DOI: 10.4274/gulhane.galenos.2023.04909
Gulhane Med J 2023;65:115-22

The relationship of food addiction with carbohydrate intake and stress in adolescents

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Date submitted:
15.11.2022
Date accepted:
17.01.2023
Online publication date:
15.09.2023

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Keywords: Food addiction, obesity, adolescents

ABSTRACT

Aims: Overweight and obesity in adulthood relate to factors at younger ages in some individuals. This study investigated the relationship of food addiction (FA) with carbohydrate intake and stress in adolescents.

Methods: A single-center cross-sectional study was performed using a questionnaire that included basic characteristics, anthropometric measurements (weight, height, body mass index), Yale Food Addiction Scale (YFAS), Depression, Anxiety, and Stress Scale (DASS 21), and the food frequency questionnaire for the consumption of high carbohydrates and sugar-containing foods.

Results: The study included 192 adolescents (146 female and 46 male) aged between 12 and 19 years. FA was detected in 8.9% of the participants. Female adolescents had a higher prevalence of FA than male adolescents (female: 10.3%; male: 4.3%, p=0.217). FA was not observed in any underweight individuals, while its prevalence was 14.3% in obese individuals. The YFAS score was 2.7±1.8, and the presence of FA was significantly related to YFAS (p<0.001). Foods that individuals with FA had the most problems with were chocolate/wafer, chips (52.9%), white bread (41.2%), deep-fried dough desserts, hamburgers/pita/lahmacun/doner, and frizzy drinks/coke (35.3%) (p<0.05). Of the food-addicted participants, 88.2% had moderate, severe, or extremely severe levels of stress, anxiety, and depression. YFAS score correlated with stress (r=0.472, p<0.001), depression (r=0.458, p<0.001), and anxiety (r=0.528, p<0.001).

Conclusions: The results of this study suggest that high sugar content related to carbohydrates in foods might have addictive effects on adolescents.

Introduction

Foods with high sugar content affect the brain reward system and may lead to food addiction (FA) by increasing the tendency toward more sugary food consumption (1). Processed foods with high refined sugar content may cause addiction and play a critical role in the pathogenesis of obesity by activating hedonic mechanisms (2). However, the addictive effect of sugar is an emerging topic, and the information on it is limited (3). Recently, adolescents' increasing consumption of sugary foods and their increasing obesity rates, as well as the fact that these sugary foods cause addictive behavioral changes, have led researchers to investigate the potential addictive impact of excessive consumption of sugar-containing food by adolescents (4). Jastreboff et al. (5) stated that the brain responses of obese adolescents who consumed glucose and fructose-sweetened beverages differed from those of underweight adolescents and that the control response against the consumption of these refined sugars may have decreased, which may further maintain their consumption.

Recent studies showed that uncontrolled and chronic stress also causes changes in eating behavior and obesity development indirectly by affecting the hypothalamic-pituitary-adrenal and hypothalamic-pituitary-gonadal axes, which control eating behavior (6). Chronic stress can disrupt the hypothalamic-pituitary-adrenocortical axis, followed by changes in neuropeptide Y, insulin, and cortisol levels, and ultimately increase metabolic risk factors (7). Moreover, chronic stress can disrupt the reward system and increase the desire for delicious

foods (8). Consuming delicious foods may show a relaxing effect in the presence of stress, and individuals may tend to increase food consumption as a stress response (9). Chronic stress causes compulsive eating behavior, which is the most prominent feature of FA. Posttraumatic stress disorder symptoms correlate with FA and the risk of being overweight or obese (10). Therefore, FA may contribute to stress-induced obesity (6). The relationship between emotional changes (especially stress) and eating behavior and its effects on anthropometric measurements has been extensively examined in adults. Along with this study, we determined whether there is FA among adolescents by surveying the consumption desire and consumption frequency of sugar-containing foods and carbohydrates and evaluated its relationship with stress, anxiety, depression, and anthropometric measurements. The hypotheses of the study were as follows: FA increases in stress, anxiety, and depression, and is related to body mass index (BMI).

