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The Comparison of Food Addiction Rates and Characteristics Between Obese and Non-Obese Individuals: A Cross-Sectional Study

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ABSTRACT

Aim: Even though obesity and food addiction have been linked, only a small number of obese individuals fulfill the diagnostic criteria for food addiction, on the other hand some normal and underweight people also meet these criteria.

To investigate the difference between the prevalence of food addiction between obese and non-obese persons using Yale Food Addiction Scale.

Material and Methods: A demographic information form and Yale Food Addiction Scale was applied to obese and non-obese individiuals admitted to family medicine and obesity outpatient clinic. Significant differences of normally distributed data were assessed using a t-test, and significant differences of not normally distributed data were analyzed using the Mann-Whitney U test. Categorical data were expressed as percentages. The associations between food addiction and age, BMI, gender, and smoking status and the associations between gender, smoking, food addiction, and obesity were determined by using the established a binary logistic regression models. P< 0.05 was considered statistically significant.

Results: Food addiction was more prevalent among obese participants and they were more addicted to carbohydrate-rich food, on the other hand non-obese participants were more addicted to chocolate. 'Important activities given up' and 'withdrawal' symptoms were more common among obese participants, which can be a determinant item of food addiction for obese participants.

Conclusion: Individuals with obesity should be screened in terms of food addiction, and psychosocial support should be given to them. Restricting foods particularly rich in carbohydrates in obese people may contribute to reduce food addiction.

Keywords: *Food addiction, Obesity, Behavior control, Substance-related disorders*

Obez ve Obez Olmayan Bireylerin Yeme Bağımlılığı Oranlarının ve Özelliklerinin Karşılaştırılması

ÖZ

Amaç: Obezite ve yeme bağımlılığı arasında ilişki olduğu bilinmesine rağmen, sadece az sayıda obez birey yeme bağımlılığı için tanı kriterlerini karşılarken, diğer yandan bazı normal ve düşük kilolu insanlar da bu kriterleri karşılamaktadır.

Yale Yeme Bağımlılığı Ölçeği kullanılarak obez ve obez olmayan kişilerin yeme bağımlılığı oranlarını karşılaştırmak amaçlanmıştır.

Gereç ve Yöntemler: Aile hekimliği ve obezite polikliniğine başvuran obez ve obez olmayan bireylere demografik bilgi formu ve Yale Yeme Bağımlılığı Ölçeği uygulandı. Normal dağılım gösteren verilerin t-testi kullanılarak , normal dağılmayan veriler ise Mann-Whitney U testi kullanılarak analiz edildi. Kategorik veriler yüzde olarak ifade edildi. Yeme bağımlılığı ile yaş, BKİ, cinsiyet ve sigara içme durumu arasındaki ilişkiler ve cinsiyet, sigara içme, yeme bağımlılığı ve obezite arasındaki ilişkiler, kurulan ikili lojistik regresyon modelleri kullanılarak belirlendi. P<0,05 istatistiksel olarak anlamlı kabul edildi.

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Bulgular: Obez katılımcılar arasında yeme bağımlılığı daha yaygındı ve karbonhidrattan zengin gıdalara daha fazla bağımlıydılar, obez olmayan katılımcılar ise çikolataya daha fazla bağımlıydı. 'Önemli aktivitelerden vazgeçme' ve 'çekilme' semptomları obez katılımcılar arasında daha yaygındı. Bu semptomlar obez katılımcılar için yeme bağımlılığının belirleyici bir öğesi olabilir.

Sonuç: Obezitesi olan bireyler yeme bağımlılığı açısından taranmalı ve onlara psikososyal destek verilmelidir. Obez kişilerde özellikle karbonhidrat bakımından zengin gıdaların kısıtlanması, gıda bağımlılığının azaltılmasına katkıda bulunabilir.

Anahtar Sözcükler: *Yeme bağımlılığı, Obezite, Davranış kontrolü, Madde bağlantılı bozukluklar*

INTRODUCTION

"Food addiction" is a behavioral addiction type characterized by a compulsive expenditure of palatable foods above metabolism's energy requirements. Another definition of food addiction is physical and/or psychological dependence on high sugar, high fat, and highly palatable foods (1). Food addiction is based on the hypothesis that certain foods like wheat, corn, potatoes, chocolate, coffee, milk, and eggs may have addictive potential, which Randolph introduced in 1956. Although it is not named, the addictive potential of chocolate was noticed long ago, as early as the 1890s.

