



Associations Between Food Addiction and Substance-Use Disorders: A Critical Overview of their Overlapping Patterns of Consumption

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Accepted: 13 September 2022

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Abstract

Purpose of Review Research on patterns of overconsumption in individuals with food addiction (FA) has focused largely on binge eating. However, compulsive overeating can be varied and dimensional. This review focuses on the similarities between the patterns of consumption in FA and in other clinically established substance-use disorders, such as alcohol and nicotine dependence. It also highlights features that make FA unique to other addiction disorders.

Recent Findings Overall, there is substantial evidence that binge-like overconsumption is a characteristic of various substance-use and eating disorders. Likewise, it appears that different overeating patterns can reflect addictive-like eating. One pattern may be *compulsive grazing* — defined as the repetitive inability to resist consumption of small amounts of food.

Summary This review adds to the increasingly compelling picture that FA and binge-eating disorder are unique conditions, and that FA resembles other substance-use disorders. We conclude that a variety of overeating patterns can reflect addictive eating behaviours in vulnerable individuals, one of which may be compulsive grazing.

Keywords Food addiction · Binge eating · Grazing · Compulsive overeating · Substance-use disorders

Introduction

In an attempt to advance the nosology of *food addiction* (FA), one recent review identified two notable priorities for future FA research — the first was to establish diagnosable features unique to addictive-like eating [1••]. Accordingly, the purpose of this special issue is to contribute to the evidence that FA is a *bona fide* and unique condition that resembles other addiction disorders. Our objective in this larger context is to review the parallels between the *patterns of consumption* seen in conventional substance-use disorders and in FA — a discussion of which is missing in the literature [2, 3, 4••]. In general, research on patterns of overconsumption in individuals with compulsive overeating has focused largely on binge eating — an issue that will be addressed in more detail later in this review [5]. However,

we know from clinical reports that patterns of excessive intake can be varied and dimensional [6, 7]. For example, subjective descriptions from individuals with obesity have included “binge eating,” “constant overeating,” “hyperphagia,” “stuffing syndrome,” “nibbling,” and “between-meal snacking” [5].

In the following sections of this paper, we focus on the similarities between the patterns of consumption in FA and in other clinically established substance-use disorders such as alcohol and nicotine dependence. We also outline differences in facets of FA that render it unique to other addictive conditions.

Background

A wealth of evidence has shown that weight loss is seldom sustained long term solely through the provision of lifestyle changes (i.e., diet and exercise) [8, 9]. Weight cycling commonly occurs in both women and men, and global obesity levels remain high [8, 9]. This has become particularly evident during the ongoing coronavirus (COVID-19) pandemic, where both obesity prevalence and food consumption have increased [10]. Indeed, there is also good evidence that

This article is part of the Topical Collection on *Food Addiction*

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factors other than lack of motivation influence weight gain, and re-gain. One perspective is that dramatic changes in food type and availability poorly serve our inherent biological predisposition to consume high-calorie foods, even in the absence of hunger [11]. The outcome is an evolutionary “mismatch” that can promote chronic and excessive intake of food — especially in certain vulnerable individuals [11].

In recent years, attention has focused on the notion that ultra-processed foods,¹ and those with a high-glycemic load, can lead to an addictive process akin to that seen in other substance-use disorders [12–14]. In other words, such foods can promote escalation of intake, withdrawal, pronounced cravings, and relapse — a syndrome which has come to be known colloquially as FA [12–14]. That is, some individuals may continuously attempt and express a desire to reduce their food intake, but repeatedly fail to do so despite emotional, social, or health consequences [15].

A salient point is that individual differences in affinity for “reward” contribute to vulnerability for addiction. Particularly, the confluence of various psychobiological and environmental risk factors can cause certain individuals to experience a heightened response to the rewarding properties of ultra-processed foods [16]. Further analysis of these risk factors is outside the scope of this review, but will be covered by other contributions in this special issue. Correspondingly, we cannot assume that all instances of overeating represent an addiction to food, in the same way that one would not expect all those who regularly consume alcohol to develop alcohol-use disorder. For example, while the majority of adults consume alcohol in their lifetime, only about 5–10% become dependent on it [17, 18]. Similarly, it is estimated that FA is prevalent in 8–15% of individuals in the general population [19, 20].

