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ARTICLE

Behavior, Psychology and Sociology

Relationship of perceived depression, stress, anxiety levels and hedonic hunger

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BACKGROUND: This study was designed to explore relationship of perceived depression, anxiety and stress (DAS) levels and hedonic hunger in adults.
METHODS: A cross-sectional survey included questions about some socio-demographic characteristics, Power of Food Scale (PFS-Tr) and Depression Anxiety Stress Scales (DASS-21) was sent via an online platform. Self-reported weight and height were also questioned. A total of 4112 adult volunteers between the ages of 18–65 years participated in this study. 72.3% of them were female.
RESULTS: The prevalence of moderate to extremely severe depression, anxiety, and stress was reported as 31%, 34% and 13% respectively. Hedonic hunger and perceived DAS levels were higher in females ($p < 0.001$). Hedonic hunger was positively correlated with perceived DAS ($p < 0.001$). While body mass index (BMI) was positively associated with PFS-Tr total score, food available and food present; negatively associated with food tasted. Body mass index was negatively correlated with perceived DAS. Hedonic hunger and perceived DAS levels decreased with increasing age. Females were more prone to both hedonic hunger and perceived DAS. About one in three participants reported moderate to extremely severe levels of depression and anxiety. Greater perceived DAS levels are associated with hedonic hunger. Underweight individuals had higher levels of perceived DAS.
CONCLUSION: To our knowledge, this is the first study to examine the prevalence and predictors of perceived DAS levels and hedonic hunger in the Turkish adult population. The findings of the study suggest that the predictors such as age, sex and BMI are a part of psychological well-being and hedonic hunger.

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INTRODUCTION

Hunger and food consumption are organized by two different systems called "homeostatic" and "hedonic" hunger. Homeostatic hunger is defined as the state of hunger caused by the depletion of energy stores physiologically [1]. The desire to consume foods beyond homeostatic need is called "hedonic hunger". Hedonic hunger refers to the increase in appetite associated with the expectation of pleasure from foods as a result of the desire to eat unavailable foods without the metabolic need [2]. Consumed foods are typically the products with high-density energy, salt, sugar and fat content [3, 4]. Neurobiological studies in both humans and animals show that when a palatable food, usually high in fat, salt or sugar is consumed, activation in reward-related areas of the brain increases, resulting in dopamine release. The levels of dopamine released are related to the feeling of happiness after consuming that food. The fact that the individual aims to take pleasure from foods makes it difficult to achieve food consumption control [5]. Continuous and frequent consumption of delicious foods causes an increase in obesity and obesity-related comorbidities (diabetes mellitus, hypertension, cardiovascular diseases, etc.) [6]. Obesity is a global epidemic and has been increasing at an alarming rate [7]. The increasing prevalence of obesity suggests that the increase in food consumption of individuals may be caused not only by the need for energy but also pleasure formed by foods [8]. Despite the evidence supporting the relationship between hedonic hunger and weight gain, most studies do not report a significant relationship between BMI and hedonic hunger [9, 10].

Changes in the emotional state of individuals can also affect food consumption and preferences. Emotional states affect the quantity and quality of consumed foods; besides food consumption also leads to emotional consequences that can affect subsequent food choices [11]. Although it is known that emotional states such as depression, stress and anxiety can change eating habits, it is controversial how they affect them. In the presence of these emotional states, while some individuals' appetite is suppressed and food consumption decreases, the reaction of others may be consume high-energy foods instead of avoiding them [12, 13]. When food is consumed to cope with negative emotions, this may lead to the emergence of hypersensitivity to food over time and trigger hedonic overeating [14]. The fact that emotional states and an environment full of delicious foods pave the way for the formation of hedonic hunger triggers the increase in the obesity epidemic and may reduce the success of the treatment. For this

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reason, it is important to evaluate perceived DAS levels and hedonic hunger behaviours and to determine the factors that affect them, in terms of studies regarding the treatment and prevention of obesity and comorbid diseases.