Methods

In this single-center, cross-sectional study, we enrolled adolescents who voluntarily agreed to participate and/or were allowed to participate by their parents/guardians. The participants were 12-19 years of age and the study period was between 20.01.2021 and 20.06.2022. Concerning the required sample size, taking alpha error 0.05 and expected power beta=0.80, 192 participants were sufficient to test a clinically significant difference in YFAS symptom score (2.1±1.8) as shown by Tompkins et al. (11). Adolescents below 12 or above 19 years of age or those who required a restricted diet were excluded.

The study was conducted online because of the Coronavirus disease-2019 (COVID-19) pandemic. To enroll participants, we prepared a social media flyer and contacted the parents/guardians of the participants.

The study questionnaire consisted of general characteristics (e.g., sex, age), anthropometric measures (e.g., weight, height, BMI), Yale Food Addiction Scale (YFAS) (12), Depression, Anxiety, and Stress Scale (DASS 21) (13), and sections including carbohydrate and sugary food consumption frequency.

Anthropometric measurements

In the online survey form, through detailed information and visuals, the participants (or their parents) recorded their actual weight and height. Participants were divided into groups according to age- and sex-specific BMI percentiles (World Health Organization MGRS, 2007) (14).

Carbohydrate and sugary food consumption frequency

We prepared a food consumption questionnaire taking the literature findings as a reference. The form surveyed the frequency of food consumption in the last month, including carbohydrate and sugar content. The foods were recorded under 24 categories as “White bread and types”, “Bran bread and types”, “Rice, pasta, noodles, bulgur, etc.,” “Pastries such as borek (yufka-based salty), bagels, acma, pogaca (dough-based salty), etc.”, “Breakfast cereals (cornflake, etc.)”, “Toast, sandwich”, “Pizza, lahmacun, pita, hamburger, etc.,” “Salted snacks (crackers, etc.)”, “Cookies, sweet biscuits”, “Cake derivatives”, “Dough desserts (baklava, tulumba, dessert with syrup, etc.)”, “Milk desserts (rice pudding, custard, etc.)”, “Fruit desserts (quince dessert, etc.)”, “Ice cream, milkshake”, “Coke and frizzy drinks with sugar (soda with fruit flavor, fruit juice, ice tea, etc.)”, “Coke and frizzy drinks with artificial sweetener, etc.,” “Packaged fruit juice”, “Fresh fruit juice”, “Energy/sports drinks”, “Coffee with sugar and/or flavor”, “Candies and jellies”, “Chocolate, wafer”, “Honey, marmalade, molasse, hazelnut butter, etc.” and “fruits”. The frequency of consumption was defined in 8 categories: every day, 1-2 times a week, 3-4 times a week, 5-6 times a week, 1 in 15 days, 1 in a month, or rarely and never.

Yale Food Addiction Scale

We used the YFAS to determine FA, which was developed based on the diagnostic criteria of the symptoms of substance addiction from the Diagnostic and Statistical Manual of Mental Disorders 4th edition by Gearhardt et al. (12). Its validity and reliability were previously reported in adults (15) and adolescents (16,17). The YFAS 25-point questionnaire assesses addiction symptoms and food consumption in the last 12 months. The symptoms are as follows: “taking more substance than planned and for a longer period”, “irresistible desire or repeated and unsuccessful withdrawal attempts”, “spending more time/performance for obtaining, using, and recovering”, “reducing or stopping important social, professional, or entertainment activities”, “continuing to use despite knowing negative results”, “developing tolerance (significant increase in amount, significant decrease in effect)”, “showing typical withdrawal symptoms, continuing to use the substance to relieve the withdrawal symptoms”. Symptoms are scored 0 if the criterion is not met and 1 if the criterion is met to reach a total score. The scale also includes a separate criterion to calculate a diagnostic score for FA. If the YFAS symptoms score is ≥3 (at least 3 of the 7 YFAS criteria had a score of 1) and if the 8th criterion score is 1 (intake causes clinically significant damage), the participant is considered to have FA.

Depression, Anxiety, and the Stress Scale

In the study, DASS 21 (13) was used to determine the stress, depression, and anxiety status of the participants. It is the abbreviation for the DASS 21 developed by Lovibond and Lovibond (13). Its validity and reliability study was conducted using Scotch Pine in Turkey (18). It contains seven questions

that determine depression, anxiety, and stress levels. Its validity in adolescents has been shown in different studies (19,20). The test classifies the stress, depression, and anxiety as "normal", "mild", "moderate", "severe" or "extremely severe" based on the score.

