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Prevalence of and Risk Factors for Food Addiction Among University Students

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PREVALENCE OF AND RISK FACTORS FOR
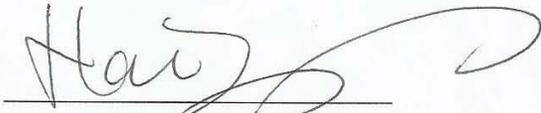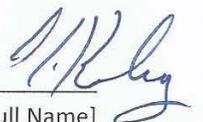
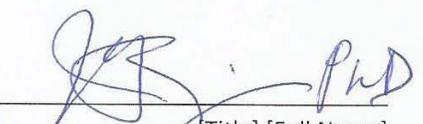FOOD ADDICTION AMONG UNIVERSITY STUDENTS

By

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Food Addiction among College Students

Abstract

The primary goal of this study was to assess the prevalence of food addiction and to determine

risk factors for food addiction among college students. Data was collected at Florida State

University (FSU) via a self-monitored survey modified from the Yale Food Addiction Scale 2.0.

The correlations between food addiction and body mass index (BMI), academic year, living

situations, the presence of a meal plan, and a history of dieting were analyzed. The results of

the study showed that 18.7% of college students have food addiction, and that obese students

as well as students that have a history of dieting are more likely to have food addiction than

their peers.

Introduction

Food Addiction and Obesity

Obesity is a devastating epidemic in our society, affecting 35% of men and 40% of women in the

United States between 2013 and 2014 [1]. People with obesity have an increased risk for an

array of diseases, including hypertension, dyslipidemia, type 2 diabetes, cancer, and coronary

heart disease [2]. The medical care costs of obesity in the United States are about $147 billion

dollars per year [2]. Psychological consequences of obesity may include decreased quality of life

and social stigma [3].

While there are many factors that influence whether a person becomes obese, such as

inactivity, genetics, and medications, the most common cause of obesity is overconsumption of

calories [4]. With over two-thirds of American adults being overweight or obese [5],

interventions for weight reduction are necessary. Unfortunately, the majority of people who

manage to lose weight are unable to maintain such weight loss over time [6]. Overeating can be triggered by food cues and a high frequency of food cravings for some individuals [7]. One possible explanation why some people overeat and become obese is these individuals may have a food addiction [8].

How Food May Be Addictive: Similarities between Addictive Foods and Drugs of Abuse

From the evolutionary standpoint, the human genome was designed for a diet in which carbohydrate intake was relatively low (35%), and these carbohydrates were frequently sourced from fruits and vegetables as opposed to grains and dairy [9]. We have a biological desire to seek and consume foods high in sugar and calories [10]. Nowadays, calorically-dense foods rich in sugar are easily accessible and abundant, and we remain driven to eat such foods [11]. Consumption of sugar sweetened beverages and solid foods high in free sugar increases the risk of obesity, as these foods tend to be calorically dense [12, 13].

Food addiction describes a pattern of abnormal, compulsive eating behaviors, typically towards foods high in sugar, fat, and salt [14]. It is unlikely that all foods have addictive potential [15]. Addictive substances, including food, are rarely found naturally in nature. However, the processing and combining of natural ingredients can create addictive substances. This can be seen in processing of grapes into wine, poppies into opium, and the coca leaf into cocaine [15]. With this understanding that addictive products are usually created through a process of refining, and possibly combining, ingredients, it becomes more comprehensible that food may become addictive as well. A wholesome ingredient such as corn may be processed into high fructose corn syrup, and then combined with hydrogenated fats and flavor enhancers to create highly-palatable foods that may become addictive for some individuals.

Animal Studies on Food Addiction

Several animal based research studies have characterized the nature of food addiction. In a study by Avena and colleagues, rats given intermittent sugar access (12 hour access to sugar solution and chow, followed by 12 hours of depravation) developed several key symptoms of addiction [16]. This intermittent access led to rats binging on the sugar solution (indicating tolerance) and daily dopamine release. This pattern of daily dopamine release is similar to that of a drug abuser, whereas rats who have tasted sugar only a few times have a blunted dopamine response. Sugar-dependent rats experienced somatic signs of teeth chattering, forepaw tremor, head shaking, and anxiety when food deprived for 24 hours. When sugar only was spontaneously taken away, rats experienced a decrease in body temperature and aggressive behaviors, indicating withdrawal. Over time, sugar dependent rats would lever press for significantly more sugar. This increased responsiveness for sugar indicates craving [17].

Altered dopamine release may be an explanation for obesity, which has been linked to a progressively worsening deficit in neutral reward responses. Altered dopamine release may include changes in reward homeostasis and the downregulated striatal dopamine receptors [17]. This altered reward homeostasis is similar to that induced by cocaine or heroin, and leads to compulsive-like feeding behavior in obese but not lean rats. The overconsumption of palatable foods (bacon, cake, chocolate etc.) triggers addiction-like neuroadaptive responses in brain reward circuits and drives the development of compulsive eating [17]. Both drugs of abuse and palatable foods reinforce behavior by releasing opioids and dopamine in the limbic system [18], and both can increase extracellular dopamine [19].

In summary, animal models of sugar dependence have provided evidence that sugar may be addictive, particularly when paired with intermittent access. Sugar-addicted rats binged and increased consumption over time (tolerance) [16, 20], experienced anxiety and depression during periods of depravation (withdrawal) [16], have increased responsiveness to sugar (craving) [16], experienced altered dopamine release [17, 16, 20, 18], and became cross-sensitized to other drugs of abuse [16, 20].

