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ORIGINAL ARTICLE

Food addiction and its relationship with disordered eating behaviours and obesity

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Abstract

Purpose Food addiction, eating disorders and obesity are all mutually reinforcing factors, or factors that can trigger each other. The aim of this study was to determine the relationship between food addiction, disordered eating behaviours and obesity.

Methods The study was conducted with 370 university students. Food addiction was assessed using the Yale Food Addiction Scale (YFAS) and disordered eating behaviours were assessed with the Eating Attitude Test (EAT)-26. A digital scale was used to measure weight, while for the measurement of height, waist and hip circumferences a non-stretching tape measure was used according to standard techniques.

Results Among the participants, 35.7% scored high on the EAT-26, while 21.1% scored high on the YFAS. Females constituted a higher ratio of those who had high scores on the YFAS and EAT-26 ($p < 0.05$). Overall, the ratio of YFAS high scorers was higher in the case of EAT-26 high scorers (32.6%) than that of low scorers (14.7%) ($p < 0.001$). A positive weak relationship existed between YFAS and EAT-26 scores ($r = 0.165$, $p = 0.001$) and the same between YFAS scores, weight, and body mass index ($r = 0.263$, $p < 0.001$; $r = 0.319$, $p < 0.001$, respectively).

Conclusion In summary, a positive relation was found between food addiction, disordered eating behaviours and body mass index. Females were shown to have a higher risk of food addiction and eating disorders than that of males. Further studies can be carried out to analyze these correlations using a wider range of controlling factors.

Level of evidence Level V, cross-sectional descriptive study.

Keywords Food addiction · Eating disorder · Obesity · Body mass index

Introduction

The term, food addiction, was first described as a combination of substance based and behavioural addiction concepts [1–3]. A food addiction diagnosis tool called the Yale Food Addiction Scale (YFAS), which is based on the substance-dependence diagnostic criteria, was developed to identify individuals who show addiction symptoms towards certain foods that are especially high in fat and sugar [2, 4]. It has been suggested that food craving, or the desire to eat a specific food, is related with binge eating as well as with food addiction [5]. In other words, certain foods might have addiction potential, which could lead to certain types of eating disorders and obesity [6]. As food addiction and disordered eating behaviours share the common symptom of binge eating, food addiction criteria overlap with binge eating disorder criteria. Furthermore, higher body mass index (BMI) is related with binge eating and higher YFAS scores [7–9].

Unhealthy eating habits are more common among university students, which could be attributed to their higher exposure to junk foods, inability to prepare healthy meals, irregular lifestyle, high alcohol consumption, and body image concerns. Cases of eating disorders and food addiction are also higher among these individuals, as is the risk of obesity [10–12]. In a study conducted with a non-clinical sample, it was found that 5.7% of the participants had a food addiction diagnosis [13]. In another study, 4.3% of postgraduate

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university students had a food addiction diagnosis [14]. Both binge eating frequency and the earlier age of being overweight were able to be predicted through high YFAS scores in one study [15]. Thus, the investigation of addiction eating behaviour among university students could shed some light on possible prevention and treatment suggestions for both obesity and eating disorders. The aim of this current cross-sectional study was to determine the relationship between food addiction, disordered eating behaviours and obesity.

Materials and methods

Sample

The study was conducted with 370 students at the Eastern Mediterranean University in the 2017–2018 academic term. Students who were native Turkish speakers and between the ages of 18 and 25 years were included, while pregnant women and individuals with severe psychiatric conditions were excluded from this study. The sample size was determined, on the basis of a 95% confidence interval and 5% sampling error, using the formula shown below. The frequency rate of a case was accepted as 0.5 to calculate the maximum sample size for the population.

The formula used for the calculation of sample size:

- N Total number of people in the university
- n Number of individuals to be sampled
- p Frequency rate of a case (probability of occurrence)
- q Frequency rate of the absence of a case (probability of non-occurrence)
- t Theoretical value found according to table t, at a specific significance level
- d Accepted sampling error according to incidence of the case

$$n = \frac{N \times t^2 p \times q}{(N-1)d^2 + t^2 \times p \times q}.$$

All the procedures performed in this study were done in accordance with the Research and Publication Ethics Board of Eastern Mediterranean University and with the 1964 Helsinki Declaration and its later amendments, or comparable ethical standards. Moreover, informed consent was obtained from all individual participants involved in the study.