Statistical Analysis

The data were evaluated with the Statistical Package for the Social Sciences Statistics for Windows, version 23.0 (IBM Corp., Armonk, NY: USA, 2015). Numerical data were expressed as mean and standard deviation (SD) or median with lower and upper values. Qualitative data were displayed as numbers and frequencies. Student's t-test was used to test the differences between two averages showing normal distribution. Mann-Whitney U test was used to test the differences between two median values showing non-normal distribution. The chi-square test was used to test the differences between categorical variables. Correlation coefficients were calculated using Spearman's, Pearson, or Eta squared tests. P<0.05 was considered statistically significant.

Results

The study included 192 adolescents (age, mean±SD = 15.3±1.6 years, 12 to 19 years, 76% female). FA was detected in 8.9% of the participants. The prevalence of FA in female and male adolescents was 10.3% and 4.3%, respectively, p=0.217).

Anthropometric findings

BMI classification was available for 172 individuals. Of them, 5.2% were underweight, 12.2% were at risk of being underweight, 59.3% were normal-weight, 19.2% were overweight, and 4.1% were obese. No underweight individuals than FA, whereas 14.3% of obese, 9.5% of at-risk underweight, 8.8% of normal weight, and 3.0% of overweight individuals had FA. There was no significant relationship between FA and BMI classification (p=0.643) (Table 1).

Table 1. BMI classification according to food addiction status (World Health Organization MGRS, 2007)

	Food addiction				p
	Yes (n=17)		No (n=175)		
	n	%	n	%	
BMI classification					0.643
Underweight (<3.p[a])	0	0	9	100.0	
Underweight risk (3-15.p)	2	9.5	19	90.5	
Normal (15-85.p)	9	8.8	93	91.2	
Overweight (85-97.p)	1	3.0	32	97.0	
Obesity (>97.p)	1	14.3	6	85.7	

[a]Percentile, BMI: Body mass index

YFAS scores

The mean YFAS symptom score was 2.7±1.8 (0.0-7.0) in FA. The mean number of YFAS symptoms was 5.1±1.5 (3.0-7.0) in FA and 2.5±1.7 (0.0-7.0) without FA (p<0.001).

Table 2 shows the distribution of foods that individuals had problems with due to excessive eating and/or desire for excessive consumption across FA status. Chocolate/wafer, chips (52.9%), white bread (41.2%), deep-fried dough desserts, hamburgers/pita/lahmacun/doner, and frizzy drinks/coke (35.3%) were the most reported foods. In participants without FA, the most common foods were chocolate/wafer (32.6%), chips (26.3%), and white bread (25.7%).

Table 2. Problematic foods according to food addiction status

	Food addiction				p
	Yes (n=17)		No (n=175)		
Foods that were declared problematic	n	%	n	%	
Ice-cream	5	29.4	12	6.9	**0.002***
Chocolate/wafer	9	52.9	57	32.6	0.091
Apple	0	0.0	2	1.1	0.658
Deep-fried dough desserts	6	35.3	26	14.9	**0.031***
Broccoli	1	5.9	6	3.4	0.606
Cookies	3	17.6	12	6.9	0.114
Cakes	4	23.5	25	14.3	0.310
Candies	4	23.5	20	11.4	0.150
White bread	7	41.2	45	25.7	0.171
Pastry	4	23.5	15	8.6	0.064
Lettuce	0	0.0	2	1.1	0.658
Spaghetti	4	23.5	27	15.4	0.386
Strawberry	1	5.9	1	0.6	**0.039***
Rice	4	23.5	13	7.4	**0.026***
Crispbreads	2	11.8	7	4.0	0.148
Chips	9	52.9	47	26.9	**0.020***
Bagel	1	5.9	4	2.3	0.374
French fries	5	29.4	4	2.3	0.162
Carrot	0	0.0	1	0.6	0.755
Steak	2	11.8	6	3.4	0.101
Banana	0	0.0	3	1.7	0.586
Pastrami/Turkish style fermented sausage/ sausage/salami	1	5.9	5	2.9	0.494
Hamburgers/pita/lahmacun/ doner	6	35.3	23	13.1	**0.001***
Pizza	4	23.5	14	8.0	**0.036***
Frizzy drinks/coke	6	35.3	25	14.3	**0.031***
None	2	11.8	51	29.1	0.126

*Categorical qualitative data were determined by chi-square tests

The ratio of having no problems with any food type was 11.8% and 29.1%, respectively, among individuals with and without FA. Participants with FA had more problems than those without FA regarding ice cream (p=0.002), deep-fried dough-based desserts (p=0.031), strawberries (p=0.039), rice (p=0.026), chips (p=0.020), hamburger/pita/lahmacun/doner (p=0.001), pizza (p=0.036), and frizzy drinks/coke (p=0.031).