Food Addiction in Humans

Food addiction has shown to result in increased tolerance, symptoms of withdrawal, risky consumption, and consumption despite negative consequences in both rat and human studies [16, 21].

To further deepen the validity of food addiction, neurological differences have been found in humans who have food addiction as compared to those who do not [22]. Brain MRI scans indicate that individuals with high food addiction scores have increased cravings and motivation to consume food in response to food cues, and have greater anticipation for reward before consumption, yet less satiety after consumption. This was determined by the activation of specific brain regions before and after consumption of a milkshake [22]. Decreased satisfaction of carbohydrates has been shown to be a sign of tolerance in women [23], similar to drug tolerance [11].

Both cocaine and food cause the release of striatal dopamine in humans. In addition, both drug abusers and obese individuals have been found to have decreased sensitivity of the dopamine-reward system. Environmental cues are effective triggers for both food and drug cravings, regardless of withdrawal symptoms [24].

Yale Food Addiction Scale

The concept of food addiction has increasingly caught the attention of researchers with the development of the Yale Food Addiction Scale (YFAS) created and validated in 2009 [25], and revised in 2016 to match the new release of the 5th edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) [26]. The DSM-5 defines "Substance-Related and Addictive Disorders" as clinical disorders evidenced by inappropriate substance use within the last 12 months that meets at least two of the following eleven criteria: impaired control (four criteria), social impairment (three criteria), risky use (two criteria) and pharmacological/clinical response (two criteria, tolerance and withdrawal) [21]. Symptom count is determined based on how frequently an individual experiences the symptom. The frequency that is determined to be significant depends on the symptom being evaluated. For example, eating to the point of feeling physically ill once a month is not significant, but becomes a significant symptom of "substance taken in larger amount and for longer period than intended" when occurrence reaches a level equal to or greater than once a week. On the other hand, avoiding work, school, or social activities out of fear of overeating at least once a month is significant for "important social, occupational, or recreational activities given up or reduced" The first and second versions of the YFAS, along with scoring instructions, can be found through the University of Michigan Food and Addiction Science & Treatment Lab website [. This updated version of the YFAS not only expanded on the number of criteria examined, but also included a continuum of severity to include mild, moderate, and severe food addiction [9]. The YFAS 2.0 has good internal consistency, as well as convergent, discriminant, and incremental validity. It appears to

be a psychometrically sound measure that reflects the current diagnostic understanding of addiction [26].

Implications of Food Addiction and Aim of this Study

Not everyone who consumes high fat, high sugar foods become addicted to them. So, the question arises, why do some people develop food addiction, and others do not? Food addiction is linked to a pattern of restricting then binging [27]. Emotion dysregulation has also been associated with food addiction, and it is likely that disordered eating is caused by an attempt to regulate negative emotions [28]. And so, many emotional eaters, binge eaters, and chronic overeaters meet the behavioral criteria for food addiction [23].

According to meta-analysis food addiction studies, the prevalence of food addiction is 19.9%. Females are almost twice as likely to have food addiction as compared to males, and those that are overweight or obese are also more likely to have a food addiction as well [29].

The primary **goal** of this study was to assess the prevalence of food addiction among college students as well as to determine the relationships between food addiction status and BMI, GPA, living situations, and diet history in college students. It is hypothesized that food addiction will be significantly associated with BMI, gender, and diet history, but will not be significantly associated with academic year, GPA, presence of a meal plan, or living situations.

Methods

The primary tool of the study was a survey based on the Yale Food Addiction Scale 2.0. Several questions were added to this scale in order to address the hypothesis of the study. Examples of additional questions include anthropometric, lifestyle, and academic questions. The survey was then sent to a sample of FSU students via email and social media. The email contained a

message that recipients have been invited to participate in a studying regarding eating attitudes and behaviors, and the email contained a Qualtrics link to the survey. This email was sent to all students in the College of Human Sciences, Department of Chemistry and Biochemistry, and additional class rosters. The survey was voluntary, anonymous, and participants were required to give consent to participate before taking the survey. The survey link was active for 50 days. A copy of the survey can be found in the appendix.

Participants were asked to report their height, weight, age, and gender. Next, they were asked what their academic year in college is, their GPA, and whether they live on or off campus and whether or not they have a meal plan. Participants were also asked if they have ever dieted, and if so, how long ago was their last diet.

Only data from those who completed the YFAS 2.0 entirely were included. All other participants were excluded. There were no additional exclusions beyond failure to complete the YFAS 2.0. BMI (kg/m^2) was calculated from the self-reported height and weight of participants. From this, participants were classified as underweight (BMI < 18.5 kg/m^2), normal weight (18.5 kg/m^2 $\leq$ BMI < 25 kg/m^2), overweight (25 kg/m^2 $\leq$ BMI < 30 kg/m^2), and obese (BMI $\geq$ 30 kg/m^2) [17]. All statistical analysis was performed with the IBM SPSS 22.0 software. The chi-squared test and oneway ANOVA was used to test for significance.

Results

Altogether 547 students initiated the survey and 326 students (59.6%) completed it entirely. Only the data from those that completed the survey was used. The average participant age was 20 ($\pm$ 2.4).

When separated into two groups based on academic year (with freshmen and sophomores in one group, and juniors and seniors in another), there was no significant difference in food addiction status and academic year. There was also no significant difference in food addiction status between those living on campus with a meal plan, living on campus without a meal plan, and those living off campus. No significance was found between food addiction and grade point average.

