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Relationship between mindful eating, hedonic hunger, and obesity

Relação entre alimentação consciente, fome hedônica e obesidade

Gökçe Ünal[1], Yasemin Açar[1], Sevtap Kabalı[1], Melahat Sedanur Macit-Çelebi[1], Zeynep Uzdil[1], Yasemin Ertaş-Öztürk[1]

[1] Ondokuz Mayıs University, Faculty of Health Sciences, Department of Nutrition and Dietetics. Samsun, Türkiye. Correspondence to: G ÜNAL. E-mail: <gokce.unal@omu.edu.tr>.

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ABSTRACT

Objective

Hedonic hunger leads to the development of obesity by encouraging overeating and a consequent increase in energy intake. Mindful eating is predicted to help maintain a healthy weight by reducing hedonic hunger levels. This study aimed to examine the association between mindful eating, hedonic hunger, and obesity in adults living in Türkiye.

Methods

This cross-sectional study was conducted between March and April 2023 using a face-to-face survey method among individuals aged 19-65 in Türkiye. Mindful eating was defined with the Mindful Eating Questionnaire. Higher scores on the scale indicate higher mindful eating. Hedonic hunger was determined using the Power of Food Scale. A higher Power of Food Scale score indicated a higher tendency towards hedonic hunger. Body weight, height, and waist circumference measurements were evaluated, and the body mass index was calculated. A 24-hour dietary recall was taken to determine the participants' energy and nutrient intake.

Results

A total of 787 volunteers (mean age: 31.2±11.9 years) participated. A one-unit increase in Mindful Eating Questionnaire total score was associated with a 0.81-unit decrease in Power of Food Scale total score (p<0.001) and a 134.38 kcal decrease in energy intake (p<0.01). Higher Mindful Eating Questionnaire total scores were associated with lower odds of having risk/high risk of health according to waist circumference (p<0.001) and waist/height ratio (p<0.05) and associated with lower odds of being obese (p<0.001).

Conclusion

Higher mindful eating is inversely associated with hedonic hunger, energy intake, and obesity in adults. Mindful eating can be beneficial for altering hedonic hunger and energy intake, thereby reducing obesity.

Keywords: Energy intake. Mindful eating. Nutrition. Obesity.

RESUMO

Objetivo

A fome hedônica conduz ao desenvolvimento da obesidade, encorajando o consumo excessivo de alimentos e o consequente aumento da ingestão de energia. Prevê-se que a alimentação consciente

ajude a manter um peso saudável, reduzindo os níveis de fome hedônica. Este estudo teve como objetivo analisar a associação entre a alimentação consciente, a fome hedônica e a obesidade em adultos residentes na Turquia.

Métodos

Este estudo transversal foi realizado entre março e abril de 2023 usando um método de pesquisa presencial entre indivíduos com idades entre 19 e 65 anos na Turquia. A alimentação consciente foi definida com o Mindful Eating Questionnaire. Pontuações mais elevadas na escala indicam uma alimentação mais consciente. A fome hedônica foi determinada com a Power of Food Scale. Uma pontuação mais elevada na Power of Food Scale indica uma maior tendência para a fome hedônica. Foram avaliadas as medidas de peso corporal, altura e perímetro da cintura e foi calculado o índice de massa corporal. Foi efetuado um registo alimentar de 24 horas para determinar a ingestão de energia e de nutrientes dos participantes.

Resultados

Participaram 787 voluntários (média de idade: 31,2±11,9 anos). Um aumento de uma unidade na pontuação total do Mindful Eating Questionnaire foi associado a uma diminuição de 0,81 unidades na pontuação total do Power of Food Scale (p<0,001) e a uma diminuição de 134.38 kcal na ingestão de energia (p<0,01). Escores totais de Mindful Eating Questionnaire mais altos foram associados a menores chances de ter risco/alto risco de saúde de acordo com a circunferência da cintura (p<0,001) e a relação cintura/altura (p<0,05), e associados a menores chances de ser obeso (p<0,001).

Conclusão

Uma alimentação consciente mais elevada está inversamente associada à fome hedônica, à ingestão de energia e à obesidade nos adultos. A alimentação consciente pode ser benéfica para alterar a fome hedônica e a ingestão de energia, reduzindo assim a obesidade.