Stress, depression and anxiety scores and FA

Table 3 shows the relationships between stress, depression, and anxiety status and the frequency of FA. Overall, 88.2% of the food-addicted participants had moderate, severe, or extremely severe levels of stress, depression, and anxiety. There was a statistically significant difference between moderate and higher levels of stress, depression, and anxiety in FA (p<0.001).

Carbohydrate and sugar consumption

Table 4 shows the relationships between BMI, stress, depression, anxiety, FA and frequency of carbohydrate and sugary food consumption. Increased stress was associated with increased consumption of salted snacks (p=0.041), dough desserts (e.g., baklava, tulumba, dessert with sirup) (p=0.017), coke and frizzy drinks with artificial sweeteners (p=0.027), packaged fruit juice (p=0.014), energy/sports drinks (p=0.001), and candies and jellies (p=0.009). An increase in depression was associated with increased consumption of cake derivatives (p=0.005), fruit desserts (e.g., quince dessert) (p=0.028), packaged fruit juice (p=0.042), energy/sports drinks (p=0.041), coffee with sugar and flavor (p=0.014), and candies and jellies (p=0.008). An increase in anxiety was associated with increased consumption of pastries such as borek (filo based salty), bagels, acma, pogaca (e.g., dough-based salty) (p=0.043), salted snacks (e.g., crackers) (p=0.016), cookies/sweet biscuits (p=0.038), cake derivatives (p=0.018), milk desserts (e.g., rice pudding, custard) (p=0.001), packaged fruit juice (p=0.007), coffee with sugar and flavor (p=0.014), candies and jellies (p=0.004), and fruits (p=0.001).

Table 3. Stress, depression and anxiety according to food addiction status

		Food addiction				Total		p
		Yes		No				
		n	%	n	%	n	%	
Stress								**<0.001***
	Normal	2	11.8	96	54.9	98	51.0	
	Mild	0		22	12.6	22	11.5	
	Moderate	5	29.4	30	17.1	35	18.2	
	Severe	5	29.4	18	10.3	23	12.0	
	Extremely severe	5	29.4	9	5.1	14	7.3	
Depression								**<0.001***
	Normal	1	5.9	73	41.7	74	38.5	
	Mild	1	5.9	21	12.0	22	11.5	
	Moderate	3	17.6	37	21.1	40	20.8	
	Severe	2	11.8	16	9.1	18	9.4	
	Extremely severe	10	58.8	28	16.0	38	19.8	
Anxiety								**<0.001***
	Normal	1	5.9	75	42.9	76	39.6	
	Mild	1	5.9	20	11.4	21	10.9	
	Moderate	5	29.4	40	22.9	45	23.4	
	Severe	1	5.9	17	9.7	18	9.4	
	Extremely severe	9	52.9	23	13.1	32	16.7	

*Categorical qualitative data were determined by chi-square tests

An increase in YFAS score was associated with an increase in the consumption of pastries such as borek (filo-based salty), bagels, acma, pogaca (e.g., dough-based salty) (p=0.009), salted snacks (p=0.002), cake derivatives (p=0.023), fruit desserts (e.g., quince dessert) (p=0.022), coke and frizzy drinks with artificial sweeteners (p=0.016), packaged fruit juices (p=0.025), fresh fruit juices (p=0.022), and fruits (p=0.026).

An increase in BMI was associated with increased consumption of rice/pasta/noodles/bulgur (p=0.038), salted snacks (p=0.005), coke and frizzy drinks with sugar (e.g., soda with fruit flavor, fruit juice, iced tea) (p=0.009), and coke and frizzy drinks with artificial sweeteners (p=0.025).

