Original article

Investigation of the Relationship between Food Addiction and Anxiety, Depression and Attention Deficit / Hyperactivity in Obese and Non-Obese

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Abstract. The aim of this study is to show the relationship between Attention Deficit Hyperactivity Disorder (ADHD) and food addiction in obese patients. It is thought that obese people have more tendency to have food addiction. Moreover, it is thougt that ADHD is related with food addiction and especially impulsivity subdimension has strong relationship with food addiction. Obesity is one of the biggest health problems common in the world. In this study, it is observed that the variables of age, gender, educational status, marital status and alcohol use and the presence of psychopathological disorders such as anxiety and anxiety are important risk factors for obesity. For this reason, it can be said that by giving priority to women at high risk, organizing prevention and intervention studies for related risk factors will be effective in preventing and controlling obesity. In addition, it can be thought that performing awareness raising and encouraging studies in terms of the importance of healthy eating and regular exercise habits in the fight against obesity will decrease the incidence of obesity.

Key words: Obesity, food addiction, anxiety, deppression, hyperactivity

Introduction

The concept of addiction was used in the 19th century (1). Especially in 1990s it was found that chocolate addiction has the same effcet with psychoactive substance like caffeine and chocolate addiction has the same pattern of behavior with other substance addictions (2). Volkow et al., (2008) showed that substance and food craving has the same neural activity. Volkow and Wise (2005) found that delicious food lead to increased dopamine in the mesolimbic region to similarly as a result of the receipt of many addictive substances. Furthermore, it was found that obesity is associated with a decrease in dopamine D2 receptors and this relationship is also available in the dependent individuals. That's why Sevinçer et al., (2015) supported that greater consumption of delicious food to get the same pleasure observed in obese individuals. Food addiction is a term characterized by the excessive food consumption which is related to bulimia nervosa,

eating disorders, and the like (5). Stice et al.,(2008) said that this is supported by the presence of a relationship between the level of reward sensation caused by the ingestion of delicious food and the degree of dopamine release.

Moreover, obese individuals have more activity in the region of the brain associated with reward than normal individuals (7). Kandeğer and Bozkurt (2016) also said that food addiction can lead to obesity and metabolic disregulation. It can be shown that there are lots of studies in the literature that supports that severity of obesity and the frequency of psychopathology and eating disorders were correlated. Gearhardt et al.,(2011) supported that foods that are processed, pleasurable and have high calorie have the addiction potential and eatening that kinds of foods presents the addictive behaviour. Moreover, according to Carter et al., 2016, foods might have addictive features as seen in alcohol and other substances. According to the results of studies, it can be said that obese people are more prone to have food addiction.

Besides them, MacKillopet al., (2011) found that there is strong relationship between impulsivity and addictive behavior. Impulsivity is one of the subdimensions of attention deficit hyperactivity disorder (ADHD). ADHD affects the social relationships of individuals and it is characterized by attention deficit, hyperactivity and impulsivity, according to DSM-IV (12). Moreover, It has been observed that the prevalence of substance and abuse dependence is higher in ADHD subjects than in the general population (13). Weinstein et al., (2015) also supported that people who have ADHD show more cigarette, alcohol, substance, internet, gambling and sex addiction. Like those findings, Kandeğer and Bozkurt (2016) reported that ADHD increases the risk of addiction. Furthermore, food addiction has the same pattern of behavior with other substance addictions. That's why, it can be said that there is strong relationship between ADHD and obese people who have food addiction are more pronte to have food addiction.

Moreover, according to the results of several studies, there is a correlation between impulsivity and pathological gambling, substance abuse, and alcohol abuse. Barnes et al., (2005) supported that impulsivity was a significant predictor of alcohol misuse for females and delinquency for males. Moeller et al., (2001) also found that impulsivity is a significant predictor of cocaine use and treatment retention. It can be said that especially impulsivity subdimension of ADHD has strong relationship with food addiction in obese patients.

The aim of this study is to show the relationship between ADHD and food addiction in obese patients. It is thought that obese people have more tendency to have food addiction. Moreover, it is thougt that ADHD is related with food addiction and especially impulsivity subdimension has strong relationship with food addiction.