In the current review, we draw parallels from alcohol and nicotine dependence as we believe these are the most appropriate addiction disorders to compare with addictive-like food consumption. Like with food, the consumption of alcohol and tobacco is attainable legally — as opposed to other substances such as cocaine or heroin. Indeed, in the early twentieth century, smoking tobacco was viewed as a “natural accompaniment of work and play” [21]. In addition, all three substances have a long history and well-established association with wealth, celebration, and cultural/religious rituals [22]. Moreover, adverse effects from chronic alcohol and nicotine consumption, such as liver cirrhosis and lung cancer, only appear after years of consumption. Likewise,

chronic overconsumption of food can lead to obesity, diabetes, or cardiovascular disease over time [4••].

Binge-Like Consumption as a Cross-Diagnostic Behavior

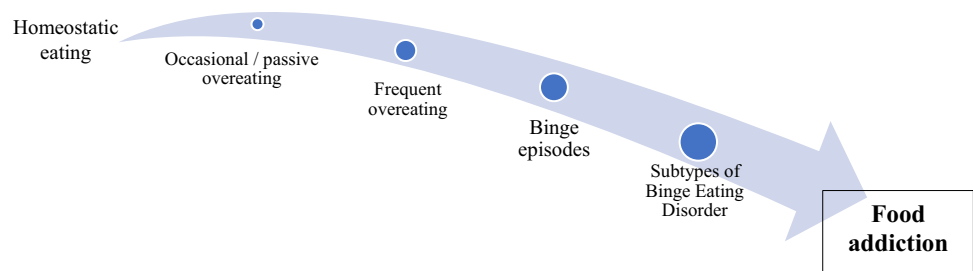
The overlap between FA and binge-eating disorder (BED) is not surprising given that they share symptomology (e.g., repeatedly failing to mitigate compulsions and impulsiveness). The two disorders can also subsume other psychopathological maladies such as attention-deficit hyperactive disorder, depression, and anxiety [23–25]. Individuals with BED and FA also display similar neurobiological profiles, wherein they both exhibit elevated food-related reward responses [26]. For example, when consuming ultra-processed foods (e.g., a chocolate milkshake), women with FA showed less activation in the lateral orbitofrontal cortex — an area of the brain associated with inhibitory control [27]. Greater activation is associated with an increased ability to self-control excessive behaviours such as food or drug overconsumption [28].

Accordingly, a key characteristic of both conditions is a loss of control (LOC) over the intake of certain foods — typically those that are hyper-palatable and calorically dense [26, 29]. For example, if the difficulty to resist the hedonic urge to eat tasty foods is strong enough, individuals may feel a subjective inability to self-regulate what and how much is eaten [30, 31]. LOC eating may develop over time from constant exposure to ultra-processed foods [30, 31]. For example, it has been shown that LOC eating episodes typically appear in childhood, while clinically relevant symptoms of FA develop first in adolescence [32, 33].

However, while BED and FA are marked by overlapping symptoms, evidence suggests that individuals with FA experience greater compulsive eating, distress, impulsivity, and mood disorders when compared to those with BED [24, 26, 34]. One viewpoint is that among those with BED, FA may reflect a more severe condition, characterized by addictive-like behaviours [35, 36]. That is, for some, the development of binge-eating behaviours — viz. increased LOC, and frequency and size of binge episodes — may ultimately trigger a severely compulsive and pathological condition that has strong clinical and biological parallels to other clinically established addiction disorders [35, 36]. Accordingly, Davis’ [35] dimensional view of overeating (see Fig. 1) proposes that food consumption patterns range from non-psychopathological homeostatic eating (energy-balance eating) at the lowest end of the continuum to FA at the highest. Binge-eating behaviors start mid-way along this continuum. In other words, untreated and/or chronic binge eating may develop into an addiction disorder in the same way that heavy alcohol consumption may lead to an alcohol-use disorder, or “chain

¹ Ultra-processed foods describe foods which are significantly altered from their original state to enhance their sensorial properties and make them hyper-palatable. Alternations may include the addition of salt, sugar, oils, fats, and other additives that are not naturally present, such as preservatives and/or artificial colors [81].

