity in university students.

METHODS

This study involved 658 healthy university students (128 males, 530 females). Individuals were following a specific diet and/or taking medications, suffering from chronic disease and/or or experiencing mental health issues were excluded from the study. Additionally, students in the Nutrition and Dietetics Department were excluded due to their knowledge of nutritional practices, which could potentially bias the results. Prior to participation, all participants provided informed consent. This study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures involving research study participants were approved by the Faculty of Medicine/Clinical Research Ethics Committee (approval number: 06-258-16). Written informed consent was obtained from all subjects.

Researchers provided participants with both verbal and visual instructions on how to reply to the questions. The questionnaire form was conducted in person and it was designed by the researchers, based on a review of relevant literature pertaining to the study objectives. The questionnaire included sections on socio-demographic characteristics, dietary habits, the Dutch Eating Behavior Questionnaire (DEBQ), and the Perceived Stress Scale-14 (PSS-14). Anthropometric measurements were administered by the researchers.

The sample size was determined based on the findings of a study conducted by Diggins et al. [30] by using G*Power 3.1 software. According to this calculation, a minimum of 486 subjects was required to achieve a statistical power of 90% with a significance level of 0.05, in order to detect relationship between perceived stress, eating behavior and BMI.

The DEBQ, comprises 33 self-report items [31], and assesses three unhealthy eating behaviors: emotional eating (13 questions), restrained eating (10 questions) and external eating (10 questions).

Each item in the instrument was scored using a five-point Likert-type scale, ranging from 1 (never) to 5 (very often). The scale's linguistic validity and reliability were established by Bozan et al. in Türkiye [32].

The PSS-14 is a reliable test measure of the perceived level of stress in specific situations [33]. Participants rated their responses on a 5-point scale from "never" to "very often" in questions such as "In the last month, how often have you felt that you were unable to control the important things in your life?" Some questions were reverse-scored with a high score indicating "never," such as "In the last month, how often have you felt confident in your ability to handle your personal problems?" The scores for all items were summed, resulting in a total score ranging from 0 to 56. The Cronbach's alpha internal consistency coefficient of the scale was 0.87 which exceeds the acceptable cutoff of 0.70. Eskin et al. conducted a validity and reliability study of the scale in Turkish [34].

Participants' body weight (measured with only light indoor clothing and barefoot) was determined to the nearest 0.1 kg using a digital scale (Fakir, DE). Height (without shoes) was measured to the nearest 0.1 cm using a handheld stadiometer. The BMI was determined as weight divided by height squared. The BMI values were classified into 3 groups as follows: underweight (≤18.5 kg/m^2), normal weight (18.5–24.9 kg/m^2), and pre-obesity/obese (≥25.0 kg/m^2) [35]. Waist Circumference (WC) was measured with a flexible measuring tape at a level midway between the lower rib margin and the iliac crest to the nearest 0.5 cm. For women, Hip Circumference (HC) was measured around the largest circumference of the hips and buttocks. For men, hip circumference was measured at the hip bones [36]. Mid-upper Arm Circumference (MUAC) was measured at the mid-arm between the shoulder and elbow. Triceps Skinfold Thickness (TSF) was measured from the left side of the body to the nearest 0.1 mm, using a Holtain skinfold caliper (Holtain Ltd., Crymych, UK), at the midpoint between the acromion process and the olecranon process. All anthropometric measurements were measured by the researchers.

All statistical analyses were performed using IBM®SPSS® 25 Statistics for Windows software and multiple mediational models were performed with Hayes Process Macros for SPSS.

The normality of the data was assessed using visual (histogram) and analytical methods (Kolmogorov-Smirnov test). Descriptive variables are presented as mean±standard deviation or number (%). Student's t-test or Wilcoxon-Mann-Whitney test for continuous variables and chi-square or Fisher's exact tests for categorical variables were used to compare variables of two independent groups. The one-way Analysis of Variance (ANOVA) test was used to compare anthropometric measurements, PSS-14 and DEBQ score between BMI groups, post-hoc tests were performed (Bonferroni correction). Additionally, Pearson correlation was performed to assess the associations among the main study variables, including anthropometric measures, BMI, PSS-14 and DEBQ score. Eating behaviors were controlled as mediators to determine their impact on the relationship between perceived stress and BMI. To determine the mediating effect of the eating behaviors on the association between the perceived stress and BMI, a multiple mediation model and bootstrap technique were performed. In addition, bootstrapping with 5000 resamples was used to estimate 95% Confidence Interval (CI) for analyzing the indirect effects.