'Food addiction' is a concept of interest recently, and there is an increasing amount of research conducted on food addiction in the literature as it is considered a predisposing factor to obesity. The easy access to highly palatable food (high in fat, salt, and/or sugar) has contributed to the rise in the food addiction rate and obesity epidemic (1-5). Although the pathophysiological mechanisms underlying food addiction have not been revealed precisely, genetic factors are suggested to be effective (1).

The American Psychiatric Association (APA) formally recognized the existence of behavioral addictions in its chapter on Substance-Related and Addictive Disorders in the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) for the first time, on account of the genetic and neurophysiological similarities of these concepts. Although the only behavioral disorder accepted as an addiction was gambling disorder in DSM-5, the other behavioral addictions, including food addiction, are expected to be recognized as addictive disorders shortly (1,2).

The Yale Food Addiction Scale (YFAS) is well-designed since it provides a direct comparison to the criteria used to categorize substance addiction in the DSM-IV (APA, 1994), with the term "food(s)" replacing the term "substance" in the scale's items (2). The YFAS is a valid and reliable scale in many studies (6).

Studies using imaging techniques have shown that dopaminergic (rewarding) circuitry works more towards palatable foods in obese individuals than in non-obese individuals. An inverse relationship was determined between Body Mass Index (BMI) and dopamine and dopamine receptors in obese individuals, and this may be evidence that food addiction is one of the underlying factors of obesity (1,7). Even though obesity and food addiction have been linked, only a small number of obese individuals fulfill the diagnostic criteria for food addiction, on the other hand some normal and underweight people also meet these criteria (8,9). In light of this information, we aimed to investigate the rate and the characteristics of food addiction between obese and non-obese individuals.

MATERIALS and METHODS

Participants and Study Design

The present cross-sectional study was conducted between 15.05.2019-15.09.2019 in a tertiary training and research hospital in Istanbul. The patients admitted to the obesity outpatient clinic with BMI≥30 kg/m^2 and the persons admitted to the family medicine outpatient clinic with BMI<30 kg/m^2 consecutively, those volunteering to participate in the study and given written consent were included in the study.

At 80% statistical power and $p<0.05$ significance level, the smallest sample size required to determine the d=0.50 effect size according to the t-test for independent groups was calculated as 184 (92 for the ger group).The institutional ethical committee approval number is 2019/0122, obtained on 27.03.2019.

Instruments

Demographic Information Form: It was developed by the researchers within the scope of the research to collect some demographic information aboutthe participants. Age, gender, and smoking habit were asked face-to-face in the demographic information form.

Anthropometric Measurements: The height of each patient was measured with a stadiometer (SECA) without shoes. The weight of each patient was measured with a bio-impedance analysis device (TANITA MC 780-MA, Tokyo, Japan), and Body Mass Index (BMI) was calculated with the Quetelet index (kg/m^2).

The Yale Food Addiction Scale (YFAS): The scale was developed by Gearhardt et al. to assess food addiction by modifying the Diagnostic and Statistical Manual of Mental Disorders-IV (DSM-IV) criteria for substance dependence (10). The validity and the reliability of the scale in Turkish were performed by Bayraktar et al. in 2012 (11). It consists of 26 questions, and the most craved foods are asked in the questionnaire. The seven symptoms evaluated in the scale were substance taken in larger amounts and for a longer period than intended, persistent desire or repeated unsuccessful attempts to quit, much time/activity to obtain /use/recovery, important social, occupational, or recreational activities given up and reduced, use continues despite knowledge of adverse consequences, tolerance, characteristic withdrawal symptoms and use causes clinically significant impairment or distress. Meeting the criteria for three or more symptoms was identified as food addiction.