Palavras-chave: *Ingestão de energia. Comer com atenção plena. Nutrição. Obesidade.*

INTRODUCTION

Mindful eating is defined as sustained attention to a sensory element of the eating experience (for example, taste) and non-judgmental (or non-evaluative) awareness of thoughts and feelings that are inconsistent with the sensory elements of the current eating experience [1]. Mindful eating has been associated with healthier eating [2], and helps weight loss through mindfulness-based interventions [3]. The literature suggests that mindfulness-based practices promote healthier eating behaviors, such as a reduction in sweet consumption and an increase in fruit and vegetable intake [4,5]. At the same time, studies have shown that mindful eating has various aspects, such as reducing excessive cravings for foods [6], overeating [5], and consumption of energy-dense foods [7]. Research suggests that mindful eating alters negative situations related to eating, helps slow down the rate of eating, and promotes feeling fuller with smaller portions [8].

Nutrient consumption is controlled by a homeostatic mechanism that encompasses the critical phases of hunger and fullness, designed to fulfill nutritional needs and regulate metabolism in the bloodstream and adipose tissue. Disruption in this homeostatic mechanism elevates food consumption and causes weight gain [9,10]. Hunger and the desire to consume food, arising from pleasurable stimuli rather than homeostatic hunger signals, are termed "hedonic hunger" [11]. Hedonic food consumption, aimed at alleviating or reacting to emotional states, facilitates the enjoyment of palatable foods, influences motivational or reward-punishment eating, and leads to excessive eating behaviors beyond the body's requirements [12,13] and thus increased energy intake [14,15]. The increase in hedonic hunger, coupled with a persistent increase in energy intake results in weight gain and obesity [16].

Mindful eating is a technique designed to diminish extrinsic motivations for eating and enhance the significance of food's sensory attributes and intrinsic motivations related to digestion [17].

Consequently, it may facilitate a slow change in eating behavior, reducing the influence of external stimuli, such as a favorite scent, thereby lessening the urge to eat in the absence of physiological hunger cues [18]. It was hypothesized that mindful eating could reduce hedonic hunger levels in individuals and lower calorie intake by reducing the consumption of palatable, high-energy foods, helping in the maintenance of a healthy body weight. Due to the limited research on the impact of mindful eating on hedonic hunger, this study aimed to examine the association between mindful eating, hedonic hunger and obesity in adults living in Türkiye.

METHODS

Participants

This cross-sectional study was conducted on adults living in Samsun, Türkiye, between March and April 2023. The Declaration of Helsinki principles were adhered to during this study, which was approved by the Clinical Research Ethics Committee of Ondokuz Mayıs University under decision number 2023/64. Compliance with the STROBE checklist for cross-sectional studies was maintained throughout the research. The study sample was determined using a convenience sampling method. Following the announcement of the study via various applications, face-to-face interviews were conducted with individuals who consented to participate. The participants were informed about the purpose of the study in writing and invited to take part. Informed consent was obtained from all of the participants.

The sample calculation of the study was performed with the G*power program (version 3.1), using the odds ratio (OR=-0.73) obtained as a result of logistic regression analysis between food consumption as a reason for emotional consolation and having overweight/obesity in the study by Ljubičić et al. [19]. According to the power analysis, the sample size was determined to be 688, with a power of 0.95 and a significance level of 0.05. Inclusion criteria were to be between the ages of 19-65, to be capable of completing the questionnaires themselves, and to be able to read and write in Turkish. Exclusion criteria were being pregnant, being hospitalized, and having perceptual impairment and communication problems. The study participants were intended to represent adults living in Türkiye. Since the region where the study was conducted had a high migration rate from different regions of Türkiye, it is thought to be generalizable to the whole society.

Procedure

Sociodemographic information, mindful eating, and hedonic hunger status of the individuals were determined by the questionnaire form. In addition, food consumption records and anthropometric measurements were collected.