RESULTS

The mean age of university students was 20.93±1.55 years, with 80.5% of them were being female. About 47.1% reported that their mother and 29.8% of their father were primary school graduates. More than half of the students (52.9%) stated that they stayed in the dormitory, 77.5% of them did not smoking. Additionally, 50.0% of them did not have a family history of obesity (Table 1).

Table 1 – Sociodemographic characteristics of participants.

Sociodemographic characteristics	Male (n=128)		Female (n=530)		Total (n=658)		Statistical test
	n	%	n	%	n	%	
Grade							
1	26	20.3	96	18.1	122	18.5	
2	32	25.0	258	48.7	290	44.1	χ^2=15.836
3	46	35.9	138	26.0	184	28.0	p=0.01*
4	24	18.8	38	7.2	62	9.4	
Mother's educational status							
Iliterate	12	9.4	32	6.0	44	6.7	
Literate	10	7.8	20	3.8	30	4.6	
Primary	60	46.9	250	47.2	310	47.1	χ^2=4.810
Secondary	26	20.3	96	18.1	122	18.5	p=0.43
High school	16	12.5	110	20.8	126	19.1	
University/college	4	3.1	22	4.2	26	4.0	
Father's educational status							
Iliterate	2	1.6	8	1.5	10	1.5	
Primary	48	37.5	148	27.9	196	29.8	
Secondary	36	28.1	160	30.2	196	29.8	χ^2=4.359
High school	22	17.2	148	27.9	170	25.8	p=0.36
University/college	20	15.6	66	12.5	86	13.1	
Mother's profession							
No profession	108	84.4	434	81.9	542	82.4	
Self-employment	2	1.6	42	7.9	44	6.7	
Officer	–	–	12	2.3	12	1.8	χ^2=6.912
Employee	14	10.9	30	5.7	44	6.7	p=0.14
Retired	4	3.1	12	2.3	16	2.4	
Father's profession							
No profession	8	6.3	16	3.0	24	3.7	
Self-employment	56	43.8	184	35.0	240	36.7	
Officer	16	12.5	48	9.1	64	9.8	χ^2 =6.698
Employee	24	18.8	108	20.5	132	20.2	p=0.24
Retired	24	18.8	170	32.3	194	29.6	
Accommodation							
With family	20	15.6	168	31.7	188	28.6	
In dormitory	62	48.4	286	54.0	348	52.9	χ^2=19.804
At home with friends	46	35.9	76	14.3	122	18.5	p=0.00*
Family history of obesity							
Yes	74	57.8	254	48.1	328	50.0	χ^2=1.941
No	54	42.2	274	51.9	328	50.0	p=0.10
Smoking							
No	86	67.2	424	80.0	510	77.5	
Quit smoking	18	14.1	44	8.3	62	9.4	χ^2=4.869
Yes	24	18.8	62	11.7	86	13.1	p=0.08

Note: *Indicate statistical significance.

66.6% of university students reported consuming two main meals a day, 41.6% reported having one snack a day (p<0.05) and 49.2% admitted to skipping meals. Additionally, 66.3% of the students reported regularly having breakfast, 67.8% did not add salt to their meals, and 93.0% did not consume at least 5 portions of fruit and vegetables daily. Moreover, 61.1% did not engage in regular physical activity; and 70.2% believed they did not have an adequate and balanced diet (Table 2).

Table 2 – Nutritional habits of participants.