Correlations between Age, BMI, YFAS score, stress, depression, and anxiety scores

As shown in Table 5, there was a weak but significant positive correlation between age and BMI (r=0.172, p=0.024). No significant relationship was observed between BMI and YFAS score (r=0.094, p=0.222), stress (r=-0.029, p=0.710), depression (r=0.029, p=0.705), or anxiety score (r=-0.018, p=0.817). A strong positive correlation was observed between the YFAS score and stress (r=0.472, p<0.001), depression (r=0.458, p<0.001), and anxiety scores (r=0.528, p<0.001). Besides, stress, depression, and anxiety scores showed a positive and strong relationship with each other (p<0.001).

Discussion

In this study, the prevalence of FA in adolescents was 8.9%. In several previous studies, the prevalence of FA in adolescents ranged between 2.6% and 38.0% (11,16,17,21-25). In the current study, the prevalence of FA was 10.3% in female adolescents and 4.3% in male adolescents. We observed no significant difference in FA prevalence between females and males. Several past studies reported no difference in the prevalence of FA by sex in adolescents, while others reported a higher frequency in females (16,21-26).

We observed no relationship between BMI classification and FA status. Nevertheless, obese individuals showed the highest rate of FA. An online study by Taş Torun et al. (27) on

Table 4. Carbohydrate and sweetened food consumption frequency according to stress, depression, anxiety, YFAS score and BMI class

Foods and drinks	Stress		Depression		Anxiety		YFAS score		BMI class	
	Chi-square	p	Chi-square	p	Chi-square	p	Chi-square	p	Chi-square	p
White bread and types	22.107	0.776	30.307	0.349	33.203	0.228	13.328	0.065	14.298	0.940
Bran bread and types of bran bread	28.052	0.258	23.345	0.499	15.213	0.914	1.484	0.961	33.905	0.086
Rice, pasta, noodles, and bulgur	25.046	0.625	20.077	0.862	32.183	0.267	14.057	0.050	37.586	**0.038***
Pastries such as borek (filo-based salty), bagels, acma, and pogaca (dough-based salty)	31.293	0.304	25.031	0.626	42.001	**0.043***	18.708	**0.009***	18.959	0.899
Breakfast cereals (cornflakes, etc.)	31.580	0.292	30.743	0.329	26.475	0.547	2.637	0.916	27.211	0.507
Toast, sandwich	30.097	0.359	20.985	0.826	29.947	0.366	4.106	0.768	18.267	0.919
Pizza, lahmacun, pita, and hamburger	32.838	0.242	32.367	0.260	32.887	0.240	8.841	0.264	30.926	0.320
Salted snacks (crackers, etc.)	42.222	**0.041***	39.577	0.072	46.314	**0.016***	22.538	**0.002***	50.986	**0.005***
Cookies, sweet biscuits	38.953	0.082	35.520	0.155	42.631	**0.038***	10.486	0.163	25.595	0.595
Cake derivatives	31.112	0.312	51.096	**0.005***	45.780	**0.018***	16.230	**0.023***	24.859	0.635
Dough desserts (e.g., baklava, tulumba, dessert with sirup)	46.201	**0.017***	33.844	0.206	34.829	0.175	11.514	0.118	32.799	0.243
Milk desserts (rice pudding, and custard)	26.075	0.569	30.588	0.336	56.342	**0.001***	12.456	0.087	27.362	0.499
Fruit desserts (quince dessert, etc.)	39.395	0.075	43.893	**0.028***	34.431	0.187	16.340	**0.022***	35.958	0.144
Ice-cream milkshake	39.314	0.076	41.245	0.051	36.333	0.134	12.646	0.081	30.552	0.337
Coke and frizzy drinks with sugar (soda with fruit flavor, fruit juice, and iced tea)	38.106	0.096	34.990	0.170	34.361	0.189	10.165	0.179	48.609	**0.009***
Coke and frizzy drinks with artificial sweeteners	44.200	**0.027***	37.005	0.119	27.561	0.488	17.297	**0.016***	44.413	**0.025***
Packaged fruit juice	46.995	**0.014***	42.169	**0.042***	49.661	**0.007***	16.028	**0.025***	30.097	0.359
Fresh fruit juice	31.435	0.298	39.090	0.079	31.569	0.292	16.367	**0.022***	26.962	0.520
Energy/sports drinks	51.733	**0.001***	37.311	**0.041***	28.903	0.224	5.110	0.530	31.816	0.132
Coffee with sugar and flavor	37.982	0.099	46.953	**0.014***	46.930	**0.014***	4.279	0.747	25.383	0.607
Candies and jellies	48.703	**0.009***	49.279	**0.008***	52.052	**0.004***	8.538	0.288	35.969	0.143
Chocolate/wafers	29.246	0.400	23.963	0.683	31.016	0.316	2.636	0.917	36.618	0.128
Honey, marmalade, molasse, and hazelnut butter	18.929	0.900	30.743	0.329	22.856	0.740	13.254	0.066	20.417	0.849
Fruits	36.360	0.134	37.589	0.106	57.841	**0.001***	15.955	**0.026***	20.466	0.847