As shown in Table 2, 19.9% of respondents were males and 80.1% of respondents were female. An option of "other" was provided for those who do not identify within traditional gender identities (such as those who identify as genderqueer); however no one selected this option. There was statistical significance between food addiction and gender (X^2=0.004).

Just over two-thirds of respondents were of normal weight (67%), and less than a third of the students were overweight or obese (28%). It is estimated that one-third of all college students are overweight or obese [30], and so this is not drastically far from average. There were not enough respondents who fell into the underweight and food dependent category to perform an accurate chai-squared test. Instead, those who were underweight and normal weight were compared to those who were overweight and obese. This yielded a significant correlation (X^2=0.005) with regards to food addiction.

The average age of respondents was 20.2, with a standard deviation of 2.4. The majority of respondents were seniors (31.5%), and a minority of respondents were sophomores (13.8%). This indicates that the respondents were not spread evenly across various academic years. There was no statistical significance between the academic years when compared individually, nor when comparing freshmen and sophomores to juniors and seniors.

There was no significance between food addiction and GPA; however, 85.8% of respondents had a GPA $\geq$ 3.0, which may not be an accurate representation of college students. The majority of students live off campus (74.2%). There was no significant relationship between those who live on or off campus, however, there was a slight significant relationship between those who do or do not have a meal plan (x^2=0.04).

About half of respondents have never dieted (52%), and about a third of respondents have dieted within the past year from time of survey (32%). There was a strong correlation between having a history of dieting and food addiction (X^2<0.000).

Of the 326 respondents that completed the YFAS 2.0, 61 people (18.7%) had a form of food addiction. Out of those with food addiction, 36 (59%) were considered to have severe food addiction. The average number of symptoms met was 2.4 (SD = 3.0). This symptom count is comparable to the average number of symptoms met by a large and diverse population (2.38 $\pm$ 3.19) [26]. The three most common symptoms in this study were: substance taken in larger amount and for longer period than intended, persistent desire or repeated unsuccessful attempts at quitting, and much time/activity spent to obtain, use, and/or recover from. Two of these symptoms (failure to reduce food intake and a lot of time spent) can also be found in the top three most common symptoms in a study that used the first version of the YFAS [11].

Table 1: Response numbers and averages

		No. (Percentage)	*p*-Value
Gender	Male	65 (19.9%)	0.004
	Female	261 (80.1%)	
Anthropometric	Age	20.2 $\pm$ 2.4	NS
	Height (inches)	66.2 $\pm$ 3.6	NS
	Weight (lbs.)	146.8 $\pm$ 30.7	0.006
	BMI	23.5 $\pm$ 4.1	<0.000
BMI* Category	Underweight <18.5	16 (4.9%)	N/A
	Normal 18.5 - 25	219 (67.2%)	
	Overweight 25 - 30	72 (22.1%)	
	Obese >30	19 (5.8%)	
Academic Year	Freshman	89 (27.3%)	NS
	Sophomore	45 (13.8%)	
	Junior	73 (22.3%)	
	Senior	103 (31.5%)	
	Graduate Student	16 (4.9%)	
GPA	3.5 - 4.0	171 (52.5%)	NS
	3.0 - 4.49	115 (35.3%)	
	2.5 - 2.9	31 (9.5%)	
	2.0 - 2.49	7 (2.1%)	
	<2.0	0 (0%)	
	No Response	2 (0.6%)	
Living Situations	On campus	84 (25.8%)	NS
	Off campus	242 (74.2%)	
Meal Plan	Has an on campus meal plan	48 (14.7%)	0.044
	Does not have a meal plan	278 (85.3%)	
Diet History	Has dieted within 6 months	69 (21.2%)	<0.000
	Has dieted within 12 months	35 (10.7%)	
	Has dieted 1 -2 years ago	22 (6.7%)	
	Has dieted over 2 years ago	32 (9.8%)	
	Has Never Dieted	168 (51.5%)	

