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When Hunger Becomes Habit: Unraveling The Neurobiology Of Eating Addiction

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Abstract

Food addiction is a psychosomatic health status that is indicated by high food cravings and frequent need to eat even in unsuitable circumstances. Using PRISMA chart guidelines to collect, extract, and clean all reports related to this review. A total of 1051 studies were collected from different search engines. Only 47 obeyed the screening after removing any reported in the scope. It has been shown that the current estimates suggest that approximately 5%–20% of adults, and nearly half of individuals with obesity, may show signs of food addiction. Different types of cravings were reported, such as Pica, chocolate, carbs, and salty food cravings. Different cases are related to frequent cravings, such as pregnant women, women with PMS, and children's desserts. It has been recommended that many governmental efforts must be carried out to control food addiction and shed light on the risk of obesity and its consequent chronic diseases.

Keywords: Craving - food addiction - compulsive eating - psychosomatic.

Introduction

Food cravings and the related idea of “food addiction” are frequently highlighted in popular media and have also attracted substantial interest in scientific research. In everyday language, the term craving is used to describe powerful urges for both food and addictive substances [1]. Beyond the shared terminology, however, cravings for food and drugs appear to overlap biologically. Strong evidence suggests that many addictive substances influence similar neural pathways, and there is compelling support—particularly from animal studies—that food and drug rewards involve common mechanisms [2].

Obesity is now regarded as one of the most serious yet preventable public health challenges worldwide. Due to fetal programming, obesity may continue to intensify over generations, functioning as an inherited consequence of acquired traits. At present, more than half of adults are considered overweight or obese [3]. These terms generally refer to excessive body fat rather than elevated weight attributable to muscle or bone density. Although body mass index (BMI) is commonly used to approximate adiposity, it is only an indirect measure and may be inaccurate for individuals. Importantly, for the first time in human history, the number of people with excess body weight exceeds those who are underweight [4,5].

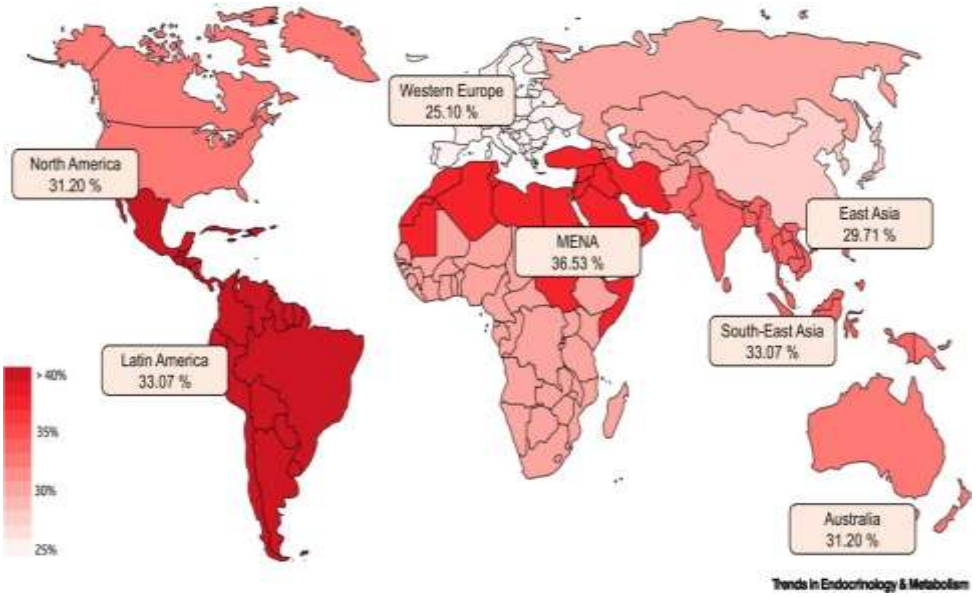
Food addiction (FA) remains controversial, lacks a universally accepted definition, and is not formally recognized in the DSM-5. Nevertheless, large population studies show that many individuals believe they engage in addictive eating and view certain foods—especially highly palatable or processed items—as having addictive properties [6]. Most current FA research relies on self-report tools modeled on diagnostic frameworks for substance-use disorders. It is essential to acknowledge the behavioral dimensions of addictive eating, as focusing solely on substance-based perspectives may restrict diagnosis and overlook important behavioral drivers [7,8].

