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REVIEW

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# Back by Popular Demand: A Narrative Review on the History of Food Addiction Research

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In recent years, the concept of food addiction has gained more and more popularity. This approach acknowledges the apparent parallels between substance use disorders and overeating of highly palatable, high-caloric foods. Part of this discussion includes that "hyperpalatable" foods may have an addictive potential because of increased potency due to certain nutrients or additives. Although this idea seems to be relatively new, research on food addiction actually encompasses several decades, a fact that often remains unrecognized. Scientific use of the term *addiction* in reference to chocolate even dates back to the 19th century. In the 20th century, food addiction research underwent several paradigm shifts, which include changing foci on anorexia nervosa, bulimia nervosa, obesity, or binge eating disorder. Thus, the purpose of this review is to describe the history and state of the art of food addiction research and to demonstrate its development and refinement of definitions and methodologies.

## INTRODUCTION

In recent years, the concept of food addiction has become increasingly popular. This concept includes the idea that certain foods (usually highly processed, highly palatable, and highly caloric foods) may have an addictive potential and that certain forms of overeating may represent an addicted behavior. This increased popularity is reflected not only in a high number of media reports and lay literature [1,2], but also in a substantial increase in the number of scientific publications (Figure 1) [3,4]. In 2012, for example, a comprehensive handbook on food and addiction was published because "science has reached a critical mass to the point where an edited book is warranted" [5]. This increased interest appears to have created the impression that the idea of food addiction only became relevant in the 21st century because of the increasing availability of highly processed foods and that the concept of food addiction was developed in an effort to explain increasing prevalence rates of obesity [6]. Some researchers even refer to alleged pioneering work in food addiction research by citing articles that were published in this century [7,8].

As will be demonstrated throughout this paper, this notion about food addiction being a new idea, which originated in recent years and may explain the obesity pandemic, is wrong. Therefore, this article briefly presents the development of food addiction research. One aim is to demonstrate that its history, although it is a relatively new field of research, actually encompasses several decades and the association between food and addiction even dates back to the 19th century. In the 20th century, focus areas of and opinions about food addiction changed dynamically, such as the types of foods and eating disorders that were proposed to be related to addiction and the methods that were used to investigate eating behavior from an addiction perspective (Figure 2). The current article, however, does not intend to outline the various phenomenological and neurobiological parallels between overeating and substance use or speculate about possible consequences and implications of the food addiction concept for treatment, prevention, and public policy. All of these issues have been extensively discussed elsewhere [9-21]. Finally, this article does not intend to evaluate the validity of the food addiction concept.

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†Abbreviations: AN, anorexia nervosa; BN, bulimia nervosa; BED, binge eating disorder; DSM, Diagnostic and Statistical Manual of Mental Disorders; OA, Overeaters Anonymous; YFAS, Yale Food Addiction Scale.

Keywords: food addiction, obesity, binge eating, anorexia, bulimia, substance dependence, chocolate