Nutritional habits	Male (n=128)		Female (n=530)		Total (n=658)		Statistical test
	n	%	n	%	n	%	
Main meals/day							
1	24	18.8	70	13.2	94	14.3	χ^2=7.005 *p*=0.03*
2	94	73.4	344	64.9	438	66.6	
3	10	7.8	116	21.9	126	19.1	
Snacks/day							
No	22	17.2	44	8.3	66	10.0	χ^2=22.816 *p*=0.00*
1	78	60.9	196	37.0	274	41.6	
2	22	17.2	244	46.0	266	40.4	
3	6	4.7	46	8.7	52	7.9	
Skipping meal							
Yes	72	56.3	252	47.5	324	49.2	χ^2=1.607 *p*=0.44
Sometimes	50	39.1	252	47.5	302	45.9	
No	6	4.7	26	5.0	32	4.9	
Regular breakfast							
Yes	78	60.9	358	67.5	436	66.3	χ^2=1.007 *p*=0.19
No	50	39.1	172	32.5	222	33.7	
Snacks before sleeping							
Yes	98	76.6	260	49.1	358	54.4	χ^2=15.723 *p*=0.00*
No	30	23.4	270	50.9	300	45.6	
Eating outside							
Yes	86	67.2	326	61.5	412	62.6	χ^2=0.710 *p*=0.24
No	42	32.8	204	38.5	246	37.4	
Consumption of at least 5 servings of vegetables and fruits/day¥							
Yes	4	3.1	42	7.9	46	7.0	χ^2=1.826 *p*=0.13
No	124	92.6	488	92.1	612	93.0	
Consumption of at least 3 glasses of milk and yogurt/day¥							
Yes	34	26.6	142	26.8	176	26.7	χ^2=0.001 *p*=0.54
No	94	73.4	388	73.2	482	73.3	
Adding salt to meal							
Yes	54	42.2	158	29.8	212	32.2	χ^2=3.616 *p*=0.04*
No	74	57.8	372	70.2	446	67.8	
Doing regular physical activity§							
Yes	54	42.2	202	38.1	256	38.9	χ^2=0.360 *p*=0.32
No	74	57.8	328	61.9	402	61.1	
Thoughts on adequate and balanced nutrition							
Yes	36	28.1	160	30.2	196	29.8	χ^2=0.105 *p*=0.43
No	92	71.9	370	69.8	462	70.2	

Note: *Indicate statistical significance. §At least 150 minutes of physical activity per week; ¥Recommended portion amounts according to Türkiye Nutrition Guideline.

The average BMI values of the university students was 22.56±3.44 kg/m^2, with 69.0% of them classified as "normal" according to BMI criteria. It was determined that students in the "pre-obesity/obesity" group, based on BMI classification, had significantly higher values for WC, HC, MUAC, NC, and TSF compared to those in "underweight" and "normal" group (p<0.001). In addition, the students in the "pre-obesity/obesity" group exhibited significantly higher scores on the PSS-14 (p<0.001) and DEBQ (p<0.001) compared to other two groups (Table 3).

There is a positive correlation between university students' BMI, HC, MUAC and TSF values, and PSS-14 and DEBQ (p<0.001), also a significant positive correlation between PSS-14 and DEBQ (r=0.109) (p<0.05). A strong positive correlation (p<0.001) was found between DEBQ sub-dimensions and BMI, TSF, MUAC, WC and HC (p<0.001); in addition to these, there was a strong positive correlation (p<0.001) of external eating with PSS-14 (r=0.236) and NC measurements (r=0.180) (Table 4).

Table 3 – Anthropometric measurements, Perceived Stress Scale-14 and Dutch Eating Behavior Questionnaire scores of participants according to body mass index classification.