Methods

Participants

This study is a quantitative study and descriptive method was used. Participants were randomly and respectively selected from obese people who applied to Balıklı Rum Hospital Nurition and Diet Service and healthy people who work in a private sector employees in Istanbul. This study was applied to 200 (100 obese and 100 healthy) individuals. Random sampling procedure was applied to select the participants and the voluntary nature of the participation was clearly explained to the participants prior to distributing the scales The ages of the participants are between 18 and 65. This study was approved by the Istanbul Fatih Sultan Mehmet University Ethics Committee. All participants were provided with the written informed consent prior to participate in the study.

Patient Group

The patient group consisted of individuals diagnosed with obesity between the ages of 18-65 according to the criteria set by WHO (BMI≥30.0 kg / m^2). Participation in the patient group was made up of people applying to the Balıklı Rum Hospital Nurition and Diet Service.

Control Group

The control group was formed from personnel and their relatives working in a private company located in Istanbul. The control group participants were aimed to be composed of individuals with no obesity history, BMI <25 kg / m^2, similar to the patient group in terms of sociodemographic characteristics.

Features of the Experimental Group (Patient Group)

- Being between the ages of 18-65.
- Knowing how to read and write to understand what you read.
- To be BMI≥30.0 kg / m^2 according to WHO criteria or to apply for diagnosis or treatment in Balıklı Rum Hospital Nurition and Diet Service.

Exclusion Criteria:

- Obesity developed secondary to medication use, hypothyroidism, cushing disease.
- Diseases such as cirrhosis, lymphedema, chronic kidney failure, which can change a person's waist circumference, weight measurements and BMI as a liar
- The presence of a severe physical or neurological disease
- Schizophrenia, clinically apparent mental retardation
- Weight gain that will cause a diagnosis of obesity has occurred in the last 6 months
- For the control group; Those with a history of significant overweight in their anamnesis were excluded from the study.

Measures

Demographic Information Form, Beck Anxiety Inventory, Beck Depression Inventory, Yale Food Addiction Scale and Adult ADHD Scale were applied to the participants.

Demographic Information Form:

Demographic Information Form was developed by the researchers to determine the age, sex, education level and socioeconomic status of the participants.

Beck Anxiety Inventory (BAI):

Beck Anxiety Inventory (BAI) was developed by Beck, Epstein, Brown, and Ster (1988) to measure self-reported anxiety levels of individuals. The BAI was adapted to Turkish by Ulusoy, ahin, and Erkmen (1998) and was found to have a high Cronbach's Alpha coefficient, .93. The Alpha coefficient for The BAI was found to be .90 in the present study.

Beck Depression Inventory:

The Beck Depression Inventory (BDI) developed by Beck et al.in 1961, rates the somatic, emotional, cognitive and motivational symptoms that are observed during depression. The split-half reliability of this version of BDI was found to be .74 (Hisli, 1998). In the present study, the Cronbach's alpha reliability coefficient was found to be.84.

Yale Food Addiction Scale (YFAS):

Yale Food Addiction Scale measures the symptoms of food dependence (primarily hight-fat and high-sugar). The scale was used in order to assess for convergent and internal validity of PEMS. The scale was developed by Gearhardt, Corbin and Brownell (2009). Preliminary studies of the scale showed good internal reliability (Cronbach's α= 0,75) and good convergent validity with similar constructs such as binge eating disorder (21).

In this research Turkish version of the scale was used. Adaptation study of YFAS was completed in 2012 by Bayraktar, Erkmen and Kurtuluş in the name of "Adaptation study of Yale Food Addiction Scale". Reliability and validity studies indicated strong internal consistency (Cronbach's α=.93) and significant correlations among items. In addition, the Cronbach' alpha of the scale in the current study was found to be .80. in this study.

Adult Attention Deficit Hyperactivity Disorder (ADHD) Scale (AADHDS):

Adult ADHD Scale was developed in 1995 in Kanada by Turgay. Each item is scored on a 5-point Likert-type scale and the scale has three subdimensions. The scale was adapted to Turkish by Günay, Savran and Aksoy (2005). The Cronbach' alpha of the scale in the current study was found to be .92. In addition, the Cronbach's alpha of the attention deficit (AD) subscale for .83; .82 for the Extreme Mobility (HD) subscale; it was found as .89 for the problem sub-dimension (P).