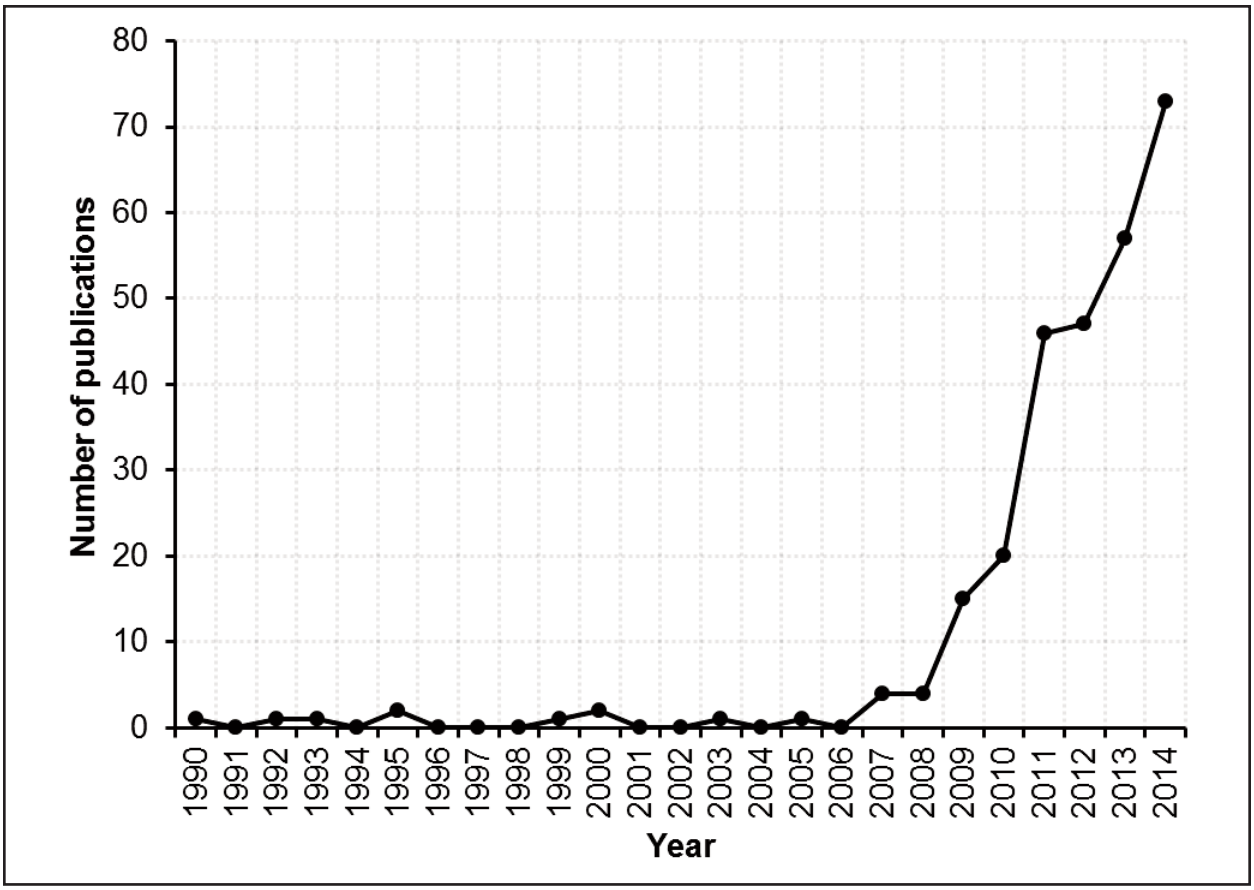


**Figure 1. Number of scientific publications on food addiction in the years 1990-2014.** Values represent the number of hits based on a Web of Science search conducted for each year separately, using the search term "food addiction" and selecting "topic" (which searches the title, abstract, and keywords within a record).

## LATE 19TH AND EARLY 20TH CENTURY: FIRST BEGINNINGS

The *Journal of Inebriety* was one of the first addiction journals and was published from 1876 to 1914 [22]. During this time, different terms were used to describe excessive alcohol and drug use (e.g., *habitual drunkenness, inebriety, ebriosity, dipsomania, narcomania, oinomania, alcoholism*, and *addiction*). Interestingly, the term *addiction* as used in the *Journal of Inebriety* primarily referred to dependence upon drugs other than alcohol and first appeared in 1890 in reference to chocolate [22]. Subsequently, the addictive properties of "stimulating" foods were also mentioned in other issues of the journal [17]. For instance, Clouston [23] stated that when "a brain has depended on stimulating diet and drink for its restoration when exhausted, there is an intense and irresistible craving set up for such food and drink stimulants whenever there is fatigue."