Measures

Anthropometric measurements

Body weight, height, and waist circumference measurements were taken. The researchers used a weight scale with 0,1 kg resolution (Tanita BC 730, Tanita Corp.) to evaluate body weight. Participants were instructed to wear light clothing and no shoes during the weight measurement. A stadiometer with 1 mm resolution (Seca 213, Seca GmbH & Co. KG) was used for the height

measurement. The measurement was applied with arms loosely hanging at the sides with palms facing the thighs by lowering the horizontal bar of the stadiometer until the hair was compressed to the crown of the head. Participants were asked to remove any objects on the head and hair [20]. The Body Mass Index (BMI) was calculated using measurements of weight in kilograms (kg) and height in meters (m). The BMI classification of the World Health Organization for adults was accepted as <18.50 kg/m^2: underweight, 18.50–24.99 kg/m^2: normal, 25.00–29.99 kg/m^2: overweight, and ≥30.00 kg/m^2: obese [21]. Waist circumference was measured with the patients standing, arms crossed over the opposite shoulders, and the measuring tape with 1 mm resolution (Mesilife, Mesitaş Medical Industry Domestic And Foreign Trade Co.) firmly placed on the lateral surface of each ilium at the mid-axillary line [20]. Waist circumference measurements ≥80 cm in women and ≥94 cm in men were considered at risk, and ≥88 cm in women and ≥102 cm in men were regarded as high risk [22]. A waist/height ratio of ≥0.5 was considered a risk [23].

Power of Food Scale

The Power of Food Scale (PFS) was used as a self-report measure of hedonic hunger. It was developed to evaluate individual differences in appetite for palatable foods when individuals were not deprived of nutrients and to measure the appetite urge to consume edible foods in nutrient-rich environments [24,25]. The Turkish validity and reliability study of the Power of Food Scale was conducted [26]. The PFS is a five-point Likert-type scale consisting of 13 items and three sub-factors, including food availability, food presence, and tasting food. Each item is scored between 1-5 (1: don't agree at all, 5: strongly agree). PFS total and subscale scores are obtained by summing the item scores and dividing the sum by the number of items. The maximum score that can be obtained from the scale is five, and the minimum score is one. Higher scores indicated a greater responsiveness to the food environment or a higher tendency towards hedonic hunger [24]. The Cronbach alpha coefficient of the PFS questionnaire was 0.852 in the current study.

Mindful Eating Questionnaire

The Mindful Eating Questionnaire (MEQ) was developed by Framson et al. [27] and adapted to Turkish by adding two new items suitable for Turkish culture by Köse et al. [28]. The MEQ is a five-point Likert-type scale (1: never, 5: always) comprising 30 items and seven sub-factors, including disinhibition, emotional eating, control of eating, focusing, eating discipline, mindfulness, and interference. When scoring the scale, the average of the total score and the average of each sub-dimension are calculated. The scale has a minimum score of one and a maximum score of five. Higher scores on the scale indicate higher mindful eating [28]. The Cronbach alpha coefficient of the MEQ was 0.793 in the current study.

Food Consumption Record

A 24-hour dietary recall was obtained through face-to-face interviews to determine food consumption. The participants were asked to report all of the food and beverages that they consumed from morning to evening. The participants' food consumption was measured using household scales (water glass, coffee cup, scoop, teaspoon, and tablespoon). The data of 24-hour dietary recalls were entered into the Turkish Nutrition Information System Program, BeBiS version 8.2, Pacific Company, Istanbul, Türkiye [29]. The amounts of energy and the percentages of carbohydrates, protein, and fat were calculated using the program.

Data analysis

The data of this study was evaluated using IBM SPSS Statistics for Windows 24.0 (IBM Corp., Armonk, NY, USA). Categorical variables were given as the number (n) and percentage (%), and descriptive variables were presented as the mean ± Standard Deviation (SD). The normality of the data was examined with Skewness and Kurtosis tests. When the test statistics are between -1 and +1, it is accepted to be normally distributed. Statistical requirements were fulfilled in logistic regression tests. The differences in the MEQ total score according to the characteristics of the participants were performed with the independent samples *t*-test and the one-way analysis of variance (One-Way ANOVA) test followed by the Bonferroni post hoc test. Mindful eating is an independent variable, and hedonic hunger, obesity, energy, and percentage of nutrients are dependent variables in this study. Linear regression analyses were used to evaluate the effect of the MEQ on the PFS, energy, and macronutrients. Binary logistic regression analyses predicted the effect of the MEQ on obesity and health-related risks with waist circumference, waist/height ratio, and BMI. Models were adjusted for sex, smoking status, and obesity in all of the regression analyses except Table 4, where the model adjusted for sex and smoking status only. $p<0.05$ was accepted as significant statistically.