Statistical Analysis

Data analyses were performed with the statistical software SPSS for IBM, version 25.0 (SPSS, Inc., Chicago, IL). Normally distributed data were shown as mean ±SD, and the data that were not normally distributed were presented as median, minimum and maximum values. Significant differences between normally distributed data were assessed using a t-test, and significant differences of not normally distributed data were analyzed using the Mann-Whitney U test. Categorical data were expressed as percentages. To determine the associations between food addiction and age, BMI, gender, and smoking status and the associations between gender, smoking, food addiction, and obesity, binary logistic regression models were established. Unadjusted and adjusted odds ratio (OR) and confidence intervals were given. P<0.05 was considered statistically significant.

RESULTS

In the Turkish validity and reliability study by Bayraktar et al. the Cronbach alpha coefficient was found to be 0.93 (11). In our study, the Cronbach alpha coefficient was 0.85.

The mean age of the total sample was 29.3±14.39 years, 67.4% (n=430) of the participants were female, and the mean BMI of the participants was 26.48±6.96 kg/m^2. The food addiction prevalence in the overall sample was 20% (n=126).

It was observed that the age and BMI of individuals with food addiction were higher, and they were primarily women and smokers. A binary logistic regression model was established to investigate the association between food addiction and some variables. When age, gender, BMI, and smoking status were added to the model, respectively, it was observed that the significant relationship between food addiction and all these variables remained (Table 1,2). Furthermore, the food addiction rate is higher among smokers even when it adjusted with age, BMI and gender (Tablo 2).

Table 1: The characteristics of including individuals with and without food addiction

	Participants with food addiction (n=126)	Participants without food addiction (n=504)	Total	P
Age (years) (mean±SD)	33.16±14.60	28.49±14.25	29.3±14.39	<0.001
18-29, n(%)	66$_a$ (52.4)	364$_b$ (72.2)	437 (68.5)	<0.001
30-39, n(%)	12$_a$ (9.5)	32$_a$ (6.3)	44 (6.9)	
40-49, n(%)	28$_a$ (22.2)	39$_b$ (7.7)	68 (10.7)	
50-59, n(%)	13$_a$ (10.3)	42$_a$ (8.3)	55 (8.6)	
≥60, n(%)	7$_a$ (5.6)	27$_a$ (5.4)	34 (5.3)	
BMI (kg/m^2)	30.31±7.96	25.54±6.37	26.48±6.96	<0.001

Table 2: The association between food addiction and age, BMI, gender and smoking status

	Participants with food addiction (n=126)	Participants without food addiction (n=504)	Unadjusted OR (95% CI)	p	B	Adjusted OR (95% CI)	p
Age (years) (mean±SD)	33.16±14.60	28.49±14.25	-	<0.001	-0.023	0.97 (0.95-0.99)	0.021
BMI (kg/m^2) (mean±SD)	30.31±7.96	25.54±6.37	-	<0.001	0.107	1.11 (1.07-1.15)	<0.001
Gender Female, n(%)	101 (80.2)	324 (64.3)	1.39-3.60 (2.24)	<0.001	0.718	1.23-3.41 (2.04)	0.006
Smoker, n(%)	36 (18.5)	40 (9)	81.40-3.97 (2.36)	<0.001	0.77	1.23-3.82 (2.17)	0.007

The characteristics of the participants, including obese and non-obese persons, are shown in Table 3. The age of the obese patientsare significantly higher than non-obese participants (p<0.001). Females are mostly found to be obese. The smoking prevalence is significantly higher among obese patients than non-obese. The rate of food addiction is higher among obese participants (Table 4). When adjusted for age, gender, and smoking status, the relationship between food addiction and obesity remained (Table 4).

All the YFAS symptoms were met by obese patients significantly more than non-obese participants except 'persistent desire or repeated unsuccessful attempts to quit (Table 5).

The rate of craving for any food in our overall sample was 89.7 %. The most craved foods were chocolate-wafer (41.1%), cake (29.9 %), chips (29.2),pizza-lahmacun (26.2), bread (25.2), crisps (22.4), cookie-biscuit (21.9%) and ice-cream (20.8%).

Craving for pastry, lettuce, bread, Turkish bagel, and cheese was more among obese participants; on the other hand, craving for chocolate/wafers was more among non-obese individuals (Table 6).

It was found that chocolate-wafer was more craved food among non-obese participants than obese patients and pastry, bread, Turkish bagel, and cheese were more craved food among obese patients than non-obese participants.

