

## **Food Addiction: A Different Perspective on Obesity** By Terral Stoltz, RD, LD

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Food addiction has become a focus of interest for those hoping to gain further insight into the causes of obesity. A growing body of evidence has found a number of similarities between excessive food consumption and addiction. The foods most often identified as having addictive properties include foods high in sugar, fat, and salt. Identifying and examining the role food addiction plays in the growing incidence of obesity might help health care providers more effectively prevent and treat the disease.

In the United States, approximately 35% of adults are obese, and the prevalence of obesity is at least 20% in all states.<sup>1</sup> Studies on the linear time trends of obesity forecast these numbers to grow over the next two decades;<sup>2</sup> one study suggests that nearly 100% of Americans will be overweight or obese by 2050 if the current trends continue.<sup>3</sup>

Obesity, of course, is not confined to the United States. The term “globesity” describes the escalating problem that plagues countries worldwide. According to the World Health Organization (WHO), obesity has more than doubled across the globe since 1980.<sup>4</sup>

Nutrition professionals working in obesity management are well aware of the devastation caused by obesity. The medical community also recognizes that efforts to address obesity should be of utmost importance. A mere 1% decrease in the predicted trends would equate to 2.9 million fewer obese adults by 2030 and a cost savings of \$4.7 billion annually.<sup>5</sup> Accordingly, obesity counseling has crossed beyond the domain of the nutrition professional and into the primary care setting where doctors, physician assistants, and nurse practitioners have all been encouraged to address and treat the issue. So why then does it seem that our joint efforts are failing us? What role might food addictions play?

This continuing education course examines the history, assessment, diagnosis, and neurobiology of food addiction and its potential role in obesity. In addition, it discusses strategies with which nutrition professionals can help clients with addictive food behaviors.

### **Treat the Cause**

To treat a condition, it helps to first know the cause. In a clinical setting, the goal is to arrive at a diagnosis and then treat the condition. According to WHO, the fundamental cause of obesity is an imbalance between calories consumed and calories expended.<sup>4</sup> The solution should be easy: decrease energy intake while increasing energy expenditure. For many, this involves dieting; however, for many, it's not the solution.

A common nutrition message is that long-term lifestyle changes are far more effective than fad diets when it comes to sustainable weight loss. A systematic review of studies published between 1931 and 1999 found the long-term success rate of diets to be just 15%.<sup>6</sup> Another study found only 20% of overweight individuals are successful at maintaining weight loss for a least one year.<sup>7</sup> Diets often fail to produce permanent results, lifestyle changes are difficult, and even invasive interventions such as bariatric surgery are no guarantee that weight loss will last. Perhaps there's a missing piece to the puzzle. If the concept of food addiction gains recognition as a medical diagnosis, it might change the way health care professionals think about and address obesity.

### **What Is Food Addiction?**

Scientists have defined food addiction as an addiction to specific foods or macronutrients, such as sugar.<sup>8</sup> Theron Randolph, MD, introduced the term “food addiction” in the 1950s to describe an addictionlike reaction in individuals who are highly sensitive to certain regularly consumed foods.<sup>9</sup> Today, a standard definition of food addiction doesn't exist, though the concept isn't new.

### **The History of Food Addiction**

It may appear that food addiction has only recently been under the spotlight, but it's existed for decades. Regardless, it's easy to get the impression that it's a modern-day dilemma as today's food environment becomes more and more saturated with processed foods that people can't seem to get enough of. The research between food and addiction dates back to the 19th century.<sup>10</sup> The first mention was in the 1890s, when the *Journal of Inebriety* referenced the eating of chocolate as an addiction and went on to describe the addictive properties of “stimulating” foods.<sup>11</sup>

In 1960, Overeaters Anonymous (OA) was formed to advocate that an addiction framework be applied to overeating. The organization utilizes the same 12-step program used by Alcoholics Anonymous to help members abstain from foods identified as addictive. It's remained one of the few self-help organizations with an addiction perspective related to eating.<sup>10</sup>