Body Mass Index (BMI)

Body mass index (BMI) was measured by dividing weight (kilogram) by the height (square) square. BMI is a standard height-weight index, which is easy to apply, important data can be obtained for everyone without gender discrimination, can be widely used in scientific studies and has been proved. If the score is below 18.5, it is extremely weak, if it is between 18.5 and 24.99, it is normal, if it is between 25.0 and 29.99, it is pre-obesity, and if it is 30 and above it is obese (24)

Procedure and Data Analysis

In this study, first of all, descriptive properties were examined with n and% values in categorical data and mean ± standard deviation values in appropriate data according to distribution characteristics. In order to examine whether the data show normal distribution in the comparison of the scores of the patient group and the normal group, the normality analysis was performed and Beck depression scale did not fall between +2 / -2; that is, it was determined that it does not show normal distribution. Mann-Whitney U test from non-parametric tests was used to compare continuous data without normal distribution, and independent samples t test was used to compare scores from other scales with normal distribution. Pearson correlation analysis was performed to measure whether there is a significant relationship between the variables. Finally, chi-square test was used to determine whether obesity was dependent on the variables in the study. The analysis of the data obtained in this study was done using the SPSS 25 (Statistical Package for the Social Sciences) program

Results

This study consists of 200 individuals, 100 of whom are patients (obese) and 100 healthy (non-obese). 76% of the participants are female and 24% are male; of those who are not obese, 56% are women and 44% are men. 23% of obese people are 18- 25, 43% are 26- 33 and 34% are 34- 45; 11% of those who are not obese are between the ages of 18- 25, 34% are between 26- 33 and 55% are between the ages of 34- 45. Obese individuals are 5% primary school, 7% secondary school, 30% high school, 51% university and 7% graduate; 7% of non-obese individuals are primary school, 5% middle school, 16% high school, 49% university and 23% graduate. 59% of the obese individuals are married, 38% are single, 2% are divorced and 1% are widowed; 61% of non-obese individuals are married, 30% are single, 7% are divorced and 2% are widows. 66% of the obese individuals are working and 34% are not working; 70% of non-obese individuals work while 30% do not. 5% of obese individuals are 1000 TL and below, 32% are 1001- 3000 TL, 24% are 3001- 5000 TL, 17% are 5001- 7000 TL, 10% are 7001- 10000 TL and 12% 10001 TL and above; 3% of non-obese individuals are 1000 TL and below, 26% are 1001- 3000 TL, 28% are 3001- 5000 TL, 18% are 5001 - 7000 TL, 16% are 7001 - 10000 TL and 9% has income of 10001 TL and above. While 12% of obese individuals have a psychiatric treatment history, 88% do not; While 16% of non-obese individuals have a psychiatric treatment history, 84% do not. While 13% of obese individuals have medical internal disease, 87% do not; While 19% of non-obese individuals have medical internal disease, 81% do not. 25% of obese individuals smoke, 75% do not; 30% of non-obese individuals smoke and 70% do not. 21% of obese individuals use alcohol and 79% do not use it; 38% of non-obese individuals use alcohol and 62% do not use alcohol. Not all obese and non-obese individuals use substances.

Table 1. Descriptive Analysis Results of the Total Scores of the Scales for the Patient Group

	n	Min. point	Max. point	χ	ss	skewness		kurtosis	
						statistics	SH	statistics	SH
BDI	100	0	31	8,93	6,76	.92	.24	.88	.48
BAI	100	0	39	10,14	9,37	1,19	.24	.75	.48
ADHD	100	1	74	31,69	15,51	.58	.24	.19	.48
ADHD-AD	100	0	17	5,57	4,03	.77	.24	.18	.48
ADHD-HD	100	0	23	5,71	4,06	1,33	.24	3,08	.48
ADHD-P	100	0	46	20,41	10,18	.42	.24	-.26	.48
YFAS	100	1	23	8,38	4,55	.57	.24	.34	.48

The Beck Depression Inventory (BDI) ,Beck Anxiety Inventory (BAI),), Attention Deficit Hyperactivity Disorder (ADHD), Attention Deficit (AD), Extreme Mobility (HD), the problem sub-dimension (P), Adult Attention Deficit Hyperactivity Disorder Scale (AADHDS), Yale Food Addiction Scale (YFAS),