YFAS: Yale Food Addiction Scale, BMI: Body mass index

Table 5. The correlation of stress, depression and anxiety scores with age, BMI and YFAS scores of participants

	BMI (kg/m²)	YFAS score	Stress scores	Depression score	Anxiety score
Age (years)	**0.172***	-0.003	-0.065	-0.134	-0.034
	0.024	0.970	0.368	0.063	0.639
BMI (kg/m²)		0.094	-0.029	0.029	-0.018
		0.222	0.710	0.705	0.817
YFAS score			**0.472****	**0.458****	**0.528****
			<0.001	<0.001	<0.001
Stress scores				**0.708****	**0.809****
				<0.001	<0.001
Depression score					**0.682****
					<0.001

*p<0.05. **p<0.01
SD: Standard deviation, IQR: Interquartile range, YFAS: Yale Food Addiction Scale, BMI: Body mass index

126 adolescents between the ages of 11 and 18 years showed 47.9% FA in individuals with increased BMI, much higher than 5.1% in the control group. In the present study, the prevalence of FA was 14.3% in individuals with BMI >95th percentile, while it was 8.3% in individuals with BMI <85th percentile. A meta-analysis reported a 19% average prevalence of FA in studies conducted on overweight or obese children and adolescents, and a 12% average prevalence in studies conducted on the general population (25). In the same study, there was no significant relationship between FA in adolescents and BMI z-scores (relative weight adjusted for age and sex) (25). The higher prevalence of FA in overweight and obese individuals suggests that FA is involved in the development of adolescent obesity. Nevertheless, the results may not be statistically significant due to the low number of individuals with FA and the lack of homogeneity of the groups formed according to the BMI classification. On the other hand, anthropometric measurements were performed with nonstandardized scales by the parents. This is a limitation of the study. According to the Turkish Health Survey in 2019, the rate of obesity in women aged 15 and over was 24.8%, and the rate of obesity risk was 30.4%. In males, the rate of obesity is 17.3%, and the rate of those at risk of obesity is 39.7% (28). Obesity rates were lower in adolescents than in adults in the current study. The weight reached and the nutritional habits acquired in adolescence generally continue into adulthood. It is important to evaluate and improve the anthropometric measurements of the adolescent group.

The mean YFAS symptom score we calculated in the current study (2.7±1.8) is higher than several previous studies conducted in the general adolescent population (17,21,23). On the other hand, studies on overweight and obese individuals have reported comparable YFAS symptom scores with our findings (11,22,29-31). Vastly, the YFAS symptom score has been reported between 1.0 and 2.0 in the general population and between 2.1 and 2.9 in overweight and obese adolescents. Higher YFAS scores in the current study than in previous studies can be explained by the gender imbalance in our sample. More females participated in the current study and more females received a FA diagnosis. Furthermore, normal-weight adolescents in this study had higher YFAS scores. Lastly, the study was conducted during the pandemic, which might have adversely influenced eating habits through lookdown measures and increased distress.

The YFAS symptom score and FA status are expected to correlate. In our sample, the mean number of YFAS symptoms was 5.1±1.5 (3.0-7.0) in those with FA and 2.5±1.7 (0.0-7.0) in those without ($p<0.001$), which was very close to a previous study (16).

Individuals with FA may develop an addiction to different foods that they have problems with because of excessive eating and/or desire for excessive consumption. In this study, food-addicted individuals reported that they had more problems with the consumption of *fast food* products than individuals without FA. These results were consistent with Keser et al. (32). We also observed that foods with higher sugar and fat content were more closely associated with FA, similar to a study by Buyuktuncer et al. (15) in adults, which reported that individuals with FA had more problems with French fries, cake derivatives, donuts, white bread, and foods with high fat and sugar contents, such as chips and chocolate.