Over the next few decades, scientific publications reported on various aspects of food addiction. In the 1980s, researchers described the restrictive eating behaviors of individuals with anorexia as an addictive behavior. They proposed that people with anorexia were psychologically and physiologically dependent upon the effects of starvation. Other studies explored the link between individuals with bulimia and addictive personality in relation to food.<sup>10</sup> Later, in the 1990s, researchers began to question why chocolate was the most commonly craved food in Western societies. After investigating studies conducted on self-identified “chocoholics” and “chocolate addicts,” they proposed that the high fat and sugar content contributed to the pleasurable experience of eating chocolate and the potential for addictive-like consumption.<sup>12,13</sup> In the 2000s, the focus shifted to examining the neural mechanisms involved in overeating and obesity. Researchers compared mechanisms involved in overeating to those involved in substance abuse. Some studies using brain imaging found that similar areas of the brain are activated during food and drug cravings, furthering the theory that food addition involves neural pathways.<sup>10</sup>

Until just over a decade ago, there were theories about the neurobiology of food addiction, but no hard evidence to support its existence. Today, there's an abundance of evidence in peer-reviewed literature and it continues to grow.<sup>8,14-19</sup> However, it remains a highly controversial topic. Part of the controversy revolves around how to assess and diagnose the condition.

### **Food Fight: Characterizing Food Addiction**

One debate concerns whether food addiction is better characterized as a behavioral addiction or a substance addiction. The proposed similarities between alcohol addiction and processed food addiction include symptoms such as craving, impulsive behaviors, and disrupted careers and relationships. And for each, abstinence has been proposed as an effective treatment. The similarities between food addiction and alcohol addiction strengthen the case for classifying food addiction as a substance-related addiction.<sup>20</sup> In addition, the hypothesis that processed foods high in sugar, fat, salt, caffeine, and refined carbohydrates are addictive suggests that each of those components could be defined as addictive substances. The authors who examined this hypothesis noted that observational and empirical data suggest that certain food consumption behaviors meet the ***Diagnostic and Statistical Manual of Mental Disorders***, 4<sup>th</sup> Edition (***DSM-IV***) criteria for substance use disorders (SUDs), similar to those observed for tobacco and alcohol addiction.<sup>21</sup>

Alternatively, others indicate that the evidence for substance-based food addiction is poor, and the available studies more consistently point to it as a behavioral addiction.<sup>22</sup> Describing food as a substance is challenging because food is often made up of many components that cannot easily be isolated. To truly define food addiction as substance related, scientists would have to isolate food components down to singular substances such as fructose, glucose, and fatty acids. Furthermore, a specific chemical in food that induces addiction by binding to a specific central nervous system receptor has yet to be discovered.<sup>23</sup>

Hebebrand et al posed the term “eating addiction” to suggest that food addiction is better defined as behavioral.<sup>22</sup> Some believe there's an overlap between behaviors such as compulsive overeating and food addiction.<sup>24</sup> Compulsive overeating is often described as binge eating disorder (BED). Individuals with BED compulsively eat large quantities of food over a short duration and feel guilty and ashamed as a result. To be diagnosed with BED, the individual must engage in compulsive eating behaviors at least weekly and over a period of at least three months. Some scientists believe that it is behaviors, such as compulsive overeating, that cause the signs of dependency observed in food addiction, as opposed to actual food itself.<sup>25</sup>

Compulsive overeating is often treated with behavioral modification techniques, such as cognitive behavioral therapy.<sup>26</sup> If food addiction were successfully treated by the same techniques, it could strengthen the case for defining food addition as behavioral.<sup>20,24</sup>

While some scientists believe food addiction is either related to substances or behaviors, others suggest it can be related to both. Albayrak et al describe a broad overlap between chemical and behavioral addiction. For example, hormones such as leptin can affect the reward system, and the reward system can influence overeating. The hormone is considered

the chemical component triggering the brain to eat, while the act of overeating is the behavioral component.<sup>23</sup>

The question remains about how to classify food addiction, and the debate continues about whether terms such as “eating addiction” or “processed food addiction” are more appropriate ways of defining it.