Tools

A questionnaire was prepared to evaluate anthropometric measurements (body weight, height, waist and hip circumferences), food addiction, and eating disorder risks of the university students. The questionnaire was conducted in face-to-face format with the participants.

Food addiction

Food addiction was evaluated according to the Yale Food Addiction Scale (YFAS), which was first validated by Gearhardt et al. based on the substance-dependence diagnostic criteria from the Diagnostic and Statistical Manual of Mental Disorders-IV (DSM-IV) [4]. The Turkish version of the YFAS was developed by Bayraktar et al., and the Cronbach's alpha value of this said version was 0.93 [16]. In this study, the Cronbach's alpha was calculated as 0.86. The YFAS consists of 25 items, where on each item, respondents who obtain at least 3 out of 7 points and who meet the diagnostic criteria of "use causes clinical distress", qualify to receive a food addiction diagnosis [4, 17]. Higher YFAS scores indicate an increased risk of food addiction.

Eating behaviours

The Eating Attitude Test (EAT)-26 was used to evaluate the eating disorders. EAT-26 was developed by Garner and Garfinkel in 1979 [18]. The validity and reliability study for Turkey was done by Savaşır and Erol in 1989, and the Cronbach's alpha value in this said study was found to be 0.70 [19]. In the present study, Cronbach's alpha was calculated as 0.87. The scale is a 5-point Likert-type scale—with response options of never, rarely, sometimes, often, usually and always—and each option has its own unique score. EAT-26 includes 26 items, where a score of 20 or more out of 78 indicates an increased eating disorder risk. EAT-26 is subdivided into three scales: dieting, bulimia and food preoccupation, and oral control. The dieting scale measures food restriction and weight loss obsession, the bulimia and food preoccupation scale measures binge eating behaviours, and the oral control scale measures self-control over food consumption [20].

Anthropometric measurements

The body weight of the students was determined using a digital scale sensitive to 0.1 kg. Height, waist and hip circumference measurements were taken on a frontal plane using a non-stretching tape measure. Waist circumferences were taken from the midpoint between the palpable rib and the iliac crest, while hip circumference measurements were taken from the widest portion of the buttocks [21]. BMI was calculated as body weight in kilograms divided by the square of height in metres. According to standard BMI classifications, a BMI below 18.5 kg/m^2 is classified as underweight, 18.5–24.9 kg/m^2 is classified as normal weight, 25.0–29.9 kg/m^2 is classified as overweight and a

BMI ≥ 30.0 kg/m^2 is categorized as obese [22]. Cutoff points for waist circumference are 80 cm and 94 cm for females and males, respectively. Values above these for waist circumference indicate an elevated risk of hypertension and diabetes. The waist-to-hip ratio was calculated for each individual as waist circumference divided by hip circumference. Waist-to-hip ratios above 0.85 and 0.90 for females and males, respectively, are described as abdominal obesity [21].

Statistical analyses

For descriptive statistics, frequency and percentage were calculated for each qualitative variable, while arithmetic mean and standard deviation were calculated for each quantitative variable. Depending on the distribution characteristics and parametric assumptions, either Student's *t* test or Mann Whitney *U* test was used to compare quantitative variables between the two independent groups. Pearson Chi-square statistics was used to evaluate associations between qualitative variables. For correlation analysis between body weight, BMI and scale scores of eating disorder and food addiction, Pearson or Spearman test of correlation was used where appropriate. Level of significance was accepted to be 0.05 throughout the study. All analyses were performed using the SPSS (Version 24) software package.

Results

The average age of the individuals was 21.5 ± 2.3 years, 56.8% of the sample was female and 43.3% was male. As seen in Table 1, males had higher YFAS scores than those of females, but no statistically significant difference was found. Females had higher total EAT-26 scores than those of males ($p < 0.001$).

In Table 2, it shows that the normal weighted individuals, according to the BMI classification, had the lowest YFAS scores, while the obese individuals, also according to the BMI classification, had the highest YFAS scores ($p < 0.001$). The underweight individuals had the highest EAT-26 scores ($p < 0.001$).