Fig. 1 A continuum of eating behaviours ranging from non-pathological homeostatic eating to food addiction. Adapted from Davis' [35] dimensional view of overeating



smoking” — smoking several cigarettes in succession — to nicotine dependence [35, 36]. For example, a longitudinal study of 1972 college students found that binge drinking in college is a risk factor for alcohol-use disorder later in life [37]. Similarly, the earlier an individual starts smoking in life, the greater their chances of becoming dependent on nicotine, and the lower their chances are of quitting smoking as an adult [38].

Most notably, however, an accumulating body of empirical evidence has shown that a significant proportion of those who engage in addictive-like eating do not binge eat, and vice versa — indicating that BED and FA represent idiosyncratic diagnoses [39•]. Comparable is research indicating that binge drinking does not necessarily warrant an alcohol-use disorder diagnosis, with the former requiring a brief intervention and the latter requiring intensive and possibly pharmacologic treatment [40].

In summary, there is good evidence that binge-related behaviors are not unique to one condition, but that instead, various substance-use and eating disorders can manifest binge-like consumption patterns. Likewise, there appears to be a pattern of excessive consumption that can also become highly compulsive yet does not represent a binge [29, 41, 42••].

“Grazing” in Food Addiction

It is becoming evident that a LOC over food consumption can occur irrespective of the volume of food consumed [43]. Interestingly, research in treatment-seeking individuals with BED and obesity has found that resolving binge eating does not tend to produce significant weight loss (e.g., [44]). Instead, individuals report lingering patterns of uncontrolled, unstructured, and repetitive consumption of small amounts of food following treatment [5].

This pattern of overeating has been called *compulsive grazing* and is characterized by a repetitive inability to resist consumption of relatively small amounts of food over an extended period of time, outside of planned meals and irrespective of hunger or satiety sensations. There also exists a non-compulsive form, which others have referred to as “nibbling” or “snacking” — and describes a pattern of overeating

that is repetitive in a distracted, rather than a compulsive, fashion [45••, 46••]. Importantly, non-compulsive grazing is sometimes viewed as an adaptive eating behavior [45••, 46••]. For example, Reas et al. [47] found that “nibbling” among university students was common, and not associated with increased BMI or other eating psychopathology. Similarly, studies looking specifically at non-compulsive grazing reported no relationship with weight gain, binge eating, or other eating psychopathology [48]. Therefore, non-compulsive grazing may be a healthy eating behavior used by weight-loss treatment-seeking individuals, in an attempt to restrict food intake [49••]. Alternatively, compulsive grazing — which includes a sense of LOC — has been associated with greater weight dysregulation, reduced body image and treatment success for obesity, increased levels of depression and anxiety, and more frequent and severe binge eating [50••]. For example, a treatment program for individuals with obesity that targeted inhibition found that treatment reduced grazing incidences, suggesting that grazing is associated with decreased self-regulation [51]. Importantly, compulsive grazing and binge eating are similar in that they are both associated with feelings of LOC over eating, yet grazing is unique in its lack of discrete time limits, the relatively slow manner in which eating occurs, and the relatively small amounts of food at each intake [45••, 46••].

Grazing has garnered the most clinical interest in the field of post-operative bariatric surgery, where it is viewed as a significant form of overeating associated with reduced treatment success. Indeed, it has frequently been described as a “high-risk behavior” [5, 52, 53]. Evidence suggests that the vast majority (~80%) of bariatric surgery patients experience post-operative grazing episodes — since it becomes physiologically impossible for them to consume large amounts of food at once [45••, 52, 54]. While it is suggested that bariatric surgery could be beneficial for those struggling with obesity, about a quarter of operated patients regain weight because of recurring disordered eating behaviours such as food compulsions, cravings, and “snacking” [54, 55]. It should be emphasized that grazing is different from the small meals prescribed to those who have had bariatric surgery [56]. In the latter situation, both the choice of food and the time of ingestion are intentionally planned and controlled to occur in response to hunger/satiety signals [52].