- Significance determined by *p*<0.05
- *BMI: Body Mass Index
- N/A: Too few students were both underweight and food addicted to determine significance using chi-squared test among all four BMI categories
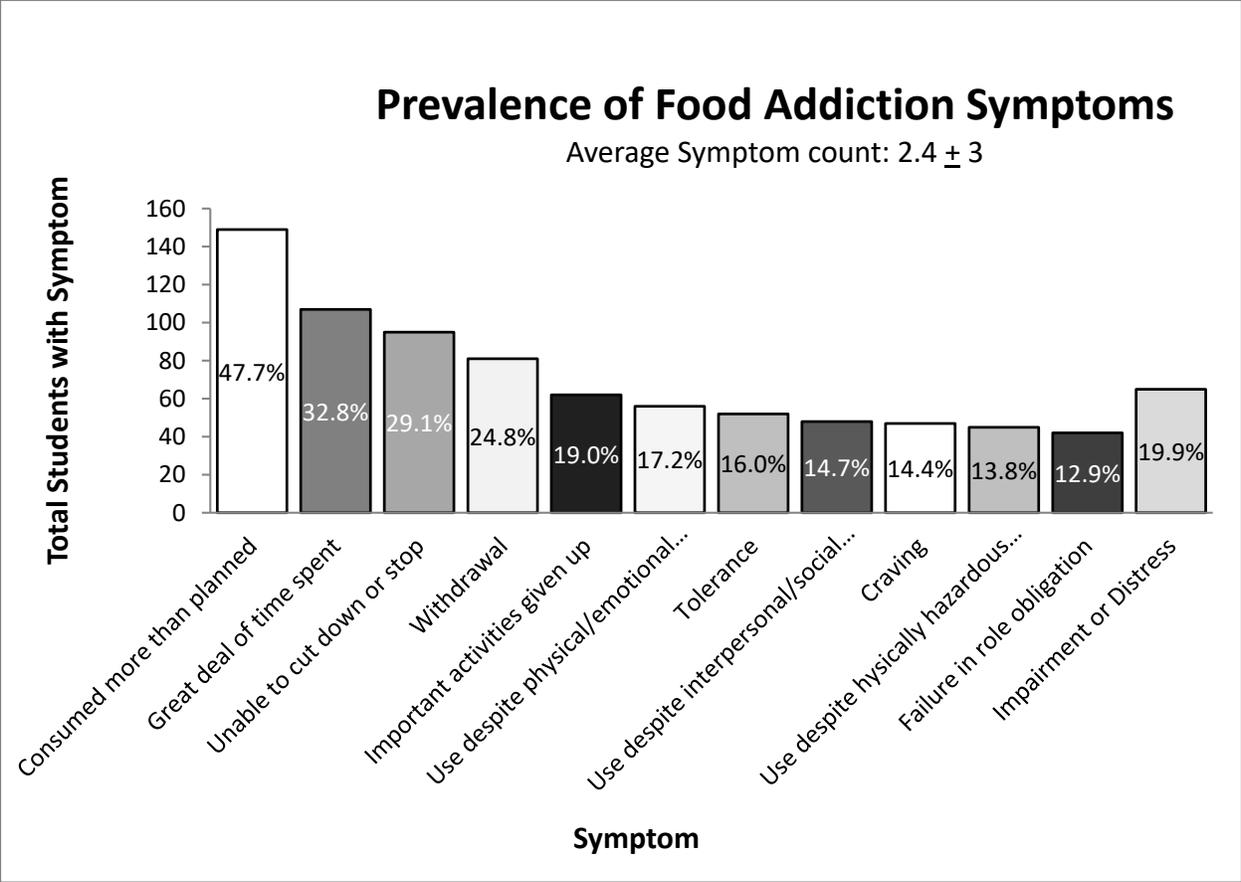
Figure 1: Prevalence of Food Addiction Symptoms
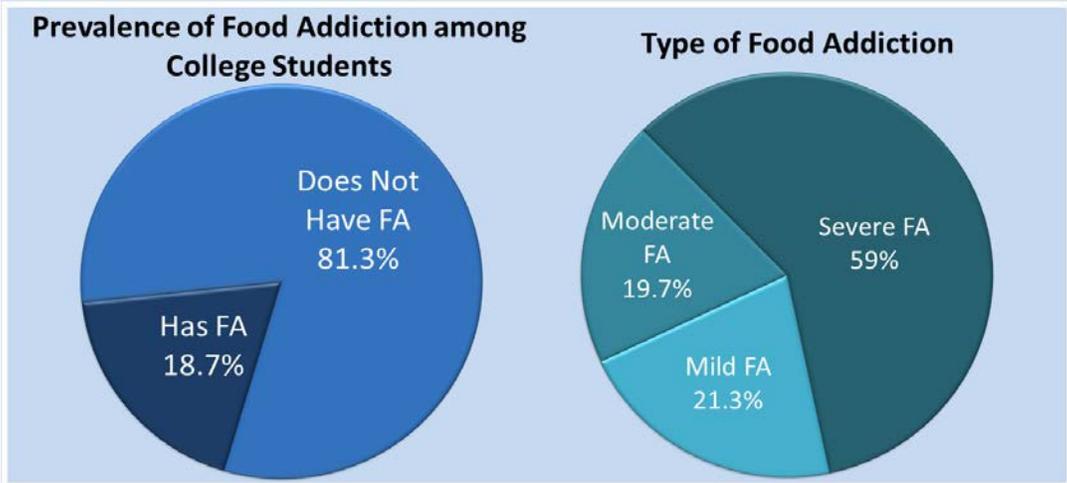
Figure 2: Prevalence of food addiction among students and type of food addiction
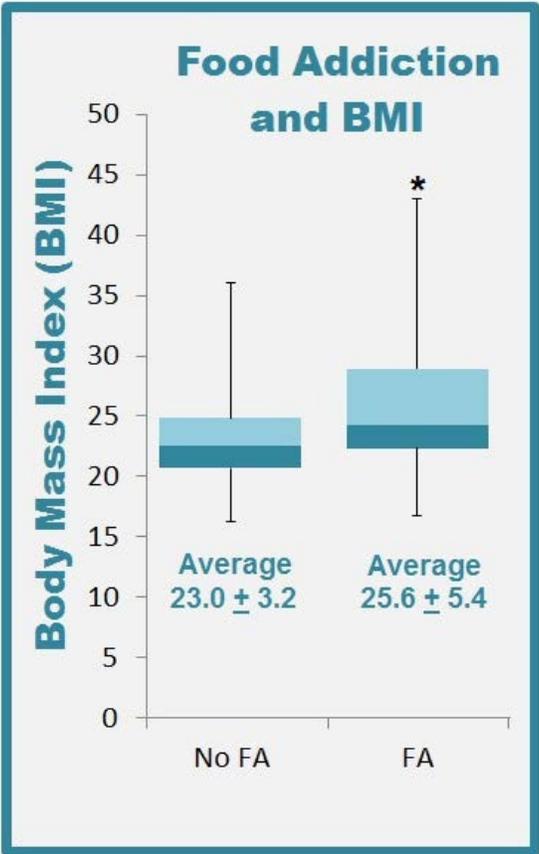
- * *p*-value <0.000