BMI and waist and hip circumferences were found to be higher in YFAS high scorers than those of low scorers ($p < 0.05$). The females with high YFAS scores had higher values of waist circumferences, hip circumferences and waist/hip ratio than those of the females with low YFAS scores ($p < 0.05$). The males with high YFAS scores had higher BMI, waist circumference, hip circumferences and waist/hip ratio than those of the males with low YFAS scores ($p < 0.05$). Furthermore, the hip circumferences of those with high EAT-26 scores were greater than those with low scores, while the BMI and hip circumferences of females with high EAT-26 scores were greater than those of the females with low EAT-26 scores ($p < 0.05$). Other anthropometric measurements did not significantly differ statistically in terms of EAT-26 high scorers and low scorers ($p > 0.05$) (Table 3).

Table 1 Distribution of YFAS and EAT-26 scores by gender

Gender	YFAS Score ($\bar{x} \pm$ SD)	*p*1	EAT-26 Score ($\bar{x} \pm$ SD)	*p*2
Female	3.6 ± 1.9	0.411	19.8 ± 11.5	< 0.001*
Male	3.8 ± 1.7		15.8 ± 11.0	
Total	3.7 ± 1.8		18.0 ± 11.5	

*$p1$, $p2 < 0.001$

Table 2 Distribution of YFAS and EAT-26 scores according to BMI classification

BMI classification	Total YFAS Scores ($\bar{x} \pm$ SD)	Total EAT-26 Scores ($\bar{x} \pm$ SD)
Underweight	3.6 ± 1.2	29.6 ± 18.4[b]
Normal	3.3 ± 1.7[a]	16.4 ± 9.6
Overweight	4.2 ± 1.8	19.4 ± 12.2
Obese	4.8 ± 1.7[a]	19.5 ± 12.8
Total	3.7 ± 1.8	18.0 ± 11.5

[a,b]$p < 0.001$

[a]YFAS scores was statistically different from each other

[b]The EAT-26 scores was statistically different from the other BMI classes

As shown in Fig. 1, 21.1% of the individuals had high YFAS scores. The ratio of YFAS high scorers was greater in females (24.8%) than in males (16.2%) ($p < 0.05$). On the EAT-26 scale, 35.7% of the total number of participants, 41.9% of the females and 27.5% of the males had high scores ($p < 0.05$). According to Fig. 2, there was a positive weak relationship between YFAS scores and both body weight and BMI ($r = 0.293$, $p < 0.001$; $r = 0.319$ $p < 0.001$, respectively). On the other hand, as shown in Fig. 3, no relation was found between EAT-26 scores and body weight and BMI ($p > 0.05$).

As can be seen in Fig. 4, the ratio of YFAS high scorers was higher in EAT-26 high scorers (32.6%) than in low scorers (14.7%) ($p < 0.001$). Finally, Fig. 5 shows that there was a positive weak relationship between YFAS scores and EAT-26 scores ($r = 0.241$, $p < 0.001$).

Discussion

The average YFAS score was 3.7 ± 1.8, and 21.1% of the participants scored high on the YFAS. The ratio of YFAS high scorers was greater amongst females (24.8%) than that