### **Diagnosing Food Addiction**

Despite the confusion and controversy, there’s a fair amount of consistency in the literature regarding the diagnostic criteria for food addiction. Most often, the disorder is examined and defined in relation to other forms of addiction.

### ***Addiction and the Diagnostic Criteria for Dependence***

The National Institute on Drug Abuse describes drug addiction as “a chronic, relapsing brain disease that is characterized by compulsive drug seeking and use, despite harmful consequences.”<sup>27</sup> Substance-related disorders are classified within the context of mental disorders in the International Classification of Diseases, 10<sup>th</sup> revision, and the **DSM-5**.<sup>22</sup>

According to the **DSM-5**, substance dependence is defined as “a cluster of cognitive, behavioral, and physiological symptoms associated with the continued use of the substance despite significant substance-related problems.” The **DSM-5** criteria have been applied to food addiction by researchers to classify and diagnose the condition. For example, there’s evidence that some people lose control over their food consumption in the same way people lose control over alcohol use or gambling. Loss of control is one of the seven criteria used to classify substance-related disorders in the **DSM-IV**.<sup>28</sup>

The diagnostic criteria for substance dependence as stated by the **DSM-IV** are the following:

- tolerance, or the need to consume increasing amounts of the substance over time in order to achieve the desired effect;
- withdrawal symptoms when the substance is not used;
- using the substance over a longer period of time and in larger quantities than intended;
- unsuccessful efforts to cut down or persistent desire to continue use;
- increased amount of time spend trying to obtain the substance or recover from its effects;
- reducing social, recreational, or occupational commitments because of substance use; and
- continual use of the substance despite consistent physical or psychological ramifications caused or worsened by the substance.

Substance dependence is diagnosed when at least three of these symptoms are present within the last year and significant distress or impairment is present.<sup>29</sup>

In 2013, the revised **DSM-5** merged substance abuse and dependence into SUD, and gambling disorder is now recognized under SUD as a behavioral addiction. More criteria were added, including the newly created symptom of craving. With the recent changes in the **DSM-5**, some believe the criteria could be used to diagnose food addiction. Evidence for the

applicability of these addiction criteria, such as tolerance and withdrawal, is primarily derived from animal studies. However, many argue all seven symptoms are also seen in humans.<sup>29</sup> Compelling support for this comes from a study in which nearly all participants with BED were diagnosed with substance dependence when the term substance was replaced with binge eating. For example, persistent desire or unsuccessful efforts to cut down or control a “substance” was replaced with “binge eating.”<sup>30</sup>

The evidence that people can lose control over their food consumption, are unable to reduce or abstain from consumption of certain foods in the face of negative consequences, and suffer from repeated failed attempts to reduce their intake continues to accumulate.<sup>29</sup>

### ***The Yale Food Addiction Scale***

To provide a standardized measure for the assessment and diagnosis of food addiction, Ashley Gearhardt, PhD, and associates developed the Yale Food Addiction Scale (YFAS), based on the ***DSM-IV*** criteria highlighted above. It contains 25 items that measure the presence of food addiction. In addition to the seven criteria outlined in the ***DSM-IV***, the YFAS includes two additional criteria: clinical significant impairment and distress as a result of overeating. When both of these criteria are present and at least three out of seven ***DSM-IV*** criteria for substance use disorder are met, then food addiction can be diagnosed.<sup>31</sup>

Though other criteria have been employed, the YFAS is the most commonly utilized scale today. Since its publication in 2009, the scale was used in almost all research related to the concept of food addiction and has shown good reliability and validity.<sup>32</sup> Since it’s desirable to have standardized measures across studies, the YFAS has contributed significantly to the scientific exploration of this topic.

### **The Neurobiology of Food Addiction**

To better understand food addiction, researchers are exploring the mechanisms involved in eating behaviors. Homeostatic and hedonic pathways, as well as appetite hormones, can all contribute to the desire to eat.