RESULTS

Table 1 includes the characteristics of the study participants. A total of 787 individuals, 432 women (54.9%) and 355 men (45.1%) with a mean age of 31.2±11.9 years (age range 19-65 years) participated in the study. Most of the participants had high school or lower education (56.3%). Based on the waist/height ratio, 45.2% had obesity-related health risks. According to the BMI classification, 27.4% of the participants were overweight, and 13.6% were obese. The mean mindful eating score was higher among women ($p=0.001$). Participants with no risk according to the waist circumference and waist/height ratio had higher mindful eating scores ($p=0.001$ and $p=0.002$, respectively). Participants with obesity had lower mindful eating scores than those with normal weight and overweight according to the BMI classification ($p<0.001$).

Table 1 – Characteristics of the study participants (n=787).

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Variables	n (%) / mean±SD (Min - Max)	MEQ Total Score mean±SD	*p*
Sex			
Women, n (%)	432 (54.9)	3.34±0.46	0.001[1]
Men, n (%)	355 (45.1)	3.23±0.45	
Age (years), mean±SD (Min - Max)	31.2±11.9 (19-65)		
Age			
19-34 years, n (%)	524 (66.6)	3.27±0.46	0.303[2]
35-49 years, n (%)	180 (22.9)	3.32±0.45	
50+ years, n (%)	83 (10.5)	3.33±0.47	
Education			
High school and lower, n (%)	443 (56.3)	3.28±0.46	0.578[1]
University and higher, n (%)	344 (43.7)	3.30±0.46	
Marital status			
Married, n (%)	345 (43.8)	3.30±0.45	0.636[1]
Unmarried, n (%)	442 (56.2)	3.28±0.46	
Smoker			
Yes, n (%)	184 (23.4)	3.19±0.46	<0.001[1]
No, n (%)	603 (76.6)	3.32±0.45	

Table 1 – Characteristics of the study participants (n=787).

Variables	n (%) / mean±SD (Min - Max)	MEQ Total Score mean±SD	*p*
Waist circumference (cm), mean±SD (Min - Max), women	76.4±13.1 (55-117)		
Waist circumference (cm), mean±SD (Min - Max), men	91.9±13.4 (62-138)		
Waist circumference			
No risk, n (%)	483 (61.4)	3.34±0.45[a]	0.001[2]
Risk (women ≥80 cm; men ≥94 cm), n (%)	139 (17.6)	3.23±0.45[b]	
High risk (women ≥88 cm; men ≥102cm), n (%)	165 (21.0)	3.20±0.46[b]	
Waist/height ratio, mean±SD (Min - Max)	0.50±.08 (0.32-0.85)		
Waist/height ratio			
No risk, n (%)	431 (54.8)	3.34±0.46	0.002[1]
Risk, n (%)	356 (45.2)	3.23±0.46	
BMI (kg/m^2), mean±SD (Min - Max)	24.7±4.7 (15.4-58.5)		
BMI classification			
Underweight, n (%)	37 (4.7)	3.30±0.46	<0.001[2]
Normal, n (%)	427 (54.3)	3.33±0.44[a]	
Overweight, n (%)	216 (27.4)	3.31±0.45[a]	
Obese, n (%)	107 (13.6)	3.29±0.46[b]	
Power of Food Scale, mean±SD (Min - Max)	3.20±0.70 (1.15-4.85)		

Note: [1]Independent samples *t*-test results; [2]One-way analysis of variance followed by Bonferroni post hoc test. Different letters indicate differences between groups after post hoc tests (Bonferroni test results). BMI: Body Mass Index; MEQ: Mindful Eating Questionnaire; SD: Standard Deviation.

Table 2 depicts the multiple regression estimates for the PFS (total and sub-scales) by the MEQ (total and subscale scores) after adjusting for sex, smoking status, and obesity. A one-unit increase in the MEQ total score was associated with a 0.81-unit decrease in the PFS total score (p<0.001). A one-unit increase in the MEQ total score was associated with a 1.05, 0.98, and 0.49-unit decrease in the food availability, food presence, and tasting food components of the PFS, respectively (p<0.001).

Multiple regression estimates for the energy intake and carbohydrate, protein, and fat percentages by the MEQ (total and subscale scores) are reported in Table 3. A one-unit increase in the MEQ total score was associated with a 134.38 kcal decrease in energy intake. A one-unit increase

Table 2 – Multiple regression estimates for Power of Food Scale (total and sub-scale scores) – dependent variables by Mindful Eating Questionnaire (total and subscale scores) – independent variables (n=787).