Figure 3: Average BMI of those with food addiction and those without

BMI Category	*n*=326	P-value
Underweight/Normal Weight		0.005
Overweight/Obese		

Figure 4: Significance of being overweight or obese (BMI ≥ 25) as compared to being underweight or normal weight (BMI < 25) and having food addiction
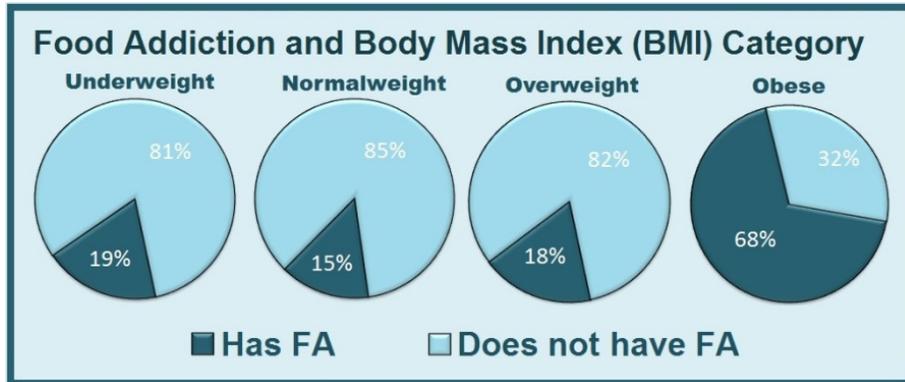
Figure 5: Percentage of college students with food addiction among different BMI categories
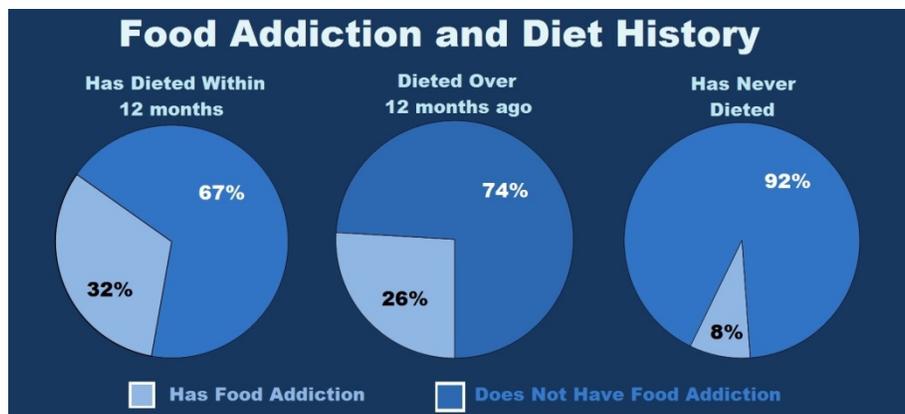

Figure 6: Percentage of college students with food addiction relative to diet history
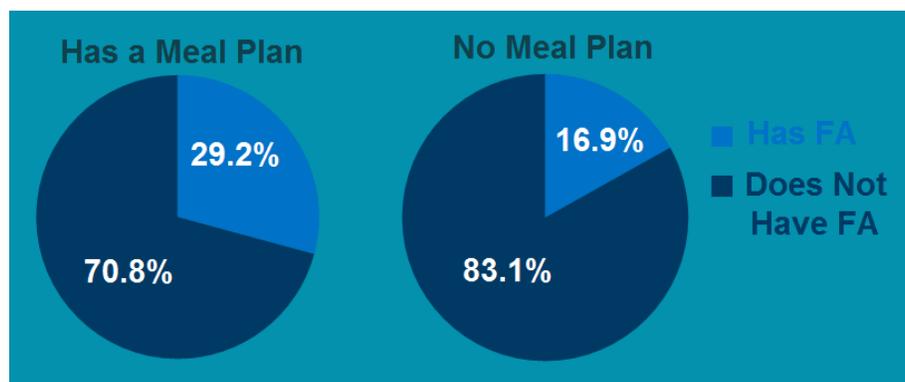

Figure 7: Percentage of college students with food addiction relative to having a meal plan

Discussion

The results of the study showed that 18.7% of students are considered to have food addiction (Figure 2). This is similar to the weighted mean prevalence of food addiction in adults, 19.9%, as determined by a meta-analysis of 25 studies [3]. This meta-analysis was performed before the release of the YFAS 2.0, which slightly expanded the diagnostic threshold for food addiction as compared to the original YFAS [26]. As a result, it is likely that more people now qualify for food addiction status with the YFAS 2.0 as compared to the original YFAS.

Females are at a greater risk for developing food addiction than males (Table 1). In general, females are more likely to have eating disorders and/or disordered eating as compared to males [31,32] as well as food addiction specifically [14,29].