DISCUSSION

This study investigated the difference in the prevalence of food addiction between obese and non-obese persons using YFAS. Our study indicated that food addiction is more

Table 3: The characteristics of the participants including obese and non-obese persons

	Obese (n=195)	Non-obese (n=443)	Total	P
Age (years) (mean±SD)	45.01±13.92	22.43±7.58	29.3±14.39	<0.001
18-29, n(%)	32_a (16.4)	405_b (91.4)	437 (68.5)	<0.001
30-39, n(%)	29_a (14.9)	15_b (3.4)	44 (6.9)	
40-49, n(%)	58_a (29.7)	10_b (2.3)	68 (10.7)	
50-59, n(%)	45_a (23.1)	10_b (2.3)	55 (8.6)	
≥60, n(%)	31_a (15.9)	3_b (0.7)	34 (5.3)	
BMI (kg/m^2)	35.5±4.60	22.49±2.89	26.48±6.96	<0.001

BMI: Body Mass Index. Each subscript letter denotes whose column proportions do not differ significantly from each other at the ,05 level.

Table 4: The associations between gender, smoking, food addiction and obesity

	Obese (n=195)	Non-obese (n=443)	Unadjusted OR (95% CI)	p	B	Adjusted OR (95% CI)	p
Age (years) (mean±SD)	45.01±13.92	22.43±7.58	-	<0.001	0.143	1.14 (1.12-1.18)	<0.001
Gender Female	166 (85.1)	264 (59.6)	2.50-6.01 (3.88)	<0.001	0.449	0.83-2.92 (1.56)	0.159
Smoker, n(%)	36 (18.5)	40 (9)	1.40-3.71 (2.28)	<0.001	0.075	0.51-2.24 (1.078)	0.840
Food addiction rate, n(%)	65 (33.3)	61 (13.8)	2.09-4.68 (3.13)	<0.001	1.128	1.71-5.55 (3.08)	<0.001

Table 5: The comparison of YFAS symptoms between obese and non-obese individuals

	Obese n(%)	Non-obese n(%)	All population n(%)	p
Substance taken in larger amount and for longer period than intended	87 (44.6)	131 (29.6)	218 (34.2)	**<0.001**
Persistent desire or repeated unsuccessful attempts to quit	123 (63.1)	270 (60.9)	393 (61.6)	0.79
Much time/activity to obtain/use/recover	65 (33.3)	104 (23.5)	169 (26.5)	**0.01**
Important social, occupational or recreational activities given up and reduced	187 (95.9)	389 (87.8)	576 (90.3)	**<0.001**
Use continues despite knowledge of adverse consequences	81 (41.5)	298 (67.3)	379 (59.4)	**<0.001**
Tolerance	142 (72.8)	365 (82.4)	507 (79.5)	**0.003**
Characteristic withdrawal symptoms	61 (31.3)	102 (23)	163 (25.5)	**0.03**
Use causes clinically significant impairment or distress	66 (33.8)	65 (14.7)	131 (20.5)	**<0.001**

Table 6: The comparison of obese and non-obese persons in terms of craved food in food addicted individuals