Variables	Total PFS			Food availability			Food presence			Tasting food		
	B (CI 95%)	β	*t*	B (CI 95%)	β	*t*	B (CI 95%)	β	*t*	B (CI 95%)	β	*t*
MEQ total score	-0.81 (-0.91, -0.72)***	-0.53	-17.10	-1.05 (-1.17, -0.93)***	-0.53	-17.34	-0.98 (-1.09, -0.87)***	-0.55	-18.22	-0.49 (-0.61, -0.37)***	-0.29	-8.22
Disinhibition	-0.46 (-0.51, -0.41)***	-0.54	-17.79	-0.59 (-0.65, -0.52)***	-0.54	-17.76	-0.50 (-0.56, -0.44)***	-0.51	-16.40	-0.32 (-0.39, -0.26)***	-0.35	-10.18
Emotional Eating	-0.33 (0..38, -0.28)***	-0.46	-14.15	-0.42 (-0.48, -0.36)***	-0.46	-14.01	-0.38 (-0.43, -0.33)***	-0.46	-14.06	-0.22 (-0.28, -0.17)***	-0.28	-7.88
Control of Eating	-0.23 (-0.28, -0.17)***	-0.31	-8.54	-0.31 (-0.37, -0.24)***	-0.33	-9.18	-0.27 (-0.33, -0.21)***	-0.32	-8.84	-0.13 (-0.18, -0.07)***	-0.16	-4.13
Focusing	-0.04 (-0.15, 0.07)	-0.03	-0.712	-0.08 (-0.22, 0.07)	-0.04	-1.06	-0.15 (-0.28, -0.03)*	-0.08	-2.35	0.08 (-0.04, 0.20)	0.05	1.26
Eating Discipline	-0.12 (-0.19, -0.06)***	-0.13	-3.53	-0.20 (-0.29, -0.11)***	-0.16	-4.54	-0.24 (-0.31, -0.16)***	-0.21	-5.93	0.03 (-0.05, 0.11)	0.03	0.74
Mindfulness	-0.25 (-0.34, -0.16)***	-0.20	-5.49	-0.29 (-0.40, -0.17)***	-0.18	-4.92	-0.29 (-0.39, -0.19)***	-0.20	-5.55	-0.19 (-0.29, -0.09)***	-0.14	-3.66
Interference	-0.28 (-0.33, -0.23)***	-0.36	-10.89	-0.32 (-0.39, -0.26)***	-0.33	-9.87	-0.35 (-0.41, -0.29)***	-0.39	-12.10	-0.18 (-0.24, -0.12)***	-0.21	-6.08

Note: *p<0.05; ***p<0.001. Models include control for sex, smoking status, and obesity (according to body mass index). B: Beta (unstandardized coefficient); CI: Confidence Interval; β: Standardized coefficient.

in the MEQ total score was associated with a 2.00% decrease in daily carbohydrate percentage and a 1.99% increase in daily fat percentage (p<0.01).

Table 3 – Multiple regression estimates for energy intake and carbohydrate, protein, and fat percentages (dependent variables) by Mindful Eating Questionnaire (total and subscale scores) –independent variables (n=787).