Variables	BMI group				*F*	*p*	Difference*
	Underweight (n=58)[1]	Normal weight (n=454)[2]	Pre-obesity/Obesity[3] (n=146)	Total (n=658)			
	$\overline{X}$±SD	$\overline{X}$±SD	$\overline{X}$±SD	$\overline{X}$±SD			
Anthropometric measurements							
WC (cm)	68.10±4.32	76.93±7.47	88.60±8.04	78.74±9.39	101.73	<0.001	1-2, 1-3, 2-3
HC cm)	8X7.58±3.43	95.51±4.56	107.37±5.21	97.44±7.38	252.96	<0.001	1-2, 1-3, 2-3
MUAC cm)	21.37±1.57	24.81±2.50	28.91±2.54	25.42±3.21	121.15	<0.001	1-2, 1-3, 2-3
NC (cm)	30.37±1.89	32.24±2.49	34.53±2.84	32.58±2.77	34.77	<0.001	1-2, 1-3, 2-3
TSF (mm)	10.98±3.26	14.93±5.07	19.04±5.84	15.49±5.56	30.02	<0.001	1-2, 1-3, 2-3
DEBQ total score	71.24±17.27	87.47±18.67	98.17±15.39	88.41±19.12	24.57	<0.001	1-2, 1-3, 2-3
Restrained eating	22.51±6.29	25.94±8.24	27.97±6.96	26.09±7.92	5.17	<0.001	1-3
Emotional eating	25.96±10.58	33.49±12.91	39.31±10.94	34.12±12.76	13.13	<0.001	1-2, 1-3, 2-3
External eating	22.75±4.61	28.03±5.30	30.89±4.94	28.20±5.55	26.05	<0.001	1-2, 1-3, 2-3
PSS-14 total score	25.09±3.36	27.37±7.24	29.85±5.28	27.72±6.72	6.38	<0.001	1-3

Note: *Post-hoc Bonferroni correction (p<0.05/3≈0.0166). WC: Waist Circumference; HC: Hip Circumference; MUAC: Mid-Upper Arm Circumference; NC: Neck Circumference; TSF: Triceps Skinfold Thickness; DEBQ: Dutch Eating Behavior Questionnaire; PSS: Perceived Stress Scale. Body Mass Index Group: [1]Underweight, [2]Normal weight, [3]Pre-obesity/Obeesity.

Table 4 – Correlation between anthropometric measurements, Perceived Stress Scale-14 and Dutch Eating Behavior Questionnaire scores.

Variables	PSS-14 total score		DEBQ total score	
	r[a]	*p*	r[a]	*p*
BMI (kg/m^2)	0.245	**<0.001**	0.431	**<0.001**
WC (cm)	0.105	0.052	0.284	**<0.001**
HC (cm)	0.223	**<0.001**	0.389	**<0.001**
MUAC (cm)	0.248	**<0.001**	0.309	**<0.001**
NC (cm)	0.076	0.176	0.122	**<0.05**
TSF (mm)	0.178	**<0.001**	0.271	**<0.001**

Note: [a]Pearson's correlation coefficient. BMI: Body Mass Index, WC: Waist Circumference; HC: Hip Circumference; MUAC: Mid-Upper Arm Circumference; NC: Neck Circumference; TSF: Triceps Skinfold Thickness; DEBQ: Dutch Eating Behavior Questionnaire; PSS: Perceived Stress Scale. Bold text indicates statistical significance.

Table 5 shows the results of the mediation model analysis. The link between elevated PSS and high BMI was significant (β=0.438 95% CI [0,249, 0.627], p<0.001). After controlling for the indirect effect of the mediators, the association between the variables remained significant, albeit with a weakened effect (β=0.358 95% CI [0.185, 0.531], p<0.001). Significant positive associations were observed between PSS and DEBQ (β=1.081 95% CI [0.005, 2.158], p<0.05), indicating that a high perceived stress score was associated with negative eating behaviors. Furthermore, a significant positive correlation was found between DEBQ (β=0.073 95% CI [0.056, 0.091], p<0.001) and BMI, suggesting that negative eating behaviors were related to higher BMI.

Table 5 – Multiple mediation model based on the perceived stress and body mass index.

Variables	B	SD	95% CI	*p*-value
Model a				
PSS → BMI	0.438	0.096	(0,249, 0.627)	**<0.001**
Model b				
Effect of predictor on outcome				
PSS → BMI	0.358	0.087	(0.185, 0.531)	**<0.001**
Effect of predictor on mediators				
PSS → DEBQ	1.081	0.057	(0.005, 2.158)	**0.048**
Effect of mediators on outcome				
DEBQ → BMI	0.073	0.008	(0.056, 0.091)	**<0.001**
Indirect effects				
BMI	0.079	0.044	(-0.040, 0.174)	>0.05

Note: PSS: Perceived Stress Score; BMI: Body Mass Index, DEBQ: Dutch Eating Behavior Questionnaire. Bold text indicates statistical significance.