Table 3 Distribution of anthropometric measurements according to YFAS and EAT-26

	BW (kg) ($\bar{x} \pm$ SD)	BMI (kg/m^2) ($\bar{x} \pm$ SD)	WC (cm) ($\bar{x} \pm$ SD)	HC (cm) ($\bar{x} \pm$ SD)	WHR ($\bar{x} \pm$ SD)
Female					
YFAS high scorers	69.5 ± 11.9	25.8 ± 4	79.5 ± 16.8	104.6 ± 13.3	0.8 ± 0.1
YFAS low scorers	61.3 ± 11.2	22.6 ± 3.7	71.2 ± 13.2	96.8 ± 10.2	0.7 ± 0.1
*p*1	0.272	0.178	< 0.001*	0.001*	0.042*
EAT-26 high scorers	64.0 ± 12.4	23.7 ± 4.4	74.3 ± 15.5	99.6 ± 13.0	0.7 ± 0.1
EAT-26 low scorers	62.9 ± 11.6	23.2 ± 3.8	72.6 ± 13.9	98.1 ± 10.3	0.7 ± 0.1
p2	0.127	0.025*	0.537	0.012*	0.753
Male					
YFAS high scorers	86.3 ± 14	27.5 ± 5.2	96.8 ± 21.7	104.9 ± 13.7	0.9 ± 0.1
YFAS low scorers	77.5 ± 13	24.6 ± 3.8	84.2 ± 14.0	99.6 ± 10.6	0.8 ± 0.1
*p*3	0.583	0.013*	0.003*	0.025*	0.004*
EAT-26 high scorers	78.4 ± 11.6	25.3 ± 3.7	88.2 ± 13.4	102.3 ± 11.5	0.9 ± 0.1
EAT-26 low scorers	79.1 ± 14.2	25.0 ± 4.4	85.5 ± 17.0	99.7 ± 11.2	0.9 ± 0.1
*p*4	0.495	0.372	0.053	0.862	0.133
Total					
YFAS high scorers	75.1 ± 14.9	26.4 ± 4.5	85.3 ± 20.2	104.7 ± 13.3	0.8 ± 0.1
YFAS low scorers	68.7 ± 14.5	23.5 ± 3.9	77.2 ± 15.0	98.1 ± 10.5	0.8 ± 0.1
*p*5	0.886	0.041*	0.001*	< 0.001*	0.176
EAT-26 high scorers	68.8 ± 13.9	24.2 ± 4.2	78.9 ± 16.2	100.5 ± 12.6	0.8 ± 0.1
EAT-26 low scorers	70.8 ± 15.3	24.1 ± 4.2	78.9 ± 16.8	98.9 ± 10.8	0.8 ± 0.1
*p*6	0.453	0.534	0.648	0.027*	0.596

FA food addicted, *NFA* non-food addicted, *BW* body weight, *BMI* Body Mass Index, *WC* waist circumference, *HC* hip circumference, *WHR* waist/hip ratio, *p1–p2* comparison of females with and without FA/eating disorder risk, *p3–4* comparison of males with and without FA/eating disorder risk, *p5–p6* comparison of both genders with and without FA/eating disorder risk

*$p1, p2, p3, p4, p5, p6 < 0.05$

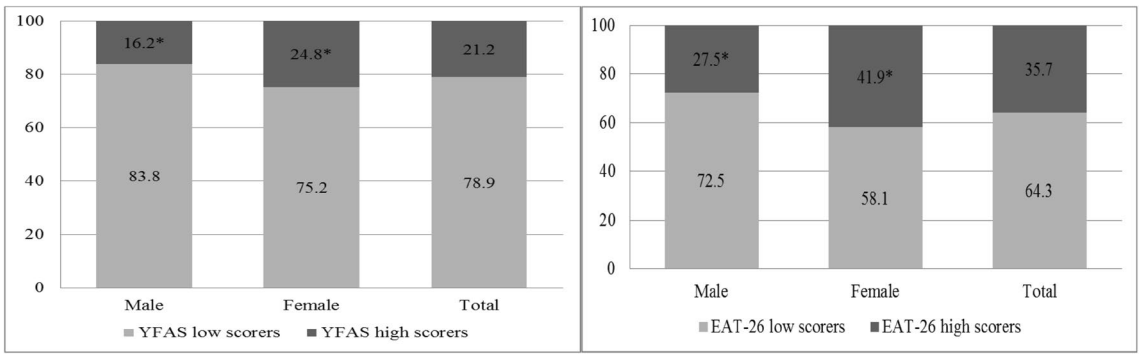

Fig. 1 Distribution of individuals according to food addiction and eating behaviour. *$p < 0.05$

of males (16.2%) ($p < 0.05$). As judged from previous studies, the trend appears to be that food addiction prevalence is higher in females than in males [23–29]. However, there are some studies which show there to be no statistically significant relationship between food addiction and gender [17, 30–32]. The reason behind the general trend of higher food addiction prevalence in females than in males could be due to the different hormonal profile and dietary preferences characterizing the genders [33]. More specifically, the craving for foods high in sugar (e.g., chocolate) during the menstruation period could be one of the major factors informing the gender differences seen in food addiction [34]. However, with that said, this study did not determine the menstrual cycle phases of females. Therefore, it would be beneficial that future studies assess the relationship between menstrual cycle phases and addictive eating behaviours.