Variables	Energy (kcal)			Carbohydrate%			Protein%			Fat%		
	B (CI 95%)	β	*t*	B (CI 95%)	β	*t*	B (CI 95%)	β	*t*	B (CI 95%)	β	*t*
MEQ total score	-134.38 (-214,53, -54.22)**	-0.12	-3.29	-2.00 (-3.33, -0.68)**	-0.11	-2.98	0.09 (-0.53, 0.71)	0.01	0.28	1.99 (0.63, 3.34)**	0.10	2.87
Disinhibition	-54.19 (-98.25, -10,13)*	-0.09	-2.41	-0.74 (-1.46, -0.01)*	-0.07	-1.99	0.22 (-0.12, 0.56)	0.05	1.29	0.56 (-0.19, 1.30)	0.05	1.47
Emotional Eating	-22.74 (-60,52, 15,04)	-0.04	-1.18	-1.17 (-1.79, -0.56)***	-0.14	-3.74	0.05 (-0.24, 0.34)	0.01	0.32	1.12 (0.49, 1.76)**	0.13	3.48
Control of Eating	-44.93 (-84.66, -5,20)*	-0.08	-2.22	-0.36 (-1.01, 0.30)	-0.04	-1.07	-0.07 (-0.38, 0.23)	-0.02	-0.46	0.50 (-0.17, 1.18)	0.06	1.47
Focusing	-73.42 (-155,51, 8,67)	-0.06	-1.76	0.17 (-1.19, 1.52)	0.01	0.24	-0.45 (-1.08, 0.18)	-0.05	-1.40	0.31 (-1.08, 1.70)	0.02	0.44
Eating Discipline	-35.25 (-86,22, 15,71)	-0.05	-1.36	-1.18 (-2.02, -0.35)**	-0.10	-2.78	-0.03 (-0.36, 0.43)	0.01	0.17	1.18 (0.32, 2.04)**	0.10	2.70
Mindfulness	-81.61 (-148,11, -15,11)*	-0.09	-2.41	-0.53 (-1.62, 0.57)	-0.04	-0.94	0.25 (-0.27, 0.76)	0.04	0.94	0.30 (-0.83, 1.42)	0.02	0.52
Interference	-68.21 (-107.37, -29.05)**	-0.12	-3.42	-0.04 (-0.69, 0.61)	-0.01	-0.13	-0.11 (-0.41, 0.20)	-0.02	-0.68	0.11 (-0.56, 0.78)	0.01	0.33

Note: *p<0.05; **p<0.01; ***p<0.001. Models include control for sex, smoking status, and obesity (according to body mass index). B: Beta (unstandardized coefficient); CI: Confidence Interval; β: Standardized coefficient.

Table 4 indicates the binary logistic regression analyses predicting obesity and health-related risks with the waist circumference, waist/height ratio, and BMI classification by the MEQ (total and subscale scores). Higher MEQ total scores were significantly associated with lower odds of having risk/high risk of health according to the waist circumference (OR=0.55, 95% CI: 0.40–0.76, p<0.001), lower odds of having health risk according to the waist/height ratio (OR=0.68, 95% CI: 0.49–0.94, p<0.05) and also associated with lower odds of being obese according to the BMI classification (OR=0.34, 95% CI: 0.22–0.55, p<0.001). Disinhibition, control of eating, eating discipline, and mindfulness subscales scores were significantly associated with lower odds of having risk/high risk of health according to the waist circumference, having a health risk according to the waist/height ratio, and being obese according to the BMI classification.

Table 4 – Binary logistic regression analyses predicting obesity and health-related risks with waist circumference, waist/height ratio, and body mass index classification (dependent variables) by Mindful Eating Questionnaire (total and subscale scores) – independent variables (n=787).

Variables	Waist circumference (Risk/High risk)[1]	Waist/height ratio (Risk)[2]	BMI classification (Obese)[3]
	OR (CI 95%)	OR (CI 95%)	OR (CI 95%)
MEQ total score	0.55 (0.40-0.76)***	0.68 (0.49-0.94)*	0.34 (0.22-0.55)***
Disinhibition	0.79 (0.66-0.94)**	0.84 (0.70-1.00)*	0.54 (0.42-0.69)***
Emotional Eating	1.01 (0.87-1.18)	1.08 (0.93-1.26)	0.98 (0.79-1.22)
Control of Eating	0.62 (0.53-0.73)***	0.71 (0.61-0.84)***	0.54 (0.44-0.67)***
Focusing	1.3 (0.94-1.82)	1.21 (0.87-1.68)	1.47 (0.92-2.36)
Eating Discipline	0.75 (0.61-0.92)**	0.75 (0.61-0.92)**	0.70 (0.52-0.94)*
Mindfulness	0.58 (0.44-0.76)***	0.68 (0.52-0.88)**	0.37 (0.25-0.55)***
Interference	0.93 (0.80-1.09)	1.01 (0.86-1.18)	0.83 (0.67-1.04)

Note: *p<0.05; **p<0.01; ***p<0.001. [1]≥80 cm for women; ≥94 cm for men, [2]≥0.5, [3]≥30 kg/m^2. Models include control for sex and smoking status.