DISCUSSION

The aim of the present study was to investigate the relationship between perceived stress, eating behavior and anthropometric measurements indicative of obesity through a cross-sectional design. Our aim was to identify potential factors potential factors underlying previous findings and suggest innovative methodologies for future clinical analyses.

Our findings showed higher perceived stress levels among pre-obesity/obese individuals compared to others (Table 3) with notable positive correlations observed between perceived stress and increases in BMI, HC, MUAC, TSF (Table 4). However, there have been relatively few studies examining the relationship between perceived stress and anthropometric measurements related to obesity. In contrast to the present results, a study of 5077 individuals demonstrated no association between perceived stress and being pre-obese or obese. Additionally, the number of stressors had a stronger effect on risk of obesity and was significantly associated with WC and percentage body fat in pre-obesity groups [37]. In another study, study involving 6022 Korean individuals, it was noted that the relationship between perceived stress and obesity status exhibited a U-shaped pattern, with a higher effect of stress on underweight individuals (OR 1.7; 95% CI 1.26, 2.17) or obese individuals (OR 1.06; 95% CI 0.88, 1.29) compared to those with normal weight [38]. Boyce and Kuijer [39] in a seven-month study with freshman university students, found that those with elevated stress levels and high initial BMIs gained weight, whereas students with elevated stress levels and low initial BMIs lost weight by the end of their first year at university. Regarding the relationship between perceived stress and anthropometric measurements of university students, in another study was found that perceived stress was positively related to weight alterations, BMI and WC in males at the end of the first semester compared to baseline [40]. A five-year follow-up study in Australia revealed that perceived stress was linked with BMI, it had a significant relationship with healthy behaviors including daily energy intake and physical activity [41]. Hence, the longer stress is perceived, the risk of obesity increases dramatically. In addition, higher relationships between perceived stress and weight progress among individuals who were normal weight, pre-obesity, or younger, which might explain why we discovered such significant links in our sample (mean age of 20.9 years, with the majority having a normal BMI) while others did not. Consequently, our outcomes are consistent with prior studies indicating a comparable link between stress and obesity [42-44]. In the present study, these findings indicated that perceived stress is a significant factor for anthropometric measurements associated with obesity.

Emotional eating is characterized by overeating as a means of coping with negative emotions like stress, anxiety, depression and anger. Emotional eating has been reported to be more frequent especially in youth years when stress is more common. Extrinsic eating, on the other hand, occurs in individuals who are more sensitive to the influence of external factors, such as the appearance and smell of food, rather than internal factors like hunger. In particular, the obesogenic environment is known to stimulate external eating behaviors. Restricted eating paradoxically can lead to weight gain individuals may consume excessive food when fasting or restricting their food intake [45].

In studies examining the eating behaviors of university students in our country, significant differences were found between the underweight group and the normal and obese groups in terms of emotional and restrained eating scores ($p<0.05$). Additionally, a positive and significant correlation was found between BMI and restrained eating and emotional eating scores [46]. In another study [47], while no significant difference was found in university students in terms of emotional eating behavior according to BMI classification; the external eating score of the obese group was lower

compared to the underweight, normal and pre-obesity according to BMI; the restrained eating score of the underweight group was found to be lower than the other three groups (p<0.001). Aydın-Çil et al. [48] determined that there was a positive relationship between emotional eating, restrained eating sub-dimensions and anthropometric measurements, but the effect of external eating on anthropometric measurements was not significant. Ayyıldız et al. [49] reported that restrained eating and emotional eating scores were higher in pre-obesity and obese individuals compared to those with normal body weight (p<0.001); and there was a significant positive correlation between BMI and restrained eating and emotional eating subgroups. Elçi-Boğaz et al. [50] found that restrained eating behavior was significantly higher in pre-obesity students compared to normal weight and obese students. In another study reported that emotional eating score is higher in underweight students compared to obese individuals; the restrained eating behavior score was higher in obese students, and the external eating behavior score was higher in underweight students [51].