This study shows that overweight/obese participants are at a higher risk for food addiction than those who are underweight/normal weight (Figure 4, p =0.005). These categories were created due to the small number of students who were both underweight and food dependent. When uncategorized, numerical BMIs were compared to food addiction status the significance was even greater (Figure 3, $p<0.000$). Other studies have also found that a higher BMI is associated with higher rates of food addiction diagnosis [26, 33, 34, 35]. However, these findings are not always conclusive. Another study that assessed food addiction specifically among college students found that the overall percentage of overweight/obese participants with food addiction was higher at 12.9% as compared to 5.5% in underweight/normal weight participants, however this was not statistically significant (p = 0.057) [14]. While it appears that food addiction status is associated with BMI, slight discrepancies among some studies warrant further research into the topic.

The apparent relationship between BMI and food addiction is concerning. Common symptoms of food addiction in this study include consuming a larger amount than expected and unsuccessful attempts of quitting [Figure 1]. A study from a larger and more diverse population found the most common symptoms to be withdrawal and being unable to cut down or stop. People who are overweight or obese and experiencing food addiction will mostly likely have extreme difficulty losing weight due to their food dependence. If a person experiences withdrawal symptoms, such as feeling irritable and sad or developing a headache, then it will be far more difficult for them to decrease consumption as compared to a person who does not experience such withdrawal symptoms. Several other food addiction symptoms, including craving, tolerance, and unsuccessful attempts to quit, may be significant hurdles for weight loss. Food-dependent individuals attempting to lose weight may benefit from the support of a registered dietitian and psychologist to assist with both diet modifications and behavior.

Those with a history of dieting were also significantly more likely to have a food addiction than those who have never dieted (Figures 1 and 6, $p<0.000$).

Most commonly, dieting refers to reducing caloric intake to lose weight [36]. This may entail the restriction of highly palatable, energy dense foods such as ice cream or fast food. About half of binge eaters develop their eating habits post-dieting [37]. It is unclear whether a person develops food addiction first and this may cause overeating and obesity, or whether a person overeats and then develops food addiction over time. It has been shown, however, that the restricting and binging of food causes food addiction to develop in rats [16]. It seems logical that a similar pattern may occur in humans, in which some individuals who restrict and binge on food develop food dependence. We live in a society that often promotes weight loss through

dieting, which may induce a pattern of restricting and binging on highly palatable foods. Thus, dieting may be the cause of food addiction for many individuals. In fact, this study shows that a history of dieting appears to be the most significant risk factor for food addiction ($p<0.000$), more so than gender (p=0.004), being overweight or obese (p=0.005), or having a meal plan (p=0.044). The connection between food addiction and dieting may have serious implications for those attempting to lose weight. More research should be done to validate the relationship between food addiction and dieting, as well as to determine if dieting causes food addiction, or if people with food addiction are more likely to initiate a diet.

Only 16.9% of those without a meal plan have food addiction, whereas 29.2% of those with a meal plan have food addiction. It has been found that the number of meals obtained from fast food restaurants is positively associated with financial access through a meal plan [38]. Fast food restaurants provide environmental cues that may trigger overeating, and fast food itself has the potential to be addictive [39]. And so, it is possible that those with a meal plan are consuming larger amounts of potentially addictive foods, and thus becoming more food dependent as compared to those without a meal plan. This study, however, is not enough to prove this correlation. More research should be done to assess the relationships between a college meal plan and disordered eating behaviors. If they are related, then this could result in a need for dramatic changes in the college foodservice systems.

Neither age nor academic year is significantly associated with food addiction (Table 1). This is to be expected from a relatively small age range (20.2 $\pm$ SD 2.4). A study by Zhiping and colleagues also found no significant relationship between food addiction status and academic year when comparing freshman and sophomores to juniors and seniors [14]. When considering a wider

array of ages, however, there is a difference in the prevalence of food addiction. Those younger than 35 years average a 17% prevalence of food addiction as compared to the 22.2% prevalence in those older than 35 years of age. It appears that older adults (aged 62 – 88) and children (<18 years) experience much lower rates of food addiction – 2.7% and 7.2%, respectively [29]. Older adults experience decreased ability to taste and smell, and thus have reduced sensory enjoyment of food. [40]. People who have food addiction may use food to regulate emotion have greater anticipation for reward before eating [28, 22]. It is possible that food addiction is unlikely to develop or survive in individuals whose diminished taste acuity, being that potentially addictive foods will not be perceived with the same intensity.

There appears to be no significant relationship between food addiction status and GPA (Table II). However, the population of students who took the YFAS 2.0 in this study is not an adequate representation of varying GPAs. 87.8% of respondents claimed to have a GPA > 3.0. And so, more research in this area would be needed for a definitive answer. It is possible that some food-addicted students will have additional academic struggles due to the clinical impairment of food addiction, and the poor food choices that food addiction typically entails. GPA has been found to be inversely correlated with BMI and fast food consumption [41]. Because food addiction is associated with a higher BMI [26] and hyperpalatable foods [42], it seems plausible that food dependence may influence GPA.

Further research should be done to assess risk factors for food addiction and the effects of food addiction on college students. While this study found no significant relationship between food addiction and GPA, it is possible that the clinical distress/impairment involved in a food addiction diagnosis may negatively impact a student's ability to succeed academically. If

students are overly distracted by food cravings and thoughts then they may find difficulty focusing on their studies or participating in extracurricular activities.