Table 2. Descriptive Analysis Results of the Total Scores of the Scales for the Non-Patient Group

	n	Min. point	Max. point	χ	ss	skewness		kurtosis	
						statistics	SH	statistics	SH
BDI	100	0	30	6,27	6,00	1,75	.24	4,26	.48
BAI	100	0	34	8,41	7,49	1,43	.24	2,31	.48
ADHD	100	1	77	28,02	16,93	.94	.24	.89	.48
ADHD-AD	100	0	18	5,22	4,09	.94	.24	.87	.48
ADHD-HD	100	0	16	5,69	4,44	.29	.24	-1,03	.48
ADHD-P	100	1	50	17,11	11,02	1,04	.24	.88	.48
YFAS	100	0	17	8,88	3,92	-.86	.24	.37	.48

Table 3. Mann - Whitney U Test Results of Beck Depression Scale

The dependent variable	Patient Group (n=100)		Non-Patient Group (n=100)		U	p
		ss		ss		
BDI	8,93	6,76	6,27	6,00	3730	.00*

*p<.01

Table 4. Independent Sample t Test Results for Scales

The dependent variable	Patient Group (n=100)		Non-Patient Patient (n=100)		t	p
	χ	ss	χ	ss		
BAI	10,14	9,37	8,41	7,49	1,44	.15
ADHD	31,69	15,51	28,02	16,93	1,60	.11
ADHD-AD	5,57	4,03	5,22	4,09	.61	.54
ADHD-HD	5,71	4,06	5,69	4,44	.03	.97
ADHD-P	20,41	10,18	17,11	11,02	2,20	.03*
YFAS	8,38	4,55	8,88	3,92	-.83	.41

*p<.05

Tablo 5. Correlations Between Scales and Sub-Scales

Scales	χ	2	3	4	5	6	7
BDI	-	**.51****	**.38****	**.25***	**.19**	**.42****	**-.04**
BAI	.67**	-	**.56****	**.37****	**.28****	**.59****	**.04**
ADHD	.70**	.48**	-	**.74****	**.73****	**.94****	**.16**
ADHD-AD	.50**	.55**	.67**	-	**.44****	**.56****	**.19**
ADHD-HD	.40**	.15	.80**	.32**	-	**.53****	**.10**
ADHD-P	.74**	.47**	.96**	.53**	.71**	-	**.13**
YFAS	-.03	-.01	.02	.10	.02	-.01	-

* P <.05; ** p <.01; the values shown in bold belong to the group that is obese, and the other values below the table belong to the non-obese group.

Table 6. Chi-Square Test Results to Determine Whether Obese Status Depends on the Variables in the Research

Variables		Obese	Non-obese			
		n	n		sd	p
Gender	Woman	76	56	8,91	1	.00*
	Man	24	44			
age	18 – 25	23	11	10,24	2	.01*
	26 – 33	43	34			
	34 – 45	34	55			
Education status	Primary	5	7	13,50	4	.00*
	Secondary	7	5			
	High school	30	16			
	University	51	49			
	Graduate edu.	7	23			
Marital status	Married	59	61	6,05	4	.20
	Single	38	30			
	Divorced	2	7			
	Widow/widower	1	2			

Working status	Working	66	70	.37	1	.54
	Non-working	34	30			
Family income status	1000 TL and below	5	3	3,27	5	.66
	1001 – 3000 TL	32	26			
	3001 – 5000 TL	24	28			
	5001 – 7000 TL	17	18			
	70001 – 10000 TL	10	16			
	10000 TL and above	12	9			
Psychiatric treatment history	Yes	12	16	.66	1	.42
	No	88	84			
Medical Internal Disease	Yes	13	19	1,34	1	.25
	No	87	81			
Smoking	Yes	25	30	.63	1	.43
	No	75	70			
Alcohol using	Yes	21	38	6,95	1	.01*
	No	79	62			
Substance using	Yes	-	-	-	-	-
	No	100	100			

*p<.01

Discussion

The aim of this study is investigation of the relationship between food addiction and anxiety, depression and ADHD in obese and nonobese participants. According to the results of this study, there was significant difference between obese and non-obese participants in terms of BDI (see Table 3). Obese' scores on the Beck depression inventory ($\bar{X}$ = 8.93) are statistically significantly higher than non-obese ($\bar{X}$ = 6.27) points. However, obese and non-obese people did not show signifficant difference in terms of BAI, ADHDP, attention deficit (AD) and hyperactivity subscales of ADHDS and YFAS (see Table 4). Obese and non-obese people signifficantly differ from each other in terms of problems subdimension of ADHDS (see Table 4). Obese individuals ($\bar{X}$ = 20.41) experience significantly more problems compared to non-obese individuals ($\bar{X}$ = 17.11) about ADHD diagnosis.