In a prospective study by van Strien et al. [52] it was determined that restrained eating increased BMI. In a study Benbaibeche et al. [53] it was determined that the external eating and emotional eating scores of obese individuals were higher than normal-weight individuals. In present study, when eating behaviors were evaluated according to BMI; it was observed that as BMI increased, restrained, emotional, and extrinsic eating scores also increased significantly (p<0.05). In addition, a significant positive correlation was found between the DEBQ total score and WC, HC, MUAC and TSF, which are used in addition to BMI in the evaluation of obesity (p<0.001). The inconsistency in the results obtained from the studies may attributed to various factors, including the diverse racial backgrounds of the study populations, differences in environmental factors, variations in nutritional habits and eating cultures, as well as variances in sociodemographic and economic characteristics.

In the presence of negative emotions such as depression and anxiety, obese individuals may exhibit emotional eating behaviors characterized by loss of control over food intake and increased food consumption as a means to alleviate negative emotions [45]. Consistent with this, our study found significant differences between underweight students and those with normal weight or pre-obesity/obese in terms of emotional eating, restrained eating and external eating behavior (p<0.05). It is worth noting that individuals with restrained eating behaviors may, under certain circumstances (such as emotional or cognitive triggers), deviate from their restrictive eating patterns and engage in excessive eating behavior [54].

Studies in the literature, have consistently shown a significant positive correlation between students' scores on restrained eating behavior and emotional eating behavior scores reveals that restrained eating behavior is closely related to emotional eating behavior [55,56]. As a matter of fact, the point where people with restrained eating have difficulty losing weight is the existence of periods of overeating that occur after a period of restriction in food intake [57]. In addition, it has been observed that students with obesity tend to exhibit high scores on emotional eating measures. While emotions can trigger increased food consumption in individuals with emotional eating tendencies, they also tend to alleviate the restrictions associated with restrained eating style [58,59]. Additionally, research suggests that individuals with obesity may be more responsive to external cues, such as food-related smells or images, potentially leading to higher food consumption [54,60].

Associated with stress eating might be a contributing reason to the obesity pandemic. Järvelä-Reijonen et al. [61] reported that high perceived stress was related to eating behavior traits, which may contribute to difficulties in weight management. As a result of another study conducted with 65 234 adults found that elevated perceived stress was linked to obesogenic eating behaviors such as greater intake of energy from fat, high-fat snacks, and fast-food [62]. In a study conducted by

Ohara et al. [63], it was discovered that anthropometric situation or emotional variables changed in eating behavior among university students. An investigation designed to assess the relationship between stress, eating behavior, and food intake in a college sample, researchers observed that students with elevated levels of stress had greater scores for emotional eating and uncontrolled eating, as well as a higher frequency of consuming fast-food snacks and sandwiches [64]. In line with previous studies, it was observed that perceived stress worsened with eating behaviors (β=1.081 95% CI [0.005, 2.158], p<0.05) in the present study. Similarly, it was established that eating behaviors played a somewhat mediator role in the effect of perceived stress on BMI (β=0.073 95% CI [0.056, 0.091], p<0.001). It is thought that this result may be due to high perceived stress-induced uncontrolled eating behaviors of individuals.

CONCLUSION

A positive relationship was found between university students' BMI, HC, MUAC and TSF values, and PSS-14 and DEBQ, indicating an important positive association between PSS-14 and DEBQ. Taking the findings of this study as a whole, it is seen that perceived stress, restricted, emotional and external eating had an effect on the increase in BMI and obesity, with eating behavior playing a mediating role in this relationship. Improving individuals' methods for managing stress may lead to better eating behaviors and reduced obesity risk. Our results provide evidence that both nutritional habits, eating cultures as well as sociodemographic and economic characteristics should be considered when explaining increased BMI and obesity, as individuals may prefer beneficial and detrimental foods in various contexts. Further studies focusing on the emotional, external, and restrained eating behaviors of individuals, as well as eating cultures, sociodemographic, and economic characteristics, can present more comprehensive and consistent data on individuals' nutritional habits and obesity risk.

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