In the current work, FA was associated with stress, depression, and anxiety. Participants with normal levels of stress, depression and anxiety constituted 51.0%, 38.5%, and 39.6% of the total participants, respectively. Other participants showed mild to severe levels of stress, depression, and anxiety. The relationship between addiction and mental problems is bidirectional. In this study, 88.2% of participants with FA had moderate, advanced, or very advanced levels of stress, depression, and anxiety. Previous studies have also reported relationships between stress, depression, and anxiety and FA assessed by DASS-21 or other methods (23,29-31,33). A review of 27 studies has concluded that many mental health problems and psychosocial disorders, including depressive symptoms, anxiety symptoms, eating disorders, low quality of life, and self-esteem, are linked to FA (33).

Concerning the food types, we observed that the consumption of some high-carbohydrate and sugary foods was particularly associated with stress, depression, and anxiety scores. Zhang et al. (34) reported that the consumption of drinks that contain more than 25 grams/day of sugar or more than 6 times a week was associated with increased anxiety and depression in adolescents. Similarly, Liu et al. (35) reported a similar association between excessive consumption of sugar-sweetened drinks and increased depression. A relationship between high sugar-containing beverage consumption and mental health issues was also shown in adolescents (36). Our findings in this regard are in agreement with the literature.

The YFAS symptom score was not affected by BMI ($p=0.222$), it showed a strong positive relationship with stress, depression, and anxiety scores ($p<0.001$). At the same time, as expected, stress, depression, and anxiety scores showed a positive and strong relationship with one another ($p<0.001$). Rose et al. (29) also did not report a significant relationship between the BMI values of the participants and the number of YFAS symptoms and mental health problems. Lin et al. (30) reported a positive correlation between BMI z-score and psychological distress, including FA and stress, depression, and anxiety. A wide variety of methodological studies have been reported in the literature. Therefore, detailed examinations are required in studies with more comprehensive and gender-distributed sampling, considering that mental health problems such as stress, depression, and anxiety may trigger overeating and lead to FA acquisition.

Study Limitations

The study has some limitations. We experienced difficulties in data collection because we could not interview the participants face-to-face due to the pandemic measures. On the other hand, the online questionnaire was completed by the respondent and parents or guardians to ensure the quality of data as much as possible. Second, the influences of COVID-19 on stress, anxiety, depression symptoms, and eating habits (37) might have caused an overdiagnosis of FA. Third, most participants were female, causing less well evaluation of the male sex. Fourth, anthropometric data were self-reported, leaving concerns of potential errors. Fifth, the overall number of FAs remained low, making it difficult to derive well-grounded conclusions. Some peculiar values that were thought to result from erroneous measurements were excluded from the evaluation. Finally, we were not able to investigate some other ingredients like fats that might also be related to FA.

Conclusion

In conclusion, this study suggests that FA and associated symptoms seen toward foods with higher sugar content increase because of stress, depression, and anxiety. For this reason, it is important to evaluate mental health problems to prevent nutrition-related problems in the adolescent period.

This study has also shown that foods high in sugar can cause addiction, although its cross-sectional design precludes causal inferences. Emotional states such as stress, depression, and anxiety can contribute to the development of FA. Contrary to expectations, FA, stress, depression and anxiety were not associated with BMI values. However, a more detailed evaluation of FA and mood changes may provide a new perspective on preventing and treating obesity in adolescents.

Acknowledgments

The authors would like to thank all the subjects who participated in this study.

Ethics

Ethics Committee Approval: Ethical approval for the study was obtained from the Hacettepe University Non-Interventional Clinical Research Ethics Committee (decision no: 2021/02-20, date: 20.06.2021).

Informed Consent: All participants gave written informed consent. Since voluntariness was taken as a basis for participation, all participants signed the volunteer consent form.

Peer review: Externally peer-reviewed.

Authorship Contributions

Surgical and Medical Practices: M.T., B.A.E., N.E., Concept: M.T., B.A.E., N.E., Design: M.T., B.A.E., N.E., Data Collection or Processing: M.T., N.E., Analysis or Interpretation: M.T., N.E., Literature Search: M.T., N.E., Writing: M.T., N.E.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declared that this study received no financial support.

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