Studies on hedonic hunger in the literature have focused on its effect on obesity. As far as we know, there is no study specifically examining the relationship and the predictors of perceived DAS levels and hedonic hunger in the Turkish adult population. This study is planned to fill this gap in the literature and to contribute to the literature on Turkish society. Our findings may provide a framework for understanding hedonic hunger behaviours and DAS levels as well as their predictors, in obesity prevention.

MATERIALS AND METHODS

Subjects

This cross-sectional study was conducted with 4112 voluntary adults between the ages of 18–65 and living in Türkiye. Before the study, a power analysis was performed using the G*Power software to determine the number of individuals to be included in the sample. Based on alpha ($\alpha = 0.05$), power ($1 - \beta = 0.80$), and the considered effect size, the minimum required sample size was calculated as 1320 participants, Every participant was informed about the content of the study and was able to access the questionnaire form after agreeing to participate in the study. Inclusion criteria: 1) residing in Türkiye, 2) being 18–65 years old 3) not using drugs that affect appetite and mental status, 4) without a diagnosis of psychological and eating disorders. Those, participants who reported that they were pregnant or breastfeeding, who did not volunteer to participate in the study, did not fill the questionnaire completely and were not in the determined age range, were excluded from the study.

Data collection

The study data were obtained through the Google Forms questionnaire form that is prepared online. The online questionnaire link was conveyed through e-mail and social media networks such as WhatsApp and Instagram. The questionnaire consisted of 5 parts. In the first part, participants' sociodemographic characteristics such as age, sex, educational level, marital status, employment status and average income level were questioned. The second part included questions regarding the status of smoking and alcohol use. The third part included self-reported body weight and height values. The fourth part included the Power of Food Scale (PFS-Tr), and the last part included the Depression, Anxiety, and Stress Scale (DASS-21).

Anthropometric measurements

The body weight (kg) and height (cm) values of the individuals were obtained based on their statements. The body mass index (BMI) value was calculated by dividing body weight (kg) by the square of height (m^2). According to the World Health Organization (WHO), BMI classification, individuals are grouped as follows: <18.5 kg/m^2 underweight, 18.5–24.9 kg/m^2 normal weight, 25.0–29.9 kg/m^2 people with overweight and ≥30 kg/m^2 people with obesity [15].

Power of food scale (PFS-Tr)

Power of Food Scale (PFS-Tr) was developed by Lowe et al. [16] to evaluate the psychological effect of different food environments and used to evaluate hedonic hunger. Moreover, it is a measure of individual differences created by thoughts, emotions and desires about appetite in environments where delicious foods are abundant and constantly available. The original scale consists of 15 questions. The Turkish validity and reliability study of the scale was conducted by Ülker et al. [17]. The Turkish version of the scale consists of 13 questions. It is evaluated according to 5-point Likert Scale. Four points are obtained as three subscale scores and a total scale score. The evaluation of PFS-Tr consists of 3 sub-evaluations: total score and food available, food present and food tasted. The first one is the food available subscale that evaluates general thoughts [1, 2, 9, 10] about foods. The second one is food present subscale that evaluates the attractiveness to food that the individual has direct access to (3, 4, 5 and 6). The third subscale is food tasted which consists of items (7, 8, 11, 12 and 13) evaluating desire/pleasure obtained from foods when they are first tasted. Total and subscale scores of PFS-Tr are obtained by adding item scores and dividing them by the number of items. High scores indicate a high tendency to hedonic hunger.

Table 1. General characteristics of individuals (n:4112).

General characteristics		*n*	%
Sex	Male	1137	27.7
	Female	2975	72.3
Age (years) (X ± SD)	26.8 ± 9.37 (M: 28.6 ± 10.60, F:26.1 ± 8.76)		
Education level	Literate	25	0.6
	Primary school	65	1.6
	Secondary school	51	1.3
	High school	450	10.9
	University	3357	81.6
	Postgraduate	164	4.0
Marital status	Single	3065	74.5
	Married	1047	25.5
Smoking status	Yes	930	22.6
	No	2876	69.9
	Quit	306	7.4
Alcohol consumption	Yes	1023	24.9
	No	3089	75.1

M Male, *F* Female

Depression, anxiety, stress scale-21 (DASS-21)