Research on FA has predominantly involved adults—particularly women—and often captures more severe presentations. Findings indicate that, based on the scale, individuals with FA typically endorse six or more of the eleven symptoms YFAS 2.0, as well as the criterion of clinical impairment or distress, meaning their eating patterns interfere with daily life. Because

the presence of clinical impairment affects FA classification [9], it has received particular attention. Impairment or distress is reported more often among women than men and is more common in individuals with obesity than in those who are overweight. These observations highlight the need to consider alternative scoring methods—such as reporting symptom counts with and without the impairment criterion. For instance, someone meeting all eleven symptoms but not reporting functional impairment may still warrant further assessment and be considered "at risk." [10-12].

Between 1990 and 2021, the global age-standardized prevalence of eating addiction rose from 300.73 to 354.72 per 100,000 people, accompanied by increases in incidence and disability-adjusted life-year (DALY) rates (Figure 1).

Figure 1 Trends in Current status and future trends of the global burden of eating addiction [13]



Methods of search

Data Sources and Search Strategy

The databases' sources used for this systematic review were PubMed Central (PMC), Web of Science (WOS), Scopus, and Google Scholar. These databases were searched for reports published in the last 15 years until August 2025.

Inclusion and exclusion criteria

The literature search was conducted through the electronic databases, and the eligibility criteria were set as follows:

The inclusion criteria are:

- In the last fifteen years of studies.
- Reports either interventional, randomized controlled trials, case-studies, case-controls, review articles, or observations relating to the assessment.

The exclusion criteria are:

- Pilot studies.
- Non-English language studies.

Data Extraction and Analysis

The data were extracted and analyzed, and all data was extracted from the included articles' texts, including abstract, introduction, results, findings, interventions, main outcomes, discussion, conclusions, and limitations (if found).

Overconsumption of ultra-processed and normal food and Weight Gain

Excessive food intake is frequently highlighted as a key factor in weight gain and obesity. Consistently consuming more calories than the body requires is believed to be a major contributor to the dramatic rise in obesity rates. Despite its frequent use in obesity research, the term "overconsumption" lacks a precise definition. Because it is a relative concept, it raises important questions: relative to what standard is intake considered excessive? At what point does normal eating become overeating, and when does it meaningfully influence weight gain and obesity? [14-17].

Gaining a clear understanding of the causes of obesity is essential for developing effective prevention and treatment strategies [18]. Researchers suggest that examining contributors to obesity—such as overeating—must be approached through the lens of energy balance. It is well established that if calorie intake regularly surpasses energy expenditure, weight gain will follow; however, if increased intake is countered by greater energy expenditure or a reduction in later intake, weight gain does not occur. Therefore, studies on overconsumption should evaluate how food intake relates to energy needs, even when energy intake is considered the primary driver of imbalance [19-23].

Research shows that food intake varies significantly both among individuals and within the same individual over time [24]. A major limitation in current methods for assessing overeating is that intake is often measured during only one eating occasion, and the accuracy of such measurements is seldom evaluated [25,26].

Considering consumption on a meal-by-meal basis may reflect how weight gain can gradually develop—e.g., repeatedly deciding to have "just one extra slice of cake" or "one more drink." Yet, with regard to obesity risk, both how often overeating episodes occur and how large they are playing a crucial role [27].