In 1932, Mosche Wulff, one of the pioneers of psychoanalysis, published an article in German, the title of which may be translated as "On an Interesting Oral Symptom Complex and Its Relationship to Addiction" [24]. Later, Thorner [25] referred to this work, stating that "Wulff links overeating, which he calls food addiction, with a constitutional oral factor and differentiates it from melancholia insofar as the food addict simply introjects erotically in place of a genital relationship while the melancholic incorporates in a sadistic and destructive manner." While this psychoanalytical perspective on overeating is certainly outdated and appears disconcerting nowadays, it is nonetheless remarkable to see that the idea of describing overeating as an addiction was already existent in the 1930s.

## 1950s: COINING OF THE TERM 'FOOD ADDICTION'

The term *food addiction* was first introduced in the scientific literature by Theron Randolph in 1956 [26]. He described it as "a specific adaptation to one or more regularly consumed foods to which a person is highly sensitive [which] produces a common pattern of symptoms descriptively similar to those of other addictive processes." He also noted, however, that "most often involved are corn, wheat, coffee, milk, eggs, potatoes and other frequently eaten foods." This view has changed, as nowadays highly processed foods with high sugar and/or fat content are discussed as being potentially addictive [27].

Randolph was not the only one using the term food addiction around this time. In an article published in 1959,