In addition, in this study, it was found that the BDI scores of obese individuals were significantly associated with BAI, ADHD Scale scores, and ADHD scale's attention deficit and diagnosis-related subscales; however, it was found that the depression scores in obese individuals did not show a significant relationship with the HD sub-dimension of ADHD and YALE (see Table5). However, it was observed that there was no significant relationship between BAI scores and YALE scale scores in obese individuals. It was found that there was a significant relationship between the ADHD scores of obese individuals and the scores obtained from the ADHD subscales, but there was no significant relationship between the YALE scores. In addition, it is observed that the scores of individuals in sub-scales of ADHD are not significantly related only with the YALE scale. In this context, it is understood that there is no significant relationship between YALE and all other variables in obese individuals.

In non-obese individuals, it is seen that BDI, BAI, ADHD, AD and Psub-dimensions of ADHD, are significantly related with each otheR, but the scale scores do not have a significant relationship with YALE scale. The scores obtained by non-obese individuals from the

ADHD- HD sub-dimension are significantly related to BDI, ADHD, and other sub-dimensions of ADHD; however, it was found that there is no significant relationship between ADHD- HD sub-dimension of ADHD and BAI, 4YALE scales. The YALE scores of non-obese individuals do not appear to be significantly associated with other variables (see table 5).

Epidemiologic findings have revealed that obesity is more prevalent in patients suffering from anxiety and/or depression. In accordance with this study, a positive correlation between BMI and depression was found in other studies in the literature (25, 26). Skilton et al., (2007) suggested that there has been the high frequency of obesity in more severe cases of anxiety and depression (27).

It was found in longitudinal studies that obesity predicts the subsequent onset of depression (26). Obesity has adverse effects on selfimage, self-esteem and mood because of being subject to social rejection, discrimination and negative stereotyping and such experiences (28). Although there has been an increase in the prevalence of depression and psychological illness in obese subjects, the nature of the relationship is not clear (29, 30). Roberts and his colleagues found a probable causal relationship between obesity and subsequent depression (26). The findigs of their study supported that obesity was able to predict subsequent depression, but didn't support the idea that depression predicts subsequent obesity. Besides, Simon et al., (2006) conducted a research to evaluate the relationship between obesity and a range of mood, anxiety, and substance use disorders and found that obesity is related with approximately 25% increase in odds of mood and anxiety disorders (31).

The findings of many researches showed that various factors like severity of depression, severity of obesity, gender, socioeconomic status (SES), gene-by-environment interactions, childhood experiences, eating and physical activity, teasing, and stress may influence the relationship between obesity and mood disorders (32, 33). Stunkard, et al., (2003) suggested that the relationship between depression and obesity may be strongest only among the most obese individuals (33). Moreover, some studies also found a stronger relationship in girls and women than boys and men (29). Socioeconomic status (SES) also plays important role on the relationship between obesity and depression.

In this study, unlike the studies in the literature, it was found that obese individuals and non-obese individuals did not differ significantly in terms of ADHD. This is probably due to the fact that ADHD is very low in the selected sample. In the study conducted by Kavakçı et al. (2011), in support of this finding, when obese and non-obese were compared; No significant difference was found between ADHD self-report scale (ASRS), Wender Utah Rating scale (WURS) scores. No significant difference was found between ADHD and the control group's age and dye adjusted weight indices. In a longitudinal study conducted by Mustillo et al in a general population sample in 2003, the diagnosis of ADHD was not associated with any obesity status (non-obesity, childhood obesity, adolescent obesity and chronic obesity). In this study, although there was no relationship between ADHD and obesity, it was found that individuals with obesity and non-obese individuals differed significantly only in terms of the diagnostic-related problems sub-dimension and those who were obese had significantly higher scores from non-obese individuals.