Depression, Anxiety, Stress Scale-21 (DASS-21), which is used to determine the level of perceived DAS, was created by Lovibond et al. [18] as a short form of DASS-42 [19]. The Turkish validity and reliability of the scale was carried out by Sarıçam [20]. It consists of 3 subscales as DAS. There are 7 items for each factor. The scale has a 4-point Likert-type response format, and the lowest score that can be obtained from each scale is 0, while the highest score is 21. In addition, 0-4 points in the depression subscale are classified as normal, 5-6 mild, 7-10 moderate, 11-13 severe, and ≥14 as extremely severe. In the anxiety subscale, the scores of normal, mild, moderate, severe and extremely severe classifications are 0-3 points, 4-5 points, 6-7 points, 8-9 points and ≥10 points, respectively. In the stress subscale, this is 0-7 points, 8-9 points, 10-12 points, 13-16 points and ≥17 points, respectively.

Ethical consideration

The ethical approval of the study was obtained from the Non-Interventional Clinical Researches Ethics Committee of İzmir Katip Çelebi University (Decision date/No: 24.12.2020/1142). This study was conducted in line with the principles of the Declaration of Helsinki. Participants were informed about the purpose of the study, and their informed consent was obtained before the questionnaire.

Statistical analysis

The online questionnaire data obtained at the end of the study were analysed by transferring from excel format to SPSS 24 (Statistical Package for Social Sciences) program. Whether the numerical data were normally distributed was examined through Kolmogorov Smirnov and Shapiro Wilk tests. In the study, descriptive values were stated as number (n), percentage (%), arithmetic mean (X) and standard deviation (SD). The t-test was used to evaluate the difference between two independent groups. One-way ANOVA test was used to compare more than two variables. Bonferroni correction was used in post hoc analysis. Parametric Pearson correlation coefficient was used to evaluate the correlation of two quantitative data. All analyses were statistically evaluated at 95% confidence interval and the significance level was set at $p < 0.05$.

RESULTS

The evaluation regarding the general characteristics of the individuals is given in Table 1. A total of 4112 individuals participated in the study (27.7% male, 72.3% female). The mean age of males and females were 28.6 ± 10.60 years, and 26.1 ± 8.76