Unfortunately, there is no simple "cure" for addiction. Drug and food addiction involves the alteration of dopamine neurons [43, 17] resulting in addiction that will potentially last for a lifetime [43]. Further research should be done in returning dopamine neurons to their native state, which has the potential to benefit both people addicted to drugs and people addicted to food. Such treatment should theoretically decrease or eliminate the symptoms of food addiction, thus making weight loss easier in people who are overweight or obese. From an economical standpoint, healthcare costs should decrease as the percentage of people overweight or obese decreases. In addition, symptoms of food addiction may include much time spent to obtain, use, or recover from food and important social, occupational, or recreational activities given up or reduced. If individuals no longer experience these hindrances then their capacity to work and contribute to society will increase, as well as that person's quality of life. Therefore, it is imperative that society be concerned about the topic of food addiction and that research is done to prevent, treat, and cure food addiction.

Study Limitations

There are several limitations in this study. There was limited control over who received the survey, and the students that received it were not a random sample from the university. In addition, the sample size was small.

It is also possible that students may underreport, or overreport symptoms. This study did not assess general psychopathy, such as depression and anxiety, to compare these issues with food addiction.

Conclusion

The prevalence of food in college students was found to be 18.7%. There were significant relationships between food addiction and gender, diet history, and being overweight or obese. There was a slight significant relationship with food addiction and having a meal plan. There was no significant relationship between food addiction and GPA, living situations, and academic year.

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Appendix

Yale Food Addiction Scale

This survey asks about your eating habits in the past year. People sometimes have difficulty controlling how much they eat of certain foods such as:

- Sweets like ice cream, chocolate, doughnuts, cookies, cake, candy

- Starches like white bread, rolls, pasta, and rice

- Salty snacks like chips, pretzels, and crackers

- Fatty foods like steak, bacon, hamburgers, cheeseburgers, pizza, and French fries

- Sugary drinks like soda pop, lemonade, sports drinks, and energy drinks

When the following questions ask about "CERTAIN FOODS" please think of ANY foods or beverages similar to those listed in the food or beverage groups above or ANY OTHER foods you have had difficulty with in the past year

#	IN THE PAST 12 MONTHS:	Never	Less than monthly	Once a month	2-3 times a month	Once a week	2-3 times a week	4-6 times a week	Every Day
1.	When I started to eat certain foods, I ate much more than planned.	0	1	2	3	4	5	6	7
2.	I continued to eat certain foods even though I was no longer hungry.	0	1	2	3	4	5	6	7
3.	I ate to the point where I felt physically ill	0	1	2	3	4	5	6	7
4.	I worried a lot about cutting down on certain types of food, but I ate them anyways.	0	1	2	3	4	5	6	7
5.	I spent a lot of time feeling sluggish or tired from overeating.	0	1	2	3	4	5	6	7
6.	I spent a lot of time eating certain foods throughout the day.	0	1	2	3	4	5	6	7
7.	When certain foods were not available, I went out of my way to get them. For example, I went to the store to get certain foods even though I had other things to eat at	0	1	2	3	4	5	6	7

	home.							
8.	I ate certain foods so often or in such large amounts that I stopped doing other important things. These things may have been working or spending time with family or friends.	0	1	2	3	4	5	6	7
9.	I had problems with my family or friends because of how much I overate.	0	1	2	3	4	5	6	7
10.	I avoided work, school or social activities because I was afraid I would overeat there.	0	1	2	3	4	5	6	7
11.	When I cut down on or stopped eating certain foods, I felt irritable, nervous or sad.	0	1	2	3	4	5	6	7
12.	If I had physical symptoms because I hadn't eaten certain foods, I would eat those foods to feel better.	0	1	2	3	4	5	6	7
13.	If I had emotional problems because I hadn't eaten certain foods, I would eat those foods to feel better.	0	1	2	3	4	5	6	7
14.	When I cut down on or stopped eating certain foods, I had physical symptoms. For example, I had headaches or fatigue.	0	1	2	3	4	5	6	7
15.	When I cut down or stopped eating certain foods, I had strong cravings for them.	0	1	2	3	4	5	6	7
16.	My eating behavior caused me a lot of distress.	0	1	2	3	4	5	6	7
17.	I had significant problems in my life because of food and eating. These may have been problems with my daily routine, work, school, friends, family, or health.	0	1	2	3	4	5	6	7
18.	I felt so bad about overeating that I didn't do other important things. These things may have been working or	0	1	2	3	4	5	6	7

	spending time with family or friends.							
19.	My overeating got in the way of me taking care of my family or doing household chores.	0	1	2	3	4	5	6	7
20.	I avoided work, school or social functions because I could not eat certain foods there.	0	1	2	3	4	5	6	7
21.	I avoided social situations because people wouldn't approve of how much I ate.	0	1	2	3	4	5	6	7
22.	I kept eating in the same way even though my eating caused emotional problems.	0	1	2	3	4	5	6	7
23.	I kept eating the same way even though my eating caused physical problems.	0	1	2	3	4	5	6	7
24.	Eating the same amount of food did not give me as much enjoyment as it used to.	0	1	2	3	4	5	6	7
25.	I really wanted to cut down on or stop eating certain kinds of foods, but I just couldn't.	0	1	2	3	4	5	6	7
26.	I needed to eat more and more to get the feelings I wanted from eating. This included reducing negative emotions like sadness or increasing pleasure.	0	1	2	3	4	5	6	7
27.	I didn't do well at work or school because I was eating too much.	0	1	2	3	4	5	6	7
28.	I kept eating certain foods even though I knew it was physically dangerous. For example, I kept eating sweets even though I had diabetes. Or I kept eating fatty foods despite having heart disease.	0	1	2	3	4	5	6	7
29.	I had such strong urges to eat certain foods that I couldn't	0	1	2	3	4	5	6	7

	think of anything else.							
30.	I had such intense cravings for certain foods that I felt like I had to eat them right away.	0	1	2	3	4	5	6	7
31.	I tried to cut down on or not eat certain kinds of food, but I wasn't successful.	0	1	2	3	4	5	6	7
32.	I tried and failed to cut down on or stop eating certain foods.	0	1	2	3	4	5	6	7
33.	I was so distracted by eating that I could have been hurt (e.g., when driving a car, crossing the street, operating machinery).	0	1	2	3	4	5	6	7
34.	I was so distracted by thinking about food that I could have been hurt (e.g., when driving a car, crossing the street, operating machinery).	0	1	2	3	4	5	6	7
35.	My friends or family were worried about how much I overate.	0	1	2	3	4	5	6	7