In this study, the average EAT-26 score was 18.0 ± 11.5, and 35.7% of the participants had high EAT-26 scores, with

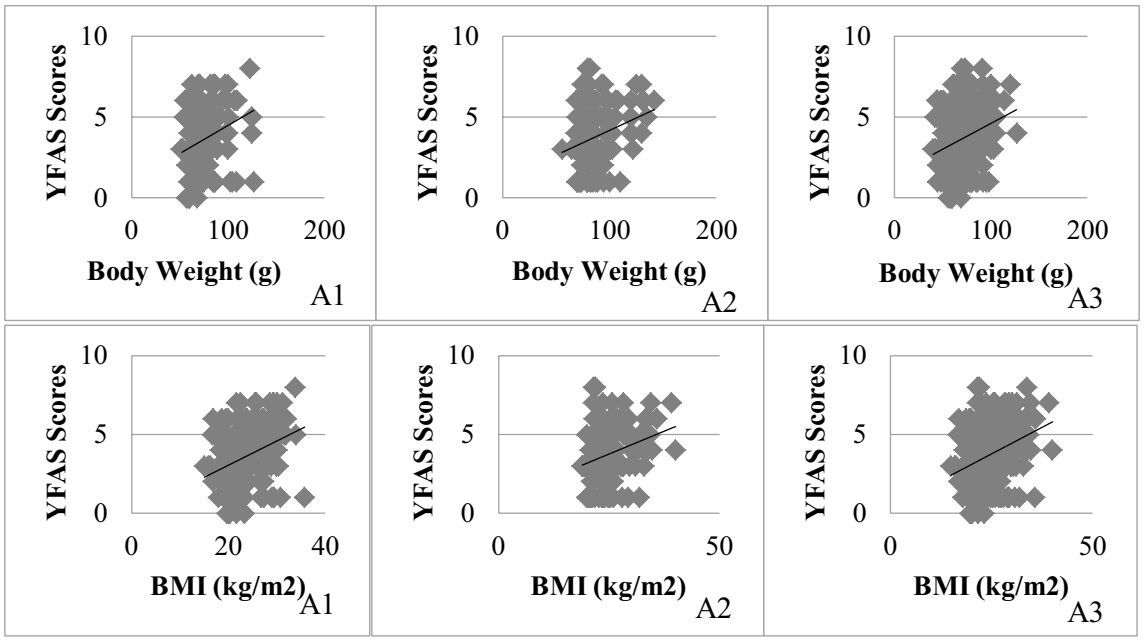

Fig. 2 Relationship between body weight, BMI and YFAS scores. Body weight; A1: Female ($r = 0.265$, $p < 0.001$), A2: Male ($r = 0.297$, $p < 0.001$), A3: Total ($r = 0.263$, $p < 0.001$). BMI; A1: Female ($r = 0.336$, $p < 0.001$), A2: Male ($r = 0.289$, $p < 0.001$), A3: Total ($r = 0.319$, $p < 0.001$)