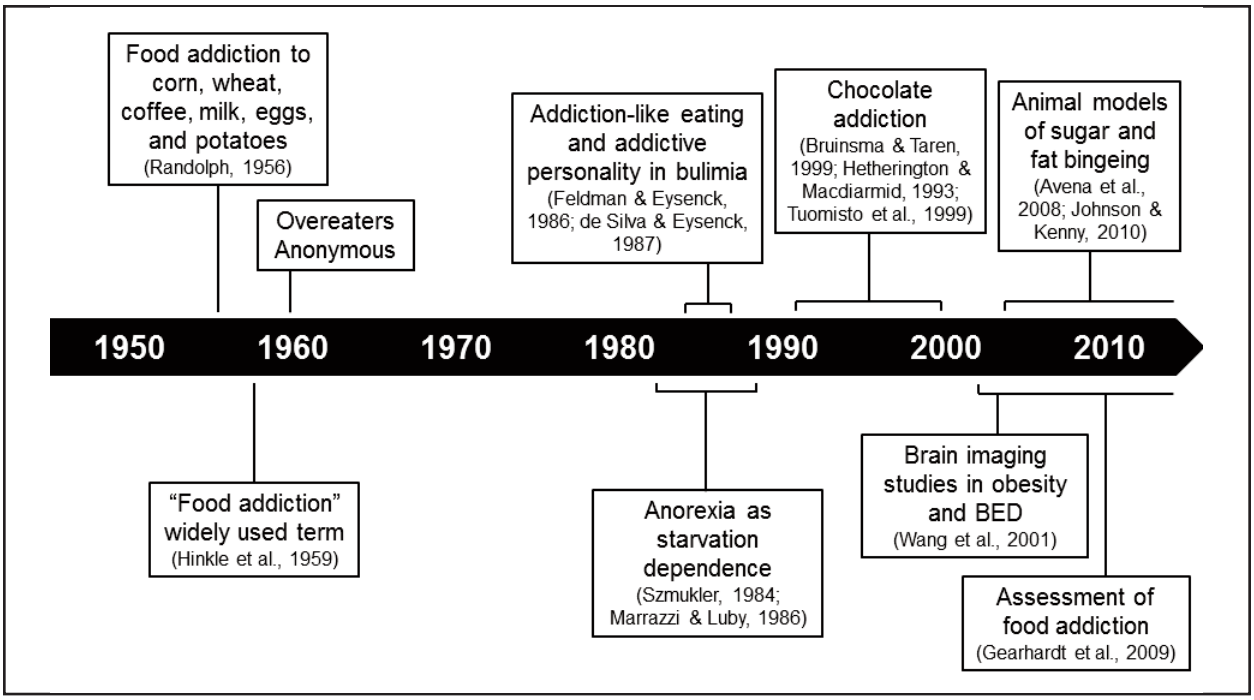


**Figure 2.** Some focus areas with selected references in the history of food addiction research.

a panel discussion that revolved around the role of environment and personality in the management of diabetes was reported [28]. During this discussion, Albert J. Stunkard (1922-2014) [29], a psychiatrist whose article in which he first described binge eating disorder (BED†) was published in the same year [30], was interviewed. For instance, he was asked, "One of the most common and difficult problems we face is that of food addiction, both in the genesis of diabetes and its treatment. Are there physiological factors involved in this mechanism or is it all psychological? What is its relation to alcohol addiction and addiction to narcotics?" [28]. Stunkard replied that he does not think that the term food addiction "is justified in terms of what we know about addiction to alcohol and drugs." However, what is more important for the historical examination in the present article is that he also stated that the term food addiction is widely used, which further supports that the idea of food addiction was well-known among scientists and the general public as early as the 1950s.

## 1960s AND 1970s: OVEREATERS ANONYMOUS AND OCCASIONAL MENTIONS

Overeaters Anonymous (OA), a self-help organization based on the 12-step program of Alcoholics Anonymous, was founded in 1960. Accordingly, OA advocates an addiction framework of overeating, and the group's primary purpose is to abstain from using the identified addictive substance (i.e., certain foods). Little research has been conducted on OA in its more than 50 years of existence, and although participants agree that OA was helpful to them, there is no consensus regarding how OA "works" [31,32]. Nevertheless, OA would not remain the only self-help organization with an addiction perspective on overeating, as similar self-help groups were established in the decades that followed [17].

Scientific research on the concept of food addiction, however, was virtually non-existent in the 1960s and 1970s, but some researchers sporadically used the term in their articles. For example, food addiction was mentioned along with other substance use problems in two papers by Bell in the 1960s [33,34] and was mentioned in the context of food allergies and otitis media in 1966 [35]. In 1970, Swanson and Dinello referred to food addiction in the context of high rates of weight regain after weight loss in obese individuals [36]. To conclude, although there were no efforts to systematically investigate the concept of food addiction in the 1960s and 1970s, it was already used by self-help groups with the aim of reducing overeating and used in scientific articles in the context of or even as a synonym for obesity.

## 1980s: FOCUS ON ANOREXIA AND BULIMIA NERVOSA

In the 1980s, some researchers attempted to describe the food restriction displayed by individuals with anorexia nervosa (AN) as an addictive behavior (or "starvation dependence") [37]. For example, Szmukler and Tantam [38] argued that "patients with AN are dependent on the psychological and possibly physiological effects of starvation. Increased weight loss results from tolerance to starvation necessitating greater restriction of food to obtain the desired effect, and the later development of unpleasant 'withdrawal' symptoms on eating." This idea was later facilitated by the discovery of the role of endogenous

opioid systems in AN [39,40]. Of note, however, the role of endorphins also was discussed in the opposite condition, that is, obesity [41,42]. Similarly, obesity was investigated under the food addiction framework in a study published in 1989, in which obese persons were compared with normal-weight controls on their level of "object representation" [43].

There were also some studies on bulimia nervosa (BN) from an addiction perspective, which originated from the field of personality psychology. These studies were preluded by two articles from 1979, which reported elevated scores on a measure of addictive personality in obese individuals [44] but lower scores in both anorexic and obese individuals as compared to smokers [45]. Comparative studies between groups of substance dependent and bulimic patients also produced inconsistent findings, with some studies finding similar scores on personality measures across groups and some studies finding differences [46-49]. These studies on addictive personality in BN were accompanied by a case study, in which substance abuse was found to be a useful metaphor in the treatment of BN [50] and the development of the "Foodaholics Group Treatment Program" [51].