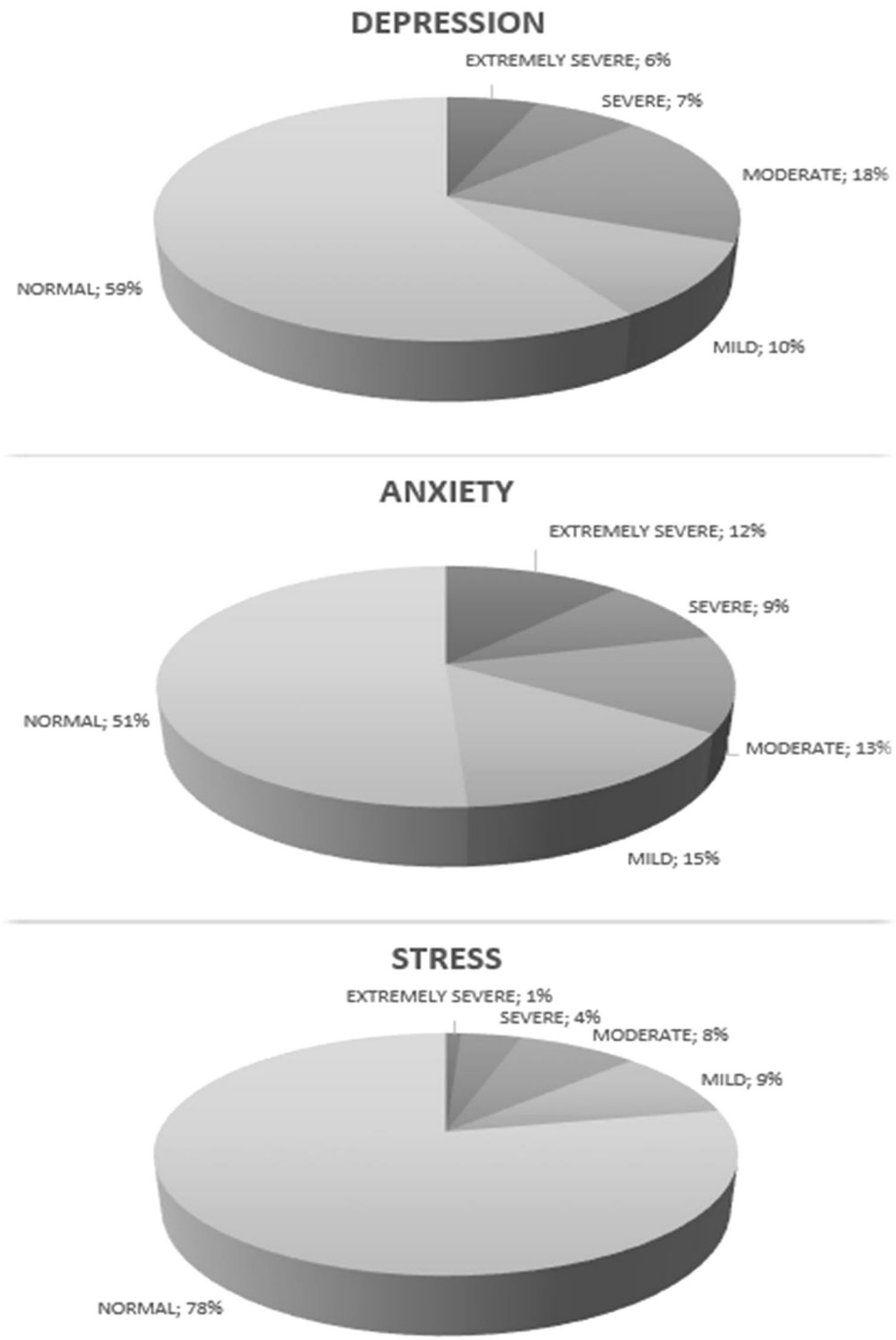


Fig. 1 Perceived depression, anxiety and stress levels of participants. The prevalence of perceived depression, anxiety, and stress levels of participants were given in Fig. 1.

years, respectively. The majority of the participants reported that they didn't smoke (69.9%) and did not consume alcohol (75.1%).

The prevalence of self-perceived depression, anxiety, and stress levels of participants according to DASS-21 was given in Fig. 1. The prevelance of moderate to extremely severe levels of depression, anxiety and stress was reported 31%, 34%, and 13% respectively.

The evaluation of BMI, PFS-Tr and DASS-21 scores by sex is shown in Table 2. The mean BMI value of males is higher than females ($p < 0.001$). While 49.1% of males and 64.2% of females have normal body weight according to the BMI classification, 47.8% of males and 24.7% of females with overweight and obesity. There is a significant difference between BMI classification by sex ($\chi^2 = 240.568$, $p < 0.001$) (data not shown). Power of food scale total scores and subscale scores of females (food available, food present and food tasted) are higher compared to males ($p < 0.001$). According to DASS-21, the prevalence of self-perceived depression, anxiety and stress levels higher in females ($p < 0.001$).

The evaluation of PFS-Tr and DASS-21 scores of individuals according to BMI classification is given in Table 3. According to the BMI classification, PFS-Tr total score of the underweight

Table 2. Evaluation of BMI, PFS-Tr, and DASS-21 scores according to gender.

	Male (n: 1137) X ± SD	Female (n:2975) X ± SD	Total (n:4112) X ± SD	*t*	*p*
BMI (kg/m^2)	25.2 ± 4.02	22.8 ± 4.26	23.5 ± 4.33	16.870	**<0.001**
PFS-Tr (Total)	3.1 ± 0.71	3.4 ± 0.70	3.3 ± 0.71	−10.404	**<0.001**
PFS-Tr (Food available)	2.7 ± 0.92	3.1 ± 0.93	3.0 ± 0.94	−9.619	**<0.001**
PFS-Tr (Food present)	3.2 ± 0.83	3.5 ± 0.80	3.4 ± 0.82	−8.871	**<0.001**
PFS-Tr (Food tasted)	3.3 ± 0.78	3.5 ± 0.74	3.5 ± 0.76	−7.975	**<0.001**
DASS-21					
Depression	4.3 ± 4.30	5.0 ± 4.70	4.8 ± 4.60	−4.497	**<0.001**
Anxiety	3.9 ± 3.75	4.5 ± 4.15	4.3 ± 4.05	−4.206	**<0.001**
Stress	3.9 ± 3.95	4.5 ± 4.33	4.3 ± 4.23	−4.094	**<0.001**

PFS-Tr Power of Food Scale, *DASS-21* Depression, Anxiety, Stress Scale, *BMI* Body Mass Index.
Bold values denote significant *p* values.