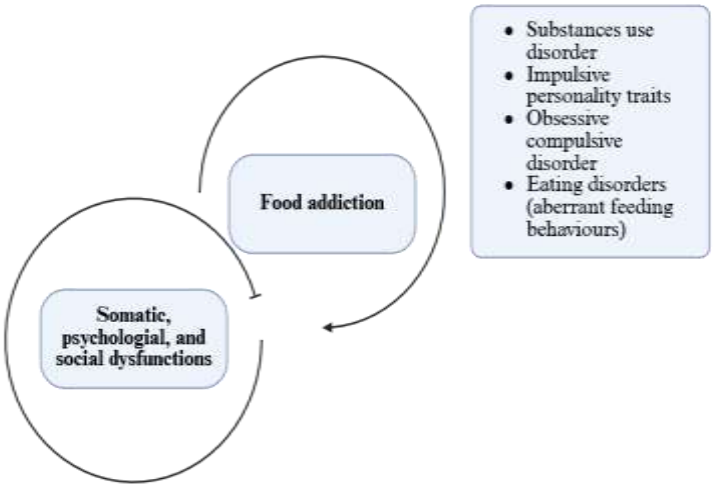
Worldwide, intake of industrially processed foods, commonly called ultra-processed foods (UPFs), has risen steadily over recent decades, now providing about 50%–60% of daily calories in certain high-income nations [28]. Compared with fresh or minimally processed foods, UPFs generally have higher caloric density and promote faster eating and energy intake. These features can encourage excessive calorie consumption and consequent weight gain when UPFs make up a large portion of the diet [29,30].

According to the NOVA food classification, UPFs are products made largely or entirely from food components not typically used in home cooking, along with ingredients such as fats, sugars, and salt [31]. Their manufacturing involves industrial techniques including extrusion, prefrying, and hydrogenation. Common examples include packaged breads, sweetened cereals, crackers, biscuits, packaged snacks, instant noodles or soups, processed meats, and some ready-to-eat meals. For many individuals—particularly those living in cities or working irregular hours—such foods are convenient, inexpensive sources of calories [32,33].

Foods as Addictive Substances

The idea that people can become "addicted" to food is still debated. Some scholars argue that because eating is fundamental to human survival, it cannot be considered an addictive behavior [14]. In contrast, other investigators highlight notable parallels between compulsive intake of highly palatable foods and drug-related addiction. These similarities include shared neural reward mechanisms—such as involvement of dopamine-driven circuits and ΔFosB activity—as well as comparable behavioral patterns like relapse, consuming more than intended, and difficulty exercising control. Psychological features such as persistent thoughts about food also resemble those seen in recognized addictions [15,34,35].

Figure 2 Evidence of a status of food addiction



Despite these observations, researchers on both sides agree that stronger evidence is required to fully validate food addiction as a clinical entity. The findings from human and animal studies with characteristics of substance use disorder [17]. Their analysis showed considerable overlap, but they emphasized the need for more thorough investigation. Many systematic reviews on the topic have either merged the phenomenon with obesity or omitted animal data, limiting clarity [37].

Current estimates suggest that approximately 5%–20% of adults—and nearly half of individuals with obesity—may show signs of food addiction, based on the Yale Food Addiction Scale (YFAS), a tool introduced in 2009 and still widely used for identifying FA-related symptoms. Opponents caution that labeling overeating as "addiction" may unnecessarily medicalize everyday behavior or reduce personal. However, neuroimaging findings reveal noteworthy parallels between overeating and drug dependence. Both conditions appear to involve reduced dopamine D2 receptor activity within the brain's reward system, as well as diminished functioning of the prefrontal cortex [21,25,38].

Biological and Learned Influences on Appetite

Biological factors influencing appetite include hormones such as insulin and gut-derived peptides, brain-based regulatory systems, and sensory cues like taste, smell, and visual stimuli. Learned factors contribute as well, with eating preferences shaped by early exposure to certain foods, cultural norms, and psychological elements including stress and conditioned triggers that may prompt cravings [11,39].