DISCUSSION

The present study sought to broaden the possible associations between mindful eating and hedonic hunger, obesity, energy, and macronutrient intake in adults. Minimal research has been conducted on this topic in the literature, particularly in Türkiye; hence, this study is one of the few, and it has significant findings. The main results of this study were as follows: Mindful eating scores are higher in women, non-smokers, and those with a waist circumference with no risk, waist/height ratio with no risk, and normal BMI. Mindful eating total scores are inversely correlated with hedonic hunger as well as energy intake. Furthermore, the higher total score for mindful eating and the following sub-scores: disinhibition, control of eating, eating discipline, and mindfulness are associated with reduced risk of health according to waist circumference and waist/height ratio, as well as reduced risk of obesity according to BMI. Briefly, higher mindful eating is inversely associated with hedonic hunger, energy intake, and obesity indicators in adults.

The analysis of mindful eating scores revealed that demographic variables exhibited variances, with women attaining higher scores in mindful eating. Contrary to these results, Ozkan and Bilici [30] reported no difference in mindful eating according to gender in adults aged 20–45 years. There are also other studies that have found no statistically significant difference between the MEQ total score according to gender in adults [31,32]. In the non-smokers, mindful eating scores were higher in the current study. Aside from this, Adams et al. [33] reported that mindfulness-based interventions may help reduce disordered eating in female smokers. Similar to Demirbaş et al. [31], no association was found between the total MEQ scores and age group, marital status, and educational status. Another study also did not find a difference according to age group (considered according to generations) [32]. Even so, there are studies that have reported that younger individuals are concerned about mindful nutrition [31,34]. In another study, a relationship was found between advanced age and awareness, and it was reported that with advancing years, it may become increasingly crucial for well-being to have a tendency to be present-oriented and adopt a non-judgmental attitude [35].

In line with the literature, it was observed that the participants with a normal BMI had higher total MEQ scores [31]. In the present study, higher MEQ total scores were associated with lower odds of having risk/high risk of health according to the waist circumference, lower odds of having health risk according to the waist/height ratio, and also associated with lower odds of being obese according to the BMI classification. Obesity is a multifactorial disease, and several mechanisms might be involved in this outcome. The simplest definition of obesity is the imbalance between energy intake and expenditure; thus, it can be considered that the findings herein support this association. Hence, energy intake was negatively associated with the MEQ total score, as well as disinhibition, control of eating, mindfulness subscales, and interference subscales. Fisher et al. [36] showed that a brief mindful attention induction could reduce food intake even when craving and hunger were experienced. Additionally, Allirot et al. [37] reported a decrease in high-energy-dense foods and energy intake after single mindful eating induction in adult women. In that study, the reduction in high-energy food consumption following the introduction of mindful eating also led to considerably reduced intakes of fat and protein when compared to the controls, but not of carbohydrates [37]. Contrary to this, the current study found that lower carbohydrate intake and higher fat intake (percentages) were associated with higher MEQ total scores. The increase in palatable, highly processed foods that are high in fat and sugar is among the dietary factors associated with obesity [38]. In addition, it has been determined that the foods consumed due to hedonic hunger are typically high in energy content, salty, sugary, and fatty foods [39]. Studies have suggested that eating awareness and the motivation to eat delicious foods were inversely related to weight gain.

Accordingly, eating awareness was associated with a lower BMI as well as reduced fat and sugar consumption [18,40]. It may be a predictable outcome that mindful eating habits or mindfulness scores will have a positive impact on dietary fat intake, as fat is a key ingredient in palatable foods and is associated with high BMI values. However, at this point, considering the level of meeting the nutritional intake recommendations of individuals will reveal more accurate results.

The increase in overweight and obesity and the associated health risks has become a critical issue for most Western countries, and the results of the studies about mindfulness are promising [18]. Eating is an over-learned behavior, often subordinated to other daily tasks, so eating automatically is inevitable. Nevertheless, mindful awareness brings the eater's focus back to what they are eating, involves the development of autonomous regulation and motivation, de-automates eating, and improves craving responses, and helps with better weight regulation [18,41]. In consonance with the results of this study, mindfulness intervention could be recommended as a cost-effective method to support treatment since mindfulness scores were found to be low in individuals with obesity and individuals at risk in terms of waist circumference and waist/height ratio. Salvo et al. [42] reported a significant decrease in body weight (1.9±0.6 kg) from pre- to post-intervention in overweight and obese women after Mindfulness-Based Eating Awareness Training.