Table 3. Evaluation of PFS-Tr and DASS-21 scores according to BMI classification of individuals.

	BMI classification					
	Underweight *n* (%)	Normal weight *n* (%)	People with overweight *n* (%)	People with obesity *n* (%)	*F*	*p*
	366 (8.9%)	2467(60%)	936 (22.8%)	343 (8.3%)		
PFS-Tr (X ± SD)						
PFS-Tr (Total)	3.2 ± 0.71^a	3.3 ± 0.70^b	3.3 ± 0.73^b	3.4 ± 0.77^b	4.724	**0.003**
PFS-Tr (Food available)	2.7 ± 0.96^a	3.0 ± 0.92^b	3.0 ± 0.94^b	3.2 ± 0.96^c	22.520	**<0.001**
PFS-Tr (Food present)	3.2 ± 0.84^a	3.4 ± 0.80^b	3.4 ± 0.84^{b,c}	3.5 ± 0.83^c	8.700	**<0.001**
PFS-Tr (Food tasted)	3.6 ± 0.76^a	3.5 ± 0.75^a	3.4 ± 0.76^b	3.4 ± 0.83^b	7.627	**<0.001**
DASS-21						
Depression	5.7 ± 4.98^a	5.0 ± 4.58^b	4.2 ± 4.39^c	4.6 ± 4.69^{b,c}	12.457	**<0.001**
Anxiety	4.8 ± 4.32^a	4.5 ± 4.06^a	3.9 ± 3.86^b	4.3 ± 4.12^{a,b}	6.256	**<0.001**
Stress	5.1 ± 4.56^a	4.4 ± 4.22^b	3.8 ± 4.04^c	4.1 ± 4.31^{b,c}	10.138	**<0.001**

PFS-Tr Power of Food Scale, *DASS-21* Depression, Anxiety, Stress Scale, *BMI* Body Mass Index, ^{a,b,c} For groups of different letters $p < 0.05$, For groups of same letters $p > 0.05$.

individuals is lower than the other BMI groups. While the score of food available is higher in people with obesity than in other groups, the score of food present is higher in people with obesity than in normal and underweight individuals. The score of food tasted is similar in underweight and normal individuals and higher than people with overweight and obesity. Depression and stress states are significantly higher in underweight individuals compared to other groups, while anxiety score is higher in underweight individuals compared to people with overweight.

Table 4 shows the correlation among age, BMI, PFS-Tr and DASS-21. Total and subscale scores of PFS-Tr show a significant positive correlation with DAS levels ($p < 0.001$) and also show a significant positive correlation among themselves ($p < 0.001$). Body mass index value has a positive correlation with PFS-Tr total score, food available and food present, while there is a negative correlation between food tasted and DAS levels ($p < 0.001$). Age has a positive correlation with BMI and negative correlation with PFS-Tr scores and DAS levels ($p < 0.001$).

DISCUSSION

The aim of this study was to evaluate of relationship between predictors of hedonic hunger and perceived DAS levels among Turkish adults. The main findings of this study are summarized as follows. It was determined that moderate to extremely severe levels of perceived depression and anxiety were detected in approximately one in three participants. However, the level of perceived stress was lower (13%). Hedonic hunger was significantly positively correlated with perceived DAS. Sex, age and BMI were factors independently correlated with hedonic hunger and perceived DAS.

The lifetime prevalence of major depression was found to be 10–25% in females and 5–12% in males [21]. In a study, depressive symptoms were found to be higher in females compared to males, and the risk of depression in females was reported to be 2 times higher than males [22]. Alexander et al. also revealed that anxiety and depressive disorders were more common in females [23]. In our study, approximately one out of every three participants reported moderate to extremely severe levels of perceived depression and anxiety. However, the level of perceived stress was lower (13%). Similarly, depression, stress and anxiety levels were observed to be higher in females.