In addition, Alfonsson et al., (2012), in a study conducted with 187 adult bariatric surgery patients, it was found that 10% of the patients were positively screened for adult ADHD and the symptoms of adult ADHD correlated significantly with anxiety, depression and irregular eating. In a study conducted by Çolpan et al. (2018) with 49 obese patients and 47 control groups, obese adolescents' perceived emotional expression levels, emotional and behavioral problems, attention deficit hyperactivity disorder, peer relationship problems, and social skill levels between the control group significant differences were found (36). Studies investigating the relationship between obesity, eating disorders, and impulsivity have reported significantly higher impulsivity, especially in bulimia nervosa and those with obstructive eating disorders (37,38,39).

In parallel with the findings of other researches, in this study, there was a significant relationship between the depression, anxiety and ADHD scores of obese individuals; however, unlike the studies in the literature, it has been determined that the scores of obese individuals from these scales do not show a significant

relationship with the YALE food addiction scale (see table 5). In addition, in this study, no significant difference was observed between obese individuals and non-obese individuals in terms of YALE scale scores (see table 4). However, studies in the literature show that YALE scores of obese individuals are significantly higher than non-obese individuals (21, 40).

In addition, in this study, it was examined which variables affect obesity and that variables of gender, age, education, and alcohol use significantly affect obesity; however, marital status, employment status, family income status, having a history of psychiatric treatment, having medical internal disease, and smoking have no significant effect on obesity (see table 6).

In studies that examine the effect of gender variable on obesity, it is seen that the prevalence of obesity is higher in women than in men. Pekcan study organized in 2012, obesity prevalence among men in Turkey of 11-22%, while the women were found to be 23-35% (41). In this context, it can be said that being a woman is a risk factor for obesity. Obesity is frequently seen in women due to the effect of estrogen hormone, oral contraceptive use, excess weight gained during pregnancy, limitations in social life and low physical activity (42).

Education level is another variable that affects obesity. In general, there is an inverse correlation between education level and obesity (43). Kaner et al., (2011), it was determined that as the level of education increases, BMI decreases, 87.1% of individuals with primary education or below and 64.4% of university graduates are obese. It has been reported that individuals with higher education level have more opportunities to obtain correct information for healthy nutrition from written and visual media, and their perception level is higher than individuals with low education level (44). Low level of education can decrease the importance given to health (45). Cohen et al. In a study conducted by [2013], similar to this study, the rate of obesity was found to be higher in individuals with lower education level compared to higher education level. Ogden et al. (2010) emphasized that there is a negative correlation between BMI and education level by stating that obesity rate is higher in adults with low education level in America and other developed countries.

In addition, another factor that affects obesity is the marital status. Obesity is more common among individuals who are married and have a long time to get married (48). Turkey In a study evaluating the prevalence of obesity and obesity light, being married or divorced obesity prevalence was reported to increase (49). The low frequency of obesity in single women may be associated with the fact that those in this group have not yet had a pregnancy and are more sensitive about body weight control.

Strong evidence from population-based studies in industrialized countries indicates that a low socioeconomic status (SES) is a risk factor for obesity (24, 50). Overweight individuals with a low SES are less likely to perceive themselves as having a weight problem compared with overweight individuals with a high SES (51), and poor individuals may not be able to afford healthy foods (eg, fruit and vegetables) that would help them maintain a normal body weight (52). Poorer neighborhoods tend to have a high concentration of fast-food restaurants (53) and a paucity of parks and other recreational facilities (54, 55). Furthermore, adolescents from families with lower SES have less opportunity to participate in sports and other physical activity pursuits because of cost or other access barriers (eg, poor parental support) (56, Kristjansdottir & Vilhjalmsson, 2001).

Conclusion

Obesity is one of the biggest health problems common in the world. In this study, it is observed that the variables of age, gender, educational status, marital status and alcohol use and the presence of psychopathological disorders such as anxiety and anxiety are important risk factors for obesity. For this reason, it can be said that by giving priority to women at high risk, organizing prevention and intervention studies for related risk factors will be effective in preventing and controlling obesity. In addition, it can be thought that performing awareness raising and encouraging studies in terms of the importance of healthy eating and regular exercise habits in the fight against obesity will decrease the incidence of obesity.

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