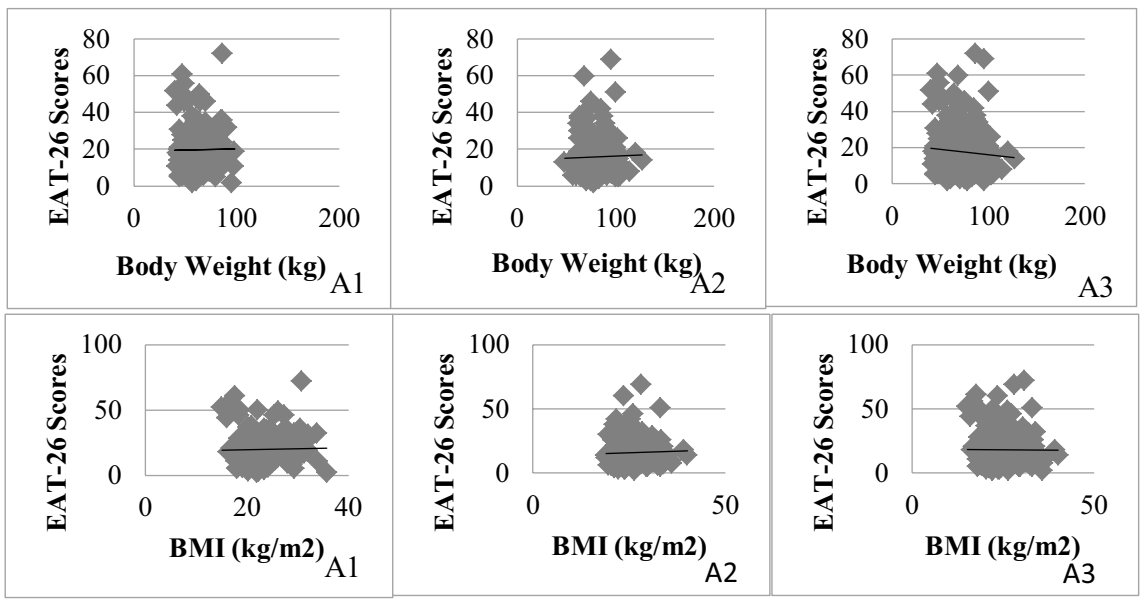

Fig. 3 Relationship between body weight, BMI and EAT-26 scores. Body weight; A1: Female ($r = 0.082$, $p = 0.238$), A2: Male ($r = 0.004$, $p = 0.956$), A3: Total ($r = -0.055$, $p = 0.290$). BMI; A1: Female ($r = 0.098$, $p = 0.155$), A2: Male ($r = 0.011$, $p = 0.891$), A3: Total ($r = 0.036$, $p = 0.491$)

the vast majority of these higher scores coming from the female participants (41.9%) ($p < 0.05$). In another study that was conducted with university students, the risk of eating behaviour disorder was high in 10% of the students, and the EAT-26 average score was 9.32 ± 9.34 [11]. Furthermore, in various other studies involving university students, one reported that 11.5% of the participating students had a high risk of eating disorders [35], another determined that the risk of eating disorders was high in 7% of the participating students [36], and still another found that 16% of undergraduate

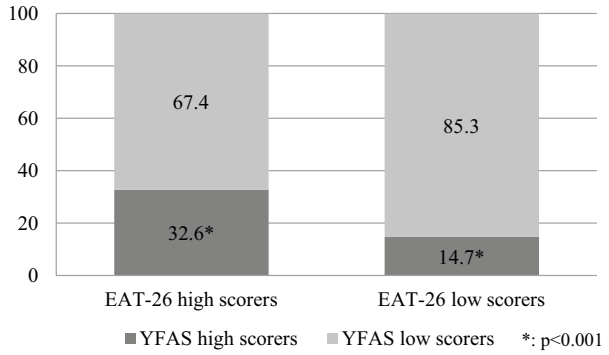

Fig. 4 Distribution of individuals according to food addiction and eating behaviour

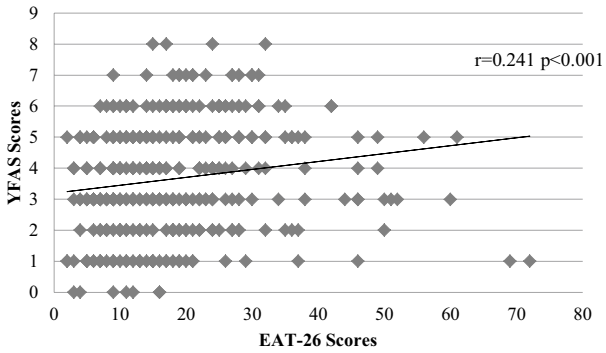

Fig. 5 Relationship between YFAS and EAT-26

students were diagnosed as having eating disorders, with the majority being female [37]. The reason behind this last stated finding could be that females are more likely to have eating disorders as a result of a strong drive to be thin and/or the media-derived dissatisfaction they have with their body [38, 39].