Negative emotions such as stress, depression and anxiety are an important part of the hedonic system and can affect food intake and preferences in different ways [13, 24]. Individuals, who experience a depressive mood, prefer delicious "relaxing foods" to relieve their negative emotions [25]. The effects of foods, which give pleasure when consumed, on mood are also more positive. Generally, high-energy foods positively affect mood through neurotransmitter systems and hormones. Moreover, the taste of foods have a positive effect on emotional state by arousing pleasant feelings [26]. A study revealed that individuals with

Table 4. The correlation among age, BMI, PFS-Tr and DASS-21.

	1	2	3	4	5	6	7	8	9
1.BMI	1								
2.PFS-Tr (Total)	0.043*	1							
3. PFS-Tr (Food available)	0.115*	0.870*	1						
4. PFS-Tr (Food present)	0.087*	0.844*	0.629*	1					
5. PFS-Tr (Food tasted)	−0.084*	0.854*	0.595*	0.577*	1				
6. Depression	−0.086*	0.166*	0.142*	0.163*	0.124*	1			
7. Anxiety	−0.061*	0.181*	0.151*	0.152*	0.161*	0.742*	1		
8. Stress	−0.081*	0.173*	0.147*	0.154*	0.144*	0.781*	0.686*	1	
9. Age	0.441*	−0.212*	−0.158*	−0.149*	−0.234*	−0.191*	−0.121*	−0.152*	1

BMI Body Mass Index, *PFS-Tr* Power of Food Scale *$p < 0.001$. *Pearson correlation test

increased stress and anxiety levels had an increased tendency to consume excessively fatty and sugary foods [27]. In an experimental study conducted by triggering acute stress, Zellner et al. [28], revealed that stress directed individuals to a less healthy and more hedonic alternative (chocolate dragee) instead of a healthy option (grapes). In the present study, negative emotions such as depression, stress and anxiety were positively correlated with hedonic hunger ($p < 0.001$).

A high level of hedonic hunger indicates that the individual is more sensitive to the food environment and is psychologically more affected by foods [29]. Ewoldt [30] revealed that sex had a significant effect on hedonic hunger, and response to hedonic hunger was stronger in females than males. In another study, PFS-Tr and all subscale scores regarding hedonic hunger were found to be significantly higher in females compared to males [31]. Sex hormones such as estradiol on homeostatic control affecting nutritional behaviors differ in male and female individuals. Although high estradiol levels in females were found to provide longer fullness than males, the fact that females were more sensitive to environmental food clues was explained by the fact that hedonic hunger levels were higher compared to males [32]. Another reason why females' hedonic hunger is higher than males can be explained by the role of neural activity in response to food clues in reward-related areas of the brain. Females exhibit higher neural activation than males when exposed to food stimuli [33, 34]. In this study, we determined that the hedonic effect of foods on females is stronger, and females are more prone to hedonic hunger ($p < 0.001$). In addition, it was determined that especially females' food consumption increased with increasing stress. The preferred foods were shown to be more hedonic alternatives such as sausages, hamburgers, pizza, and chocolate. [35]. Similarly, Uçar et al. [36] reported that there was a stronger relationship between hedonic hunger and stress in female students compared to male students; as the level of stress increased, the level of hedonic hunger increased. When these findings are discussed together, it is suggest that negative moods such as depression, stress and anxiety may be associated with an increase in females' hedonic hunger levels.

It has been revealed that in the food preferences of people with obesity, the reward value of food has a directing role by skipping the homeostatic regulation mechanisms [37]. Exposure to stimuli (seeing foods, smelling foods, etc.) due to the diversity of foods in the environment affects people with obesity more [38]. Studies reveal that as BMI increases, PFS score also increases, i.e., as individuals' BMI increases, the pleasure is taken from foods also increases [1, 39]. Similarly, it was determined that there was a positive correlation among BMI, other sub-dimensions except food tasted and PFS-Tr total score [40]. In accordance with the literature, in this study, a significant positive relationship was found between BMI and individuals' total PFS-Tr score and food available and food present which are subscales of PFS-Tr and a significant negative relationship was found between food tasted and BMI ($p > 0.001$). A high score in the food tasted subscale in underweight individuals suggests that these individuals may be more prone to consuming delicious food. In the study conducted by Riberio et al. [41], it is underlined that hedonic hunger is not only a characteristic of people with obesity but also an important factor in terms of developing obesity.