A person's eating habits are influenced by many elements, such as culture, finances, and biology [7]. Human appetite regulation seems to have evolved to manage inconsistent food availability, and the body tends to tolerate both periods of too little and too much food. As a result, when food is readily accessible, highly calorie-dense, and physical activity is limited, weight gain becomes likely [12]. This suggests that obesity is driven more by an unhealthy environment than by defects in biological appetite control. In these conditions, the main way to prevent obesity is through conscious control of food intake. However, deliberate restriction and dieting are effortful and may produce negative psychological effects, including reduced cognitive function [17]. Such restraint is also vulnerable to lapses, which can weaken control overeating and sometimes lead to disordered eating patterns. These problems arise partly because eating behavior tends to reinforce itself—for instance, strict, uninterrupted dieting often suppresses hunger, whereas irregular eating linked to repeated loss of control can intensify hunger [23]. These characteristics of appetite regulation can hinder behavior change but can also present opportunities. Therefore, future studies should investigate social-psychological variables and dieting behaviors associated with lasting weight management, aiming to uncover

effective mental and behavioral tactics used by individuals who successfully lose weight and keep it off [31].
Scientific views on how appetite is regulated have shifted significantly over the past five decades. During the 1950s–1960s, the hypothalamic "dual-center" model proposed by Anand and Brobeck was considered to fully explain the beginning and cessation of eating. With advances in understanding neurotransmission, this two-center concept was replaced by models based on aminergic pathways [39]. More recently, the dominant framework highlights communication between fat tissue and short-term digestive signals, offering insights into appetite regulation, obesity development, and patterns of weight loss and regain [40].

Type of cravings
Food cravings can, in some cases, reflect underlying nutritional deficiencies that influence the body's physiological drive to seek specific foods or substances [38]. For example, iron deficiency is frequently associated with pica, a condition characterized by the consumption of non-food items, particularly ice, which may temporarily enhance alertness or alleviate fatigue linked to anemia [23]. Similarly, inadequate magnesium intake has been suggested to contribute to chocolate cravings, as chocolate—especially dark varieties—contains considerable amounts of magnesium that support neuromuscular function and energy metabolism. Protein deficiency may also manifest as heightened cravings for carbohydrate-rich foods, likely because carbohydrates provide rapid energy that compensates for insufficient dietary protein; however, this response does not address the underlying nutritional imbalance and may encourage excess energy intake [25,33]. In addition, low sodium levels can trigger cravings for salty foods due to sodium's essential role in maintaining electrolyte balance, nerve transmission, and muscle activity. Collectively, these examples illustrate how nutrient shortages can shape specific craving patterns, emphasizing the importance of balanced dietary intake to prevent maladaptive eating behaviors [26].

Iron Deficiency → Craving Ice & Non-Food Items (Pica)
One notable form of craving is the urge to chew ice or consume non-food substances, a behavior commonly associated with iron deficiency. This condition, known as pica, may involve eating items such as ice, clay, paper, or starch. Although the exact mechanism is not fully understood, some theories suggest that chewing ice may temporarily improve alertness or reduce feelings of fatigue often linked to low iron levels [28]. These unusual cravings can indicate underlying nutritional problems and often improve once iron stores are replenished [34].

Magnesium Deficiency → Craving Chocolate
A strong desire for chocolate may be linked to inadequate magnesium intake. Chocolate—particularly dark chocolate—is naturally rich in magnesium, which plays essential roles in muscle function, mood regulation, and energy metabolism [38]. When magnesium levels drop, people may be drawn to chocolate as a quick source of relief or comfort. While satisfying the craving with chocolate is common, focusing on healthier magnesium-rich foods such as nuts, leafy greens, or legumes provides more balanced nutritional support [29].

Protein Deficiency → Craving Carbohydrates
When protein intake is insufficient, the body may compensate by increasing cravings for carbohydrate-rich foods [14]. Carbohydrates are quickly converted into glucose, supplying immediate energy; therefore, individuals with low protein consumption may instinctively reach for sweets, bread, or pasta. This response can be counterproductive, as it does not address the underlying protein deficit and may contribute to overeating. Prioritizing protein-dense foods such as eggs, dairy, lean meats, lentils, or tofu helps sustain energy and reduce excessive carb cravings [21].