## 1990s: CHOCOHOLICS AND CRITICAL REMARKS

Following these first attempts to describe eating disorders as an addiction, there were some comprehensive reviews published in the 1990s and in 2000, in which the addiction model of eating disorders was critically discussed based on conceptual, physiological, and other considerations [52-55]. However, with the exception of a few articles, two in which addictive personality in individuals with eating disorders or obesity were investigated [56,57] and two in which unusual cases of addiction-like carrot consumption were reported [58,59], a new research focus seemed to have emerged: chocolate.

Chocolate is the most often craved food in Western societies, particularly among women [60,61], and the food that people most often have problems with controlling consumption [27,62]. It was already noted in 1989 that chocolate has a combination of high fat and high sugar content, which makes it a "hedonically ideal substance" [63] — an idea which is similar to speculations about "hyperpalatable" addictive foods some 25 years later [3,27]. In addition to chocolate's macronutrient composition, other factors like its sensory properties or psychoactive ingredients such as caffeine and theobromine also were discussed as contributors to the addictive-like nature of chocolate [64,65]. However, the xanthine-based effects of chocolate have been found to be unlikely to explain liking for chocolate or its addiction-like consumption [61].

Few studies were conducted in which so-called "chocoholics" or "chocolate addicts" were investigated. One was a descriptive study reporting craving and consumption patterns among other variables [66]; another one compared similar measures between "chocolate addicts" and controls [67]; and one study compared such groups on subjective and physiological responses to chocolate exposure [68]. A major shortcoming of these studies was, however, that "chocolate addiction" status was based on self-identification, which is vulnerable to bias and validity and is limited by the fact that most nonprofessional participants do not have a precise definition of addiction. Finally, two studies examined associations between "chocolate addiction" and addiction to other substances and behaviors and found positive, but very small, relationships [69,70].

## 2000s: ANIMAL MODELS AND NEUROIMAGING

In the early 2000s — approximately 40 years after OA was founded — a pilot study was published in which the treatment of bulimic and obese patients with a 12-step program was reported [71]. Besides this therapeutic approach, however, the focus of this decade was the examination of neural mechanisms underlying overeating and obesity that may parallel findings from substance dependence. In humans, these neural mechanisms were primarily investigated by positron emission tomography and functional magnetic resonance imaging. For example, a groundbreaking article by Wang and colleagues [72] reported lower striatal dopamine $D_2$ receptor availability in obese individuals as compared to controls, which the authors interpreted as a correlate of a "reward deficiency syndrome" similar to what has been found in individuals with substance dependence [73,74]. Other studies, for example, found that similar brain areas are activated during the experience of food and drug craving, and studies in which neural responses to high-calorie food stimuli were investigated found that individuals with BN and BED exhibit higher activation in reward-related brain areas as compared to controls, just like individuals with substance dependence show higher reward-related activity in response to substance-related cues [75,76].

Another important line of food addiction research in this decade was rodent models. In one of these paradigms, rats are food deprived daily for 12 hours and then given 12-hour access to both a sugar solution and chow [77]. Rats who underwent this schedule of intermittent access to sugar and chow for several weeks were found to exhibit behavioral symptoms of addiction such as withdrawal when access to sugar was removed, and they also showed neurochemical changes [77,78]. Other studies found that rats provided with a high-calorie "cafeteria" diet gained weight, which was accompanied by a downregulation of striatal dopamine $D_2$ receptors and continued consumption of palatable foods despite aversive consequences [79]. To conclude, these studies suggest that consumption of high amounts of sugar may indeed lead to addiction-like behavior and, in combination with high fat intake, to weight gain in rodents [80] and that overlapping neural circuits are involved in the processing of food- and drug-related cues and in the control of eating behavior and substance use, respectively.