	Obese n(%)	Non-obese n(%)	Total	P
Ice-cream	18 (54.5)	15 (45.5)	33 (26.2)	0.69
Chocolate-wafer	26 (37.7)	43 (62.3)	69 (54.8)	**0.001**
Cauliflower	5 (83.3)	1 (16.7)	6 (4.8)	0.11
Cake	27 (47.4)	30 (52.6)	57 (45.2)	0.38
Pastry	25 (65.8)	13 (34.2)	38 (30.2)	**0.04**
Strawberry/cherry/grape	12 (60)	8 (40)	20 (15.9)	0.41
Cracker	5 (62.5)	3 (37.5)	8 (6.3)	0.52
Crisps	10 (38.5)	16 (61.5)	26 (20.6)	0.13
Carrot	4 (80)	1 (20)	5 (4)	0.19
Banana	6 (54.5)	5 (45.5)	11 (8.7)	0.83
Bacon-sausage	10 (62.5)	6 (37.5)	16 (12.7)	0.35
Toast/sandwich	149 (58.3)	109 (41.7)	24 (19)	0.46
Cola/soda	17 (56.7)	13 (43.3)	30 (23.8)	0.52
Apple	5 (62.5)	3 (37.5)	8 (6.3)	0.52
Doughnut	9 (42.9)	12 (57.1)	21 (16.7)	0.38
Cookie/biscuit	229 (48.9)	23 (51.1)	45 (35.7)	0.65
Candy	19 (57.6)	1 (42.4)	33 (26.2)	0.42
Bread	31 (64.6)	17 (35.4)	48 (38.1)	**0.02**
Pasta	26 (60.5)	17 (39.5)	43 (34.1)	0.15
Rice	21 (60)	14 (40)	35 (27.8)	0.24
Turkish bagel	20 (71.4)	8 (28.6)	28 (22.2)	**0.02**
Chips	26 (54.2)	22 (45.8)	48 (38.1)	0.64
Red meat	15 (65.2)	8 (34.8)	23 (18.3)	0.14
Hamburger	14 (42.4)	19 (57.6)	33 (26.2)	0.22
Pizza-lahmacun-doner	22 (46.8)	25 (53.2)	47 (37.3)	0.40
Cheese	15 (75)	5 (25)	20 (15.9)	**0.02**
Craving for any food	64 (52)	59 (48)	123 (97.6)	0.52

prevalent among obese patients than non-obese and obese individuals were more addicted to carbohydrate-rich food, and those who were more non-obese were more addicted to chocolate. 'Activities given up and reduced' and 'withdrawal' symptoms were found to be more common among obese patients than non-obese ones, which can be more determinant items of food addiction for obese participants. However, 'use continues despite knowledge of adverse consequences and 'tolerance' symptoms were more prevalent among non-obese participants, which can be more determinant for non-obese persons.

Some studies reported no difference between food addicted and non-addicted groups in terms of age (12,13). Another study showed a negative correlation between age and food addiction (14). Our study observed that the group with food addiction clustered more in the 40-49 age group than those without food addiction, and the mean age of the food addicted group was elder than the other group in our study. This result may be related to food addiction behavior starting at a young age and settling at later ages.

In concordance with our results, food addiction rates were significantly higher in women than men in the literature (15-18). However, some studies reported no significant relationship between food addiction and gender (19-21).

Smoking and food addiction have common addiction mechanisms. Both use the rewarding pathway of dopamine. The mesolimbic dopamine pathway connects the ventral tegmental area in the midbrain to the ventral striatum of the basal ganglia in the forebrain. Smoking and consuming hyper-palatable food provide a shortcut to the brain's reward system by flooding the nucleus accumbens with dopamine; consequently, a sense of pleasure is felt. With the repeated intake of cigarettes and hyper-palatable food, dopamine receptors are downregulated in time, and food intake would become driven by the need to avoid withdrawal symptoms rather than by pleasure and homeostatic needs. Without an additional intake, cravings and withdrawal symptoms occur (22,23). The results of the studies conducted about the association between food addiction and smoking is conflicting in the literature. A study conducted among adolescents suggested that adolescents who ever smoked were more prone to be addicted to food than those who never smoked (6). Another study carried out among nurses found that nurses who smoked were less likely to have a food addiction diagnosis, contrary to most of the results in the literature. It was explained that food and cigarettes might compete for the same neurotransmitters (e.g., dopamine) in the brain; thus, inverse relationships occurred between food addiction and smoking (24). Benzerouk et al. determined the rate of smokers as 18.8% in individuals with food addiction and 27.1% in those without food addiction in which persons who were prepared for obesity surgery were included; however, this difference was not significant (25). The food addiction rate was found to be higher among smokers even when it is adjusted with age, BMI and gender. Our result was in line with most of the studies in the literature.

The overall food addiction rate was 7.9% in a German (12) and 11.4% in a Turkish sample (17). In our hospital-based study, the overall food addiction rate was higher than these results (20%).

The prevalence of food addiction varied between 1.6% and 24% in healthy weight adults and between 7.7% and 56.8% in overweight and obese adults in different studies (15). It

is estimated that approximately 15-25% of obese patients meet the YFAS criteria for food addiction (26-29).