Sodium Deficiency → Craving Salty Foods
Cravings for salty foods may reflect the body's need to restore sodium levels. Sodium plays a vital role in maintaining fluid balance, nerve signaling, and muscle function [15]. When sodium

levels fall—due to sweating, dehydration, or inadequate intake—the body may encourage increased consumption of salty snacks or meals. Although responding to these cravings can quickly correct minor deficiencies, focusing on moderate, balanced sources such as soups, broths, or salted nuts helps regulate intake without excessive consumption [41].

Table 1 Nutrient-Deficiency–Related Cases [23,31,37,41]

Type of Craving	Possible Deficiency	Example Case
Ice, clay, starch	Iron deficiency (Pica)	Women with chronic anemia craving ice or dirt
Chocolate	Magnesium deficiency	People with muscle cramps or fatigue often crave chocolate
Salt	Sodium deficiency / adrenal fatigue	After excessive sweating or dehydration
Meat	Iron or protein deficiency	Vegetarians or low-protein dieters craving steak

Case-related food cravings

Craving certain foods may arise from medical or psychological factors, shifts in hormones, or shortages of nutrients [42]. Although it is common to experience cravings from time to time, strong, frequent, or atypical cravings could signal an underlying problem that should be assessed by a healthcare professional [19].

Night-eating habits

Night-eating habits can develop gradually as individuals shift their calorie intake toward the evening [13]. A pattern of delayed eating may begin due to busy schedules, long work hours, or emotional stress. Over time, the body becomes accustomed to anticipating food late at night, and this expectation encourages cravings even when the person has consumed adequate calories earlier in the day. Night-time is also associated with reduced self-regulation, making it easier to indulge in high-calorie snacks [21,43]. Physiological factors, such as lower leptin and higher ghrelin levels, may contribute to increased hunger signals during the evening. In addition, some individuals link late-night eating to relaxation or entertainment, pairing food with activities such as watching television. This repeated association strengthens behavioral conditioning and can create a cycle that is difficult to break [22,44,45-51].

Childhood associations (e.g., dessert after meals)

Food cravings are often deeply rooted in early life experiences. When children are routinely offered sweets after meals, they learn to associate certain foods with reward, celebration, or emotional comfort. These habits form powerful memories that shape preferences across the lifespan [29]. As adults, similar environmental cues, such as finishing a meal or seeking comfort during stressful moments, may automatically trigger cravings for the same types of foods experienced in childhood. Families that used food to manage behavior or emotions may unintentionally reinforce emotional or reward-based eating patterns. These early behaviors can become ingrained, making cravings feel instinctive rather than intentional [34].

Reward-based eating

Reward-based eating occurs when individuals consume food primarily to satisfy emotional or psychological needs rather than physical hunger [46]. Highly palatable foods rich in sugar, fat, or salt activate reward pathways in the brain, triggering feelings of pleasure and reinforcing continued consumption [32]. For some, these foods become a tool for coping with stress, sadness, or boredom. Over time, the anticipation of this emotional relief can elicit cravings even without a nutritional need. Repeated reinforcement may diminish the satisfaction received from the same amount of food, encouraging larger portions or more frequent indulgence. This cycle

can contribute to habitual overeating, emotional dependency on food, and difficulty distinguishing hunger from emotional cues [21].

Menstrual cycle and PMS-related food cravings

Many women experience noticeable changes in appetite and food preference across the menstrual cycle [35]. During the luteal phase, hormonal shifts can increase desire for specific foods, particularly those high in carbohydrates and sugar. These foods may provide temporary mood elevation due to their effects on neurotransmitter activity. Symptoms associated with premenstrual syndrome, such as irritability, fatigue [43], abdominal discomfort, and mood instability, may further amplify cravings as individuals seek relief or distraction through eating. These cravings typically fluctuate in intensity from person to person and may be influenced by stress levels, sleep quality, and overall dietary patterns [27].