## 2010s: ASSESSMENT OF FOOD ADDICTION IN HUMANS AND PROGRESS IN ANIMAL RESEARCH

In recent years, researchers have tried to more precisely define and assess food addiction. For example, Cassin and von Ranson [81] substituted references to "substance" with "binge eating" in a structured interview of the substance dependence criteria in the fourth revision of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-IV) and found that 92 percent of participants with BED met the full criteria for substance dependence. Another approach was the development of the Yale Food Addiction Scale (YFAS), which is a self-report measure for the assessment of symptoms of food addiction based on the diagnostic criteria for substance dependence in the DSM-IV [82]. Specifically, the YFAS measures the seven symptoms for substance dependence as stated in the DSM-IV with all items referring to food and eating: 1) taking the substance in larger amounts or for a longer period than intended (e.g., "I find myself continuing to consume certain foods even though I am no longer hungry."); 2) persistent desire or repeated unsuccessful attempts to quit (e.g., "Not eating certain types of food or cutting down on certain types of food is something I worry about."); 3) spending much time to obtain or use the substance or recover from its effects (e.g., "I find that when certain foods are not available, I will go out of my way to obtain them. For example, I will drive to the store to purchase certain foods even though I have other options available to me at home."); 4) giving up important social, occupational, or recreational activities due to substance use (e.g., "There have been times when I consumed certain foods so often or in such large quantities that I started to eat food instead of working, spending time with my family or friends, or engaging in other important activities or recreational activities I enjoy."); 5) continued substance use despite psychological or physical problems (e.g., "I kept consuming the same types of food or the same amount of food even though I was having emotional and/or physical problems."); 6) tolerance (e.g., "Over time, I have found that I need to eat more and more to get the feeling I want, such as reduced negative emotions or increased pleasure."); and 7) withdrawal symptoms (e.g., "I have had withdrawal symptoms such as agitation, anxiety, or other physical symptoms when I cut down or stopped eating certain foods."). Two additional items assess the presence of a clinically significant impairment or distress resulting from overeating. Similar to the DSM-IV, food addiction can be "diagnosed" if at least three symptoms are met and a clinically significant impairment or distress is present [82,83].

The YFAS has been employed in a considerable number of studies in the past 6 years, which show that individuals with a food addiction "diagnosis" can be differentiated from those without a "diagnosis" on numerous variables ranging from self-report measures of eating pathology, psychopathology, emotion regulation, or impulsivity to physiological and behavioral measures such as a multilocus genetic profile associated with dopaminergic signaling or motor responses to high-calorie food-cues [62]. Although the YFAS has proved to be a useful tool for the investigation of addictive-like eating, it is, of course, not perfect and its validity has been questioned [84]. For example, it has been found that approximately 50 percent of obese adults with BED receive a YFAS diagnosis and that these individuals show higher eating-related and general psychopathology than obese adults with BED who do not receive a YFAS diagnosis [85,86]. In the light of these findings, it has been argued that food addiction as measured with the YFAS may merely represent a more severe form of BED [87,88]. Furthermore, the food addiction model continues to be a heavily debated topic with some researchers strongly supporting its validity [3,7,21,89-91], while others argue against it based on different physiological effects of drugs of abuse and specific nutrients such as sugar, conceptual considerations, and other issues [84,92-97]. Most recently, it has been proposed that even if there is a kind of eating behavior that may be called an addiction, the term food addiction is misguided as there is no clear addictive agent, and, thus, it should be rather considered as a behavioral addiction (i.e., "eating addiction") [98].

Animal research on food addiction has progressed in recent years as well. This includes, for example, a plethora of studies showing differential effects of specific nutrient components (e.g., high-fat diet, high-sugar diet, combined high-fat and high-sugar diet, or high-protein diet) on eating behavior and neurochemistry [99,100]. Other research demonstrates that certain eating regimes also can affect offspring in rodents. For instance, it has been found that *in utero* exposure to a highly palatable diet influences food preferences, metabolic dysregulations, brain-reward functioning, and the risk for obesity [99,101]. New paradigms for the assessment of food addiction-like behavior have been employed, which measure, for example, compulsive food intake under aversive circumstances [102]. Finally, application of certain drugs, which reduces substance use in rats, has been found to reduce addiction-like intake of palatable foods [103].