[44]

Yale Food Addiction Scale Scoring Instructions

All questions on the YFAS 2.0 are continuous. To reflect diagnostic thresholds, a cut-off for each question was established to allow for determination of a diagnosis and severity level. Questions on the YFAS 2.0 have eight frequency response options that range from "Never" to "Every Day." The threshold for the YFAS 2.0 symptom questions were determined by examining specificity for each response option based on Receiver Operator Characteristic (ROC) curves. There is no existing gold standard for assessing "food addiction," thus we created a multivariate latent variable that included constructs that are theoretically associated with addictive-like eating (e.g., BMI, binge eating frequency, TFEQ disinhibition, and TFEQ hunger). A confirmatory factor analysis of the multivariate latent variable suggested an excellent fit to a one-factor solution, χ^2 (2 df) = 1.53, p = .47, CFI = 1.00, RMSEA = .00 (95% CI; 0.000,

0.075), SRMR = .008, with standardized factor loadings ranging from .37 to .95. The latent variable was

saved and imported into the data set for purposes of conducting ROC analyses. The highest quartile of

the multivariate latent factor scores was used as the outcome indicator for the ROC curve analyses to

identify YFAS 2.0 question thresholds. To reduce the likelihood of over-pathologizing normal eating

behaviors, thresholds with specificity of .90 or greater were chosen as the cut-off for each question.

Thresholds for these questions ranged from once a month to 4-6 times a week, although the threshold

for the majority of YFAS 2.0 questions was once a week (eight questions) or 2-3 times a week (eight

questions). To maintain consistency with the diagnostic scoring option of the original YFAS, the same

thresholds used for the clinical significance questions (impairment or distress) were retained for the

YFAS 2.0 (i.e., two to three times a week or more) [44].

Each question falls under a DSM 5 Substance-Related and Addictive Disorders (SRAD) symptom criterion or clinical impairment/distress:

1) Substance taken in larger amount and for longer period than intended

Questions #1, #2, #3

2) Persistent desire or repeated unsuccessful attempts to quit

Questions #4, #25, #31, # 32

3) Much time/activity to obtain, use, recover

Questions #5, #6, #7

4) Important social, occupational, or recreational activities given up or reduced

Questions #8, #10, #18, #20

5) Use continues despite knowledge of adverse consequences (e.g., emotional problems, physical problems)

Questions, #22, #23

6) Tolerance (marked increase in amount; marked decrease in effect)

Questions #24, #26

7) Characteristic withdrawal symptoms; substance taken to relieve withdrawal

Questions #11, #12, #13, #14, #15

8) Continued use despite social or interpersonal problems

Questions #9, #21, #35

9) Failure to fulfill major role obligation (e.g., work, school, home)

Questions #19, #27

10) Use in physically hazardous situations

Question #28, #33, #34

11) Craving, or a strong desire or urge to use

Questions #29, #30

12) Use causes clinically significant impairment or distress

Questions #16, #17

Each question has a different threshold: 0 = threshold not met, 1 = threshold is met

1) Once a month: #9, #10, #19, #27, #33, #35

2) Two to three times a month: #8, #18, #20, #21, #34

3) Once a week: #3, #11, #13, #14, #22, #28, #29

4) Two to three times a week: #5, #12, #16, #17, #23, #24, #26, #30, #31, #32

5) Four to six times a week: #1, #2, #4, #6, #7, #15, #25

After computing the threshold for each question, sum up the questions under each criterion (e.g.

Tolerance, Withdrawal, Clinical Significance, etc.). If the score for the symptom criterion is $\geq$ 1, then the

criterion has been met and is scored as 1. If the score = 0, then the symptom criterion has not been met

and is scored as 0.

Example:

Tolerance: (#24 =1) + (#26 = 0) = 1, Criterion Met

Craving (#29=0) + (#30 = 0), Criterion Not Met

Failure to fulfill role obligations (#19 =1) + (#27 = 1), Criterion Met and scored as 1

For the symptom count scoring option, add up all of the scores for each of the 11 criterion (e.g.

Tolerance, Withdrawal, Use Despite Negative Consequence). Do not add clinical significance to the

score. This score should range from 0 to 11 (0 symptoms to 11 symptoms.) [44].

For the "diagnosis" scoring option, a participant can meet for mild, moderate or severe food addiction.

Both the symptom count score and the clinical significance criterion are used.

     No Food Addiction = 1 or fewer symptoms

     No Food Addiction = Does not meet criteria for clinical significance

     Mild Food Addiction = 2 or 3 symptoms and clinical significance

     Moderate Food Addiction = 4 or 5 symptoms and clinical significance

     Severe Food Addiction = 6 or more symptoms and clinical significance