Pregnancy

Pregnancy is a period marked by significant physiological, hormonal, and psychological changes, all of which can influence cravings. Many pregnant individuals report a sudden desire for foods, often those with strong flavors or unique textures. Sensory changes, such as increased sensitivity to taste and smell, may alter which foods seem appealing [31]. Cravings might also reflect shifting nutritional needs, as the body demands greater amounts of certain nutrients. Some may even develop aversions to foods they previously enjoyed, further shaping their eating patterns. Although cravings during pregnancy are usually temporary, they can be intense and unpredictable, highlighting the complex interplay between biology and behavior [18].

Cognitive control of eating

control plays an important role in managing cravings and regulating food intake [28]. People who rely heavily on strict dietary rules may temporarily suppress cravings, but intense restriction can lead to heightened desire for forbidden foods. When self-control weakens, whether due to fatigue, stress, or emotional burden, cravings often become more difficult to resist [32]. Over time, repeated cycles of restraint followed by overeating can undermine confidence and create a negative relationship with food. Individuals may experience guilt or frustration when they feel unable to control eating, which can further contribute to emotional eating patterns. Developing balanced, flexible approaches to eating may help reduce the intensity of cravings and encourage healthier long-term habits [44].

Treatment of food addiction

A key potential benefit of recognizing the overlap between substance addiction and overeating is the opportunity to create more effective treatment strategies. Traditional weight-management methods, such as healthy eating and regular physical activity, often show low long-term adherence and may even lead to weight regain [47]. One explanation is that these strategies address the consequences of overeating rather than its root causes. Interventions that focus on reducing impulsivity and strengthening self-control may therefore offer better outcomes [31].

Research has shown that performance on the go/no-go task—an indicator of inhibitory control—accounts for unique differences in dietary habits and exercise patterns and also influences how well intentions translate into action [22]. This indicates that people with stronger impulse regulation are more likely to achieve their health goals, suggesting that techniques aimed at improving executive control could support weight-loss success [41].

Increased desire for addictive substances has been linked to cognitive biases such as attentional, approach, and emotional biases. For this reason, bias-reduction training has been investigated as a tool to lower craving, and recent work has begun to apply these methods to overeating [7,15].

Non-invasive brain stimulation has also been studied for its ability to reduce cravings and addictive tendencies by modulating brain activity and boosting dopamine. The two most used approaches—transcranial magnetic stimulation (TMS) and transcranial direct current stimulation (tDCS)—are administered while individuals are awake and are generally considered safe when applied according to established standards [46].

Government efforts to control eating

While individuals ultimately decide what they eat, the surrounding food environment strongly shapes the choices available to children, families, and communities. In the 2001 Surgeon General's Call to Action to Prevent and Decrease Overweight and Obesity, former U.S. Surgeon General David Satcher emphasized that meaningful personal behavior change requires supportive surroundings, including affordable healthy foods and opportunities to be physically active. Policies and interventions that modify environmental conditions can empower people to make better dietary decisions. In many cases, strategies focused solely on individual nutrition and exercise have fallen short because they were implemented in settings that do not facilitate healthy choices. Ultimately, healthier options must be the most convenient ones [4,13,22,47].

A supportive food environment is characterized by families having access to grocery stores or other places where nutritious and reasonably priced foods—such as fruits and vegetables—are readily available; by restaurants and public spaces offering clearly identifiable healthy options; by lower-income residents receiving information about and taking part in programs like the Supplemental Nutrition Assistance Program (SNAP); by women being encouraged and supported to breastfeed; and by widespread availability of drinking water in public areas. This chapter explores strategies that local governments can use to foster environments with these essential features to encourage healthy eating [22,34,39,44,46].

Conclusion and future perspectives

Food addiction is a psychosomatic condition characterized by intense urges to eat and repeated consumption of food, even in inappropriate situations. Current estimates indicate that around 5%–20% of adults—and nearly half of people with obesity—may exhibit features consistent with this disorder. Various craving patterns have been described, including pica, cravings for chocolate, carbohydrates, or salty foods. Certain groups commonly experience recurrent cravings, such as pregnant women, women with premenstrual symptoms, and children who frequently desire sweets. Public health authorities are encouraged to implement strong control strategies to address food addiction and raise awareness about its contribution to obesity and related chronic diseases.

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