## CONCLUSIONS AND FUTURE DIRECTIONS

The term addiction was already used in reference to food by the end of the 19th century. In the middle of the 20th century, the term food addiction was widely used, not only among laypersons but also among scientists. However, it was also poorly (if at all) defined, and the term often was used without scrutiny. Empirical articles aiming at validating the concept of food addiction in humans were lacking in most decades of the 20th century, and an addiction model of eating disorders and obesity was more critically discussed by the end of the century. Food addiction research underwent several paradigm shifts, which involved, for example, a focus on obesity in the middle of the 20th century, a focus on AN and BN in the 1980s, a focus on chocolate in the 1990s, and a focus on BED and — again — obesity in the 2000s in light of results from animal and neuroimaging studies.

Thus, although research on food addiction has increased substantially in recent years, neither is it a new idea nor was it conceptualized to explain the rising prevalence rates of obesity. The aim of this article is to increase awareness of the long history of the food addiction concept and its dynamically changing scientific paradigms and methods. If researchers reflect on this history, it may be easier to find a consensus about what is actually meant by food addiction and it may inspire important next steps that have to be taken, and, thus, progress in this field of research will be facilitated [104].

For example, many themes that revived in the last couple of years were already discussed a few decades ago. These include, for example, studies on an addictive personality underlying both overeating and substance use [105,106] or the idea of considering AN as an addiction [107,108], with both topics being present as early as the 1980s. The idea of considering BN as an addiction [109] also dates back several decades. Thus, it appears that the focus on obesity in the context of food addiction in recent years (e.g., [13,110]) seems somewhat misguided, considering that researchers stated decades ago that addiction-like eating is neither restricted to individuals with obesity nor can obesity be equated with food addiction [28,50].

Another recurring theme seems to concern the measurement of food addiction. As stated above, there were some studies in the 1990s in which food addiction was based on self-identification. This issue was taken up again in recent studies, which show that there is a large mismatch between food addiction classification based on the YFAS and self-perceived food addiction [111,112], thus implying that individuals' own definition or experience of food addiction is not consistent with the substance use model proposed by the YFAS. Although researchers do not agree about the precise definitions of food addiction symptoms yet [84,113], it appears that standardized measures such as the YFAS are necessary to prevent over-classification of food addiction. Although the rationale behind the YFAS, namely translating substance dependence criteria of the DSM to food and eating, is straightforward, it also has been criticized as it differs from definitions that other researchers have about addiction [93,98]. Thus, an important future direction may be if and how food addiction can be measured in humans other than using the YFAS.

If food addiction research will be guided by the translation of DSM substance dependence criteria to food and eating in the future, an important question will be which implications arise from the changes in the diagnostic criteria for substance dependence in the fifth revision of the DSM for food addiction [114]. For example, are all addiction criteria (as described in the DSM-5) equally applicable to human eating behavior? If not, does this obliterate the concept of food addiction?

Besides these basic questions about the definition and measurement of food addiction, other important avenues for future research may include, but are not limited to: How relevant is the concept of food addiction for the treatment of obesity or binge eating and in public policy making? If it is relevant, how can it be implemented best [17,91]? What are the disadvantages (if any) of the concept of food addiction [115-119]? How can animal models of addiction-like eating be improved to more specifically reflect relevant processes in humans [120]? Can addiction-like eating actually be reduced to the addictive effects of one or more substances or should "food addiction" be replaced by "eating addiction" [98]?

Although food addiction has been discussed in the scientific community for decades, it remains a highly controversial and heavily debated topic, which, of course, makes it an exciting field of research. Notwithstanding that scientific output on this topic rapidly increased in the last couple of years, its systematic investigation is still in its infancy, and, thus, research efforts will most likely increase in the years to come.

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