In the current study, the MEQ total score and subscale scores (excluding focusing and eating discipline) were inversely associated with the PFS total score and sub-scale scores. Hedonic hunger is associated with binge eating behavior disrupting the inhibitory control mechanism that stops food intake [43]. Therefore, the inverse relationship between the MEQ disinhibition score and the PFS scores was an expected finding. Some studies have found a link between hedonic hunger and some forms of disordered eating [39,44]. Moreover, among people who are extremely sensitive to the food environment, self-control may help them avoid overeating, which may operate as a protective factor that lowers the chance of becoming overweight [12]. In this line, the negative relationship between the emotional eating and control of eating subscales and the PFS reported in the current study is consistent with the literature. For this reason, methods that will help to regulate the hedonic hunger mechanism are necessary to prevent adverse conditions such as unhealthy nutrition and obesity caused by hedonic hunger. One of the indicators of hedonic hunger is hypersensitivity to food availability. Individuals who are hypersensitive to food availability have high appetite urges to consume delicious foods available in their environment [12]. In one study, it was shown that people who are sensitive to food availability but have high levels of self-control have a lower frequency of consumption of unhealthy and delicious foods, as well as a lower frequency of overeating and snacking. In other words, self-control may be a protective factor that reduces the risk of obesity in individuals who are hypersensitive to the availability of foods, one of the hedonic hunger indicators, by preventing overeating [12]. There are also study results supporting a weak association between hedonic hunger (assessed with the PFS) and BMI [16,45]. From this point of view, behavioral interventions such as mindful eating that will help individuals control their eating behaviors are seen as a potential factor that can reduce unhealthy eating behaviors associated with hedonic hunger.

The present study had several limitations that must be addressed. The cross-sectional design of the study herein could not indicate causation. Experimental studies evaluating the long-term impact of mindful eating intervention on hedonic hunger and related factors (energy intake and obesity) may help to prove the causality of the relationship shown in the current study. The fact that the data were selected from a single region is a factor that reduces the representativeness of the individuals to the adult population in Türkiye and is another limitation of the study. In addition, since the participants

in this study consisted of individuals living in Türkiye, studies conducted in different countries will help support the results. Another limitation of the study is that the anthropometric indicators of obesity were limited to BMI, waist circumference, and waist/height ratio, and valid anthropometric indicators of obesity, such as neck circumference and waist/hip ratio, were not included.

CONCLUSION

This study provides important data about the interactions among mindful eating, hedonic hunger, obesity, energy, and nutrient intake in adults, as there are not many articles specifically investigating the relationship between mindful eating and hedonic hunger. Important associations were found between mindful eating and hedonic hunger as well as mindful eating and obesity parameters. Considering the effects of mindful eating on obesity and eating behavior, it is believed that interventions will be effective in gaining healthy lifestyle habits. Therefore, future research should focus on explaining the potential explanations and directions between mindful eating and hedonic hunger. The disinhibition of hedonic hunger can be evaluated by further studies incorporating mindful eating interventions. Future studies can be focused on assessing the impact of mindfulness-based therapies on individuals' dietary preferences, as well as their energy and nutrient consumption.

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CONTRIBUTORS

Conceptualization. G ÜNAL, Y AÇAR, S KABALI, MS MACIT-ÇELEBI, and Y ERTAŞ-ÖZTÜRK. Data curation: Y AÇAR, S KABALI, Z UZDIL, and Y ERTAŞ-ÖZTÜRK. Formal analysis: G ÜNAL. Investigation: G ÜNAL, Y AÇAR, S KABALI, MS MACIT-ÇELEBI, Z UZDIL, and Y ERTAŞ-ÖZTÜRK. Methodology: G ÜNAL, Y AÇAR, MS MACIT-ÇELEBI, Z UZDIL, and Y ERTAŞ-ÖZTÜRK. Visualization: Z UZDIL and Y ERTAŞ-ÖZTÜRK. Writing – original draft: G ÜNAL, MS MACIT-ÇELEBI, Z UZDIL, and Y ERTAŞ-ÖZTÜRK. Writing – review and editing: G ÜNAL, Y AÇAR, S KABALI, MS MACIT-ÇELEBI, Z UZDIL, and Y ERTAŞ-ÖZTÜRK.