The concept of food addiction is thought to be related to eating disorders due to the presence of common features, such as substance dependence and overeating [40]. In this study, the ratio of YFAS high scorers was higher in EAT-26 high scorers (32.6%) than in low scorers (14.7%) ($p < 0.001$). In addition, there was a positive weak relationship between YFAS scores and EAT-26 scores ($p < 0.001$). Thus, high YFAS scores were associated with an increased risk of eating disorders. Other similar studies also observed like results [7, 24, 29, 30, 41–44]. It can, therefore, be argued that the risk of eating disorder can trigger the risk of food addiction and vice versa.

According to the present study results, BMI, waist and hip circumferences were higher in YFAS high scorers than in YFAS low scorers ($p < 0.05$). Furthermore, there was a positive relationship between BMI, body weight and YFAS scores ($p < 0.001$). Hence, as BMI and body weight values increase, the risk of food addiction also increases. The normal weighted participants had the lowest YFAS scores, while the obese participants had the highest scores, according to the BMI classification ($p < 0.001$). In another study, the results similarly showed that as BMI and body weight increase, YFAS scores increase as well [28]. In a number of other studies conducted on this subject, there has been a positive association reported between body weight and food addiction [7, 45] and a positive relationship between BMI and food addiction [17, 29, 40, 46, 47]. Furthermore, other studies have shown that the vast majority of food-addicted individuals were overweight or obese [11, 48, 49]. As there is behavioural and neurobiological similarity between overeating and food addiction, the consequence of food addiction is expected to be obesity. Moreover, considering that potentially addictive foods are high in fat and sugar and also energy dense, obesity is inevitable [1]. Moreover, one study showed that increased binge eating, depression and anxiety were associated with increased food addiction behaviours in obese individuals [50].

In the present study, the underweight participants, according to the BMI classification, had the highest EAT-26 scores ($p < 0.001$). On the other hand, BMI and hip circumferences were greater in the females with high EAT-26 scores than in those with low scores ($p < 0.05$). In one study conducted with a youth population, it was reported that there was no relationship between disordered eating behaviours and gender [51]. However, in a few other studies, a positive relationship was found between disordered eating behaviours and gender [52–55]. The present study observed there to be no relationship between BMI, body weight and EAT-26 scores. Moreover, obese individuals were reported to have the highest eating disorder risk in one study [56]. The relationship between the EAT-26 scores and BMI depends on the type of eating disorder, which means that if a higher eating disorder risk is found among overweight and obese individuals, it corresponds to a higher incidence of binge eaters [11]. However, there was no scale specifically used to identify a binge eating disorder risk in the participants of the present study.

In conclusion, this study finds that there is a positive relationship between food addiction and eating disorder risk and BMI, and that females tend to have a higher risk of food addiction with eating disorders than that of males. The results from this study provide important data on university students, particularly insofar as the data can help young adults to be aware of the prevalence of their risk to food addiction and disordered eating behaviours and their relationship with obesity. Furthermore, these results are important insofar as they relate to understanding how to cope with food addiction, disordered eating behaviours and obesity. Finally, the data collection tools used in this study are reliable, simple and practical for use on the young adult population.

Limitations

This study had some limitations that need to be mentioned. First, there was no scale specifically used to identify a binge eating disorder risk, which, if there had been, a better evaluation of binge eating and its relationship with food addiction and disordered eating behaviours could have been conducted. Second, body composition was not analyzed in this study. Therefore, it can be recommended that in future studies, to assess obesity, body compositions can be evaluated in addition to major anthropometric measurements to better understand the relationships between food addiction and disordered eating behaviours. Third, this study was conducted on only one university campus. Multi-central large sample studies would be beneficial for establishing a stronger relationship between the main tools used for young adults. Finally, psychological factors, such as depression and emotional eating, and economic statuses were not evaluated in this study. Including these factors would help to evaluate their role in coping with food addiction, disordered eating behaviours and obesity in young adults.

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Compliance with ethical standards

Conflict of interest The authors declare no conflicts of interest in connection with this article.

Ethical approval The study was approved by the Ethical Board of Scientific Research and Publication of Eastern Mediterranean University, dated 06.11.2017 and numbered 2017/50-36.

Informed consent Informed consent was obtained from all the participants.

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