Despite being labelled a high-risk eating behavior, grazing remains vastly understudied within the FA population. A PubMed search of the terms “grazing” and “food addiction” produced 5 results — two articles of which we had written [6, 42••]. In the first, we investigated relationships between FA and other patterns of overeating, including compulsive grazing, in a general population sample [42••]. We found a positive relationship between FA and grazing. Interestingly, after accounting for compulsive grazing in the statistical model, binge eating added no further unique variance to the symptom severity of FA. We recently conducted a second study in a high-risk sample of weight-loss seeking individuals with overweight or obesity [57••]. In this sample, which had an FA prevalence of 28%, we similarly found that grazing was significant, but binge eating was not, in our model. Interestingly, grazing was the greatest contributor of variance in the dependent variable (FA). Together, these studies support the view that individuals with addictive tendencies towards food also display elevated levels of compulsive grazing. Others have also found that those with FA are more likely to report higher consumption of sweet and salty “snack foods” such as chips, pastries, and ice cream [6]. Therefore, it is probable that FA comprises various dietary patterns, including both binge eating and grazing.

Consumption Patterns in Traditional Substance-Use Disorders

Similar to food, consumption patterns in other addictive substances, such as nicotine and alcohol, can also vary. For example, Epstein et al. [58] identified four clinically relevant patterns of alcohol consumption in alcohol-dependent adults — binge, episodic, sporadic, and steady — and found that only 6.5% of individuals with alcohol-use disorder binge drink [58]. That is, while some individuals may engage in one binge-drinking episode per day, others may consume similar volumes of alcohol continuously throughout the day over several discrete drinking episodes [59]. As such, alcohol-use disorder may involve daily heavy drinking that does not fall under the definition of binge drinking [40].

Similarly, the portrait of a “high-functioning alcoholic” (HFA) suggests that some individuals with alcohol-use disorder can still maintain high-position jobs and stable relationships [60]. They often do not drink to the point of “blacking out” — in other words, they often do not binge drink [60]. Clinical reports of HFA college students show that they binge drink only on certain days of the week, for a certain number of days, or only after they have completed their responsibilities (e.g., assignments and/or studying) [60]. Others are daily drinkers who sustain a steady blood alcohol level [60]. Since binge drinking is so pervasive in college culture, clinicians report difficulties knowing when

it is actually pathological [60]. Instead, some maintain it is the LOC and attempts to ameliorate negative feelings that better defines someone with an alcohol-use disorder [60]. That is, the overconsumption of alcohol in a binge-drinking pattern is not equivalent to having an addiction towards it.

Likewise, various patterns of intake have been identified in those with nicotine dependence. For example, one study identified five classes of cigarette smoking patterns: no-context, puffers, social, moderate, and heavy smokers [61]. The authors of this study suggested that such a classification may represent a transitional process from experimentation to nicotine dependence [61]. Similarly, while some with nicotine dependence are considered “chain smokers,” others show patterns of intermittent smoking, which involves consuming less than five cigarettes per day, and smoking less than daily [62]. However, even intermittent smokers may experience symptoms of withdrawal, craving, and relapse when they attempt to abstain [62]. Evidence suggests that three quarters of intermittent smokers relapse after attempting to quit [62, 63].

Comparably, a seminal study on nicotine dependence in youth showed that symptoms of dependence can develop irrespective of the volume or frequency of cigarettes smoked [64]. Participants reported a mean cigarette consumption of 2 per week at the onset of dependence symptoms [64, 65]. Some youth developed nicotine dependence after smoking only eight cigarettes a month, reporting difficulties quitting and withdrawal [64, 65]. As such, it has been suggested that different types of interventions may be needed for different types of smokers [61]. For instance, traditional cessation programs may not be successful with non-daily smokers, primarily because they do not perceive themselves as having a problem [61].