Studies have shown that depression, stress and anxiety are higher in people with obesity [42, 43]. Contrary to these studies, our findings showed that underweight individuals had higher DAS levels than normal weight and people with overweight. Similar to our results, Barcın-Guzeldere et al. [44] reported that BMI was negatively associated with perceived stress score. These findings can be explained by individuals' different responses to stress [45]. Higher perceived stress in individuals with low BMI suggests that stress may suppress appetite. In addition, the fact that the majority of the participants in our study were women (72.3%) and the BMI of male was higher than that of female may be another factor explaining the difference between our findings and the literature.

Taste and other sensorial properties of foods can affect the sense of pleasure taken from foods, and a decrease is observed in taste sensitivity, taste threshold and smell functions with aging. A study suggested that the sense of taste decreased with increasing age [46]. In another study conducted on age and taste perception, it was revealed that older males preferred intense tastes compared to young individuals [47]. In our study, when the relationship between age and hedonic hunger was examined, it was determined that there was a significant negative relationship between them, and hedonic hunger decreased with increasing age (r: -0.212).

Data on the effect of age on DAS levels are not clear in the literature. The most common trend found was an initial increase and then a decrease in DAS levels with increasing age. Possible factors are decreased emotional sensitivity with age, increased emotional control and psychological immunization to stressful experiences [48, 49]. In our study, we determined that the perceived DAS levels decreased with increasing age.

STRENGTHS AND LIMITATIONS OF THE STUDY

This study has certain limitations. Firstly, since this is a cross-sectional study, it does not include individuals diagnosed with depression, stress or anxiety. Moreover, due to the properties of the scales used, individuals were listed according to the severity of their symptoms instead of being divided into diagnostic groups such as being in depression and not in depression. Therefore, the effect of symptoms on hedonic hunger in a spectrum was examined rather than making a comparison between diagnosed and undiagnosed individuals. Secondly, weight and height

measurement values were obtained according to the statements of the individuals. Thirdly, the individuals' food consumption was not questioned. Another limitation was that although we tried to reach more male participants, our sex distribution was not balanced. Despite these limitations, the findings of this study are noteworthy. To our knowledge, this is the first study to specifically examine the relationship and predictors of perceived DAS levels and hedonic hunger in the Turkish adults. Another strong point of this study is that all questionnaires used in the study were validated for the Turkish population. Thanks to its large sample size, this study provides preliminary data that can be used in future studies on the interaction between hedonic hunger and depression, anxiety and stress, and the factors affecting them.

CONCLUSION

In the modern world, food intake is associated not only with the need for energy and nutrients, but also with the easy availability of foods with high energy in every environment due to the presence of environmental food clues. Although choosing foods and consumption amounts are free decisions, they are affected by the reward value of foods. Even though many people have experienced hedonic hunger, some individuals are much more sensitive to environmental food clues. In this study, it was revealed that the factors causing differences in hedonic hunger sensitivity are individual differences such as sex, BMI, age and psychological factors such as depression, stress and anxiety. While the main factor triggering the crisis is obesogenic environment, it is not possible to solve the current obesity epidemic by focusing only on the treatment of people with obesity. We hope that this study will help develop strategies by understanding the predictors of DAS levels, and hedonic hunger.

DATA AVAILABILITY

The data that support the findings of this study are available from the corresponding author, TY, upon reasonable request.

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YT, AF, YMV, and AE were responsible for the study design. YT, and AF were responsible for data collection. YT, and AF were responsible for data analysis. The first draft of the manuscript was written by YT which was subsequently revised based on the input from all authors. All authors read and approved the final version of the manuscript.

COMPETING INTERESTS
The authors declare no competing interests.

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