In some studies investigating the rate of food addiction among obese participants who were prepared for obesity surgery, the prevalence of food addiction was 25%, 16.5%, and 26.4%, respectively (25,26,30). In a study conducted among a German sample, 17,2% of obese individuals had food addiction which was 3.5 times higher than non-obese persons (12). Pursey et al. reported that food addiction prevalence was twice as high in the overweight/obese population than those with non-obese participants (24.9% and 11.1%, respectively) (15). Steward et al. reported that the food addiction rate in obese participants was significantly higher than normal-weight participants (24.2% vs. 2.8%). Our results showed that food addiction prevalence was 33% in obese participants, which was three-fold higher than non-obese participants in line with the literature. However, in a study conducted with nurses, the rate of food addiction among obese nurses was much more significant (66%) (24).

The most frequent food addiction symptoms determined by YFAS in our overall sample were ''activities given up and reduced'' (90.3%), 'tolerance' (79.5%), 'unsuccessful attempts to quit' (61.6%). These rates are quite high compared to a study investigating the prevalence of food addiction in a German sample. 'Loss of control' (19.2%), 'activities given up' (18.9%), and 'withdrawal' (18.5 %) were the most common symptoms in that study (12).

Foods rich in fat, salt, sugar are believed to have the most significant addictive potential. In our study, chocolate, cake, chips, and pizza high in fat and sugar were the most addictive food in the overall population, similar to the literature (31,32).

Generally, there was no difference between obese and non-obese individuals regarding the type of addictive foods in people with food addiction except chocolate-wafer, pastry, bread, Turkish bagel, and cheese in our sample. Chocolate addiction was significantly more prevalent among non-obese participants, whereas pastry, bread, Turkish bagel addiction were more common among obese individuals in our study. It is hypothesized that chocolate and carbohydrate cravings are two distinct concepts. Carbohydrate craving is evaluated in the context of 'emotional eating' and is motivated by the desire of comforting effect of negative emotions (33). A review by Ganley indicated that emotional eating is more common in those who are overweight or obese; however, the causality of the association is not clear (34).

Baked foods such as pastry, bread, Turkish bagels have a significant part in our Turkish food culture, and this type of food is consumed together with cheese. Food craving for carbohydrate-rich foods was a mediator between addictive eating and elevated BMI (35). Randolph hypothesized that the fast alterations in metabolic fuels that occur after consuming these meals are similar to the pharmacokinetic characteristics of illicit substances and may cause addictive behaviors (36). We thought that the addictive effect of foods with a high glycemic load, such as pastry, bread, and bagel, causes more desire for them when consumed in large quantities and therefore contributes to obesity.

A desire for hedonic reward drives chocolate craving, and chocolate addicts state that they crave chocolate only and could not substitute with anything else when they craved chocolate; on the other hand, when craving carbohydrates, then any sweet-fat food was consumed (37). The fact that chocolate addicts were mostly non-obese and carbohydrate addicts were mostly obese in our study can be attributed to this hypothesis.

This study has a few limitations. First, our study was cross-sectional and the directionality between determinants were not identified clearly. Second, self-administered scales were used which can affect the precision of the data.

In conclusion, food addiction is accepted as a behavioral addiction type and is a popular issue recently. Our results suggested that food addiction is three-fold more prevalent among obese individuals; for that reason, obese persons should be screened in terms of food addiction, and psychosocial support should be given to those with food addiction. Addiction to carbohydrate-rich food was found to be more common among obese participants. Restricting foods particularly rich in carbohydrates in obese people may contribute to reducing food addiction.

Acknowledgments

None

Author Contributions

All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by Hacer Hicran Mutlu and Hasan Hüseyin Mutlu. The first draft of the manuscript was written by Hacer Hicran Mutlu and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Conflict of Interest

The authors declare they have no conflict of interests.

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Ethical Approval

This study was performed in line with the principles of the Declaration of Helsinki. Approval was granted by the Ethics Committee of Göztepe Training and Research Hospital (Date 27.03.2019/No 2019/0122). • Consent to participate: Informed consent was obtained from all individual participants included in the study.

Peer Review Process

Extremely peer-reviewed and accepted.

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