Differences in Consumption Among Those with Food Addiction Compared to Those with Traditional Substance-Use Disorders

Global prevalence of traditional substance-use disorders has remained relatively steady over the past two decades [66]. Alternatively, food portions, and the percent of daily calories from “fast foods” (e.g., hot dogs, hamburgers, French fries), have significantly increased [67]. Such foods are cheap, easily obtainable, heavily marketed, and legal [68]. Therefore, the likelihood of exposure to a food-related cue is high. This is particularly relevant since food-related cues have been shown to increase appetitive behavior (i.e., salivation, gastric acid secretion, insulin release), and desire to eat, even in the absence of hunger [7, 69]. Moreover, and as has also been seen with other addiction disorders, repeated exposure to such foods and their cues increases sensitization — meaning an individual

can become hyper-reactive to these cues, and therefore more likely to act on their compulsion to eat [70, 71]. Importantly, while it is common for traditional addiction rehabilitation programs to promote restraint from externally triggering stimuli (e.g., certain social settings, drug paraphernalia), it is considerably more difficult for those with FA to avoid food cues. Given that food and associated cues are ubiquitous in most developed countries, refraining from the compulsion to overeat may be more difficult for the affected individual than in the case of other addiction disorders [7, 72].

Other arguments against the validity of the FA construct are that unlike drugs, food is necessary for survival (e.g., [3]). While it is true that humans must eat to survive, several scholars have eloquently argued that it is only the ultra-processed, calorically dense foods that have addictive potential (see [73, 74]). In other words, a healthy, life-sustaining diet does not require the consumption of ultra-processed foods — or foods that have high levels of refined sugar or processed fats. It has been estimated that more than 50% of the calories in ultra-processed foods come from added sugars, and that some form of sugar has been added to about 75% of the food supply chain [75–77]. Likewise, the tobacco industry participates in nicotine “dosing,” to ensure that nicotine levels in cigarettes encourage overconsumption [77].

Lastly, while all addictions reflect a set of underlying symptoms and processes, they can manifest differently depending on the substance consumed [15]. This variability has been acknowledged in the current version of the *Diagnostic and Statistical Manual (DSM-5)* [78]. For instance, a diagnosis of substance dependence can be given if an individual meets any combination of two of the 11 symptoms presented [78]. This was reduced from three symptoms in the preceding version of the DSM, further highlighting the heterogeneous nature of these addictions [78]. Furthermore, while opioid withdrawal is a life-threatening condition where symptoms range from restlessness to seizures [79], nicotine withdrawal is characterized by irritability and anxiety and causes relatively little impairment in one’s daily life [78]. Still, one cannot refute that both substances trigger an addictive response and are difficult to abstain from when consumed regularly [68]. In other words, a substance can still be considered highly addictive without having acute life-threatening side effects, or severe withdrawal [68]. Correspondingly, withdrawal symptoms from FA include headaches, fatigue, irritability, anxiety, depressive moods, and restlessness [80]. However, the chronic overconsumption of caloric and ultra-processed foods may still play a role in premature death. Non-communicable conditions such as diabetes and cardiovascular disease — which are highly co-morbid with obesity — are the leading causes of mortality in the world [68, 74]. Therefore, and similar to

nicotine dependence, the absence of severe and immediate withdrawal symptoms is not a sufficient reason to devalue the addictive potential of a substance.

Conclusions

We review the evidence that a variety of overeating patterns can reflect addictive eating behaviours in vulnerable individuals, similar to what is seen in other substance-use disorders. Given that BED and FA are frequently conflated in discussions of compulsive overeating, it is important to emphasize that binge eating is not essential for a diagnosis of FA. That is, while the transition from BED to FA clearly describes some overeating experiences, others exhibit a progression to food dependence that includes other LOC patterns such as compulsive grazing. Such heterogeneity is similar to conventional substance-use disorders like alcohol and nicotine dependence.

The study of eating patterns that contribute to, and are characteristic of, addictive tendencies towards food is particularly germane given that weight-loss programs focusing on energy balance remain largely ineffective, and since obesity relapse remains high. It is also important to understand addictive-like overeating in the context of both internalized and externalized (family/friends/society) stigmatization [see 34,73,74]. An acknowledgement that eating can become compulsive and addictive for some may help explain the lack of control experienced in those with obesity. This knowledge may reduce stigmatization from others and increase one’s willingness to seek treatment for their obesity.

Declarations

Conflict of Interest The authors declare no competing interests.

Human and Animal rights and Informed Consent All reported studies/experiments with human subjects performed by the authors have either been previously published or are in preparation to be published, and comply with all applicable ethical standards (including the Helsinki Declaration and its amendments, institutional/national research committee standards, and international/national/institutional guidelines).

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