### ***Why Do We Eat?***

Humans have an elaborate network essential to energy regulation that involves the brain, central and peripheral nervous systems, gastrointestinal system, hormonal system, and adipose tissue.

The human drive to seek food was once based primarily on survival. Historically, our brains were driven to find and consume food in order to live. Today, consumption of food in the absence of hunger is widespread, and eating for pleasure rather than survival is a modern phenomenon that often leads to weight gain and obesity.<sup>33</sup>

To understand what truly motivates us to eat, researchers have explored two complementary drives involved in the regulation of food intake: homeostatic and hedonic pathways.<sup>33</sup>

### ***Homeostatic Eating***

The homeostatic pathway is likely what drove our ancestors to food. It increases the motivation to eat when energy stores are depleted and tightly controls energy balance. In contrast, the hedonic pathway is reward based and increases the desire to consume rewarding foods regardless of energy needs.<sup>34</sup> A rewarding food could be described as one that triggers the release of dopamine, otherwise known as the “feel good” hormone.

To further elucidate the difference, homeostatic eating is described as the type of eating that takes place after a prolonged fast or to replenish energy stores after a marathon. Conversely, eating a high-calorie dessert after a fully satiating meal describes hedonic eating.<sup>35</sup>

### ***Appetite Hormones***

In conjunction with these pathways, hormones also play a role in human eating behaviors. Circulating hormones involved in appetite, such as leptin and ghrelin, relay information about peripheral energy levels to the brain. Leptin is synthesized by white adipose tissue and suppresses food intake while stimulating metabolic processes in the presence of excess energy stores. Ghrelin, which is derived in the stomach, does the opposite by stimulating food intake and energy storage in response to negative energy balance.<sup>35</sup>

Though it makes physiologic sense to assume appetite hormones are related to homeostatic eating, they may also be involved in hedonic eating by regulating mesolimbic dopamine signaling related to reward.<sup>35</sup> Thus, hedonic and homeostatic pathways likely overlap more than initially thought. The mesolimbic dopamine pathway regulates emotional and motivational behavior, and evidence shows that “natural rewards” such as food can cause substantial synaptic modifications to the mesolimbic dopamine system.<sup>19</sup> Further research is needed to differentiate between the two motivations to eat, the interplay of appetite hormones, and their direct impact on addictive eating behaviors. For more information on the role of appetite hormones in eating, read “[Appetite Hormones](#)” in the July 2015 issue of *Today's Dietitian*.<sup>36</sup>

### ***Hedonic Eating***

There's evidence that BMI is related to the degree of preference for and consumption of palatable foods high in fat, sugar, and salt. Widespread availability of these energy-dense foods is a probable factor in obesity. Perhaps rather than focusing on how to compare or differentiate homeostatic and hedonic eating behaviors, it may be helpful to discern how the homeostatic mechanism can be overridden by the hedonic.<sup>35</sup>

It's no surprise that hedonic eating has been associated with food addiction. The presentation of palatable foods is proven to stimulate the same reward centers in the brain that drugs of abuse do. When it comes to reward, our brains don't know the difference between food and drugs. The mesolimbic pathway is one of the pathways involved in the rewarding aspects of both food and drugs. The release of dopamine into the nucleus accumbens is believed to coordinate several aspects of an animal's desire for food reward through hedonic eating. As with many physiological mechanisms, however, the dopamine pathway does not act alone. Other neurochemicals are involved in triggering reward and pleasure from eating.<sup>34</sup>

Eating highly palatable foods stimulates neurons. These brain cells respond to rewarding foods by firing signals and releasing brain chemicals that then travel to interconnected neurons. It's been established that neurons can "encode" for palatability. In other words, a neuron shows preference by firing more in the presence of certain stimuli, such as high-sugar foods.<sup>37</sup>

In addition to the dopamine pathway, the opioid circuitry is also stimulated by highly palatable foods. The opioids are the pleasure chemicals produced in the brain that also have rewarding effects similar to those experienced through certain drugs. Stimulating this reward circuitry with food drives individuals to eat in the same way a drug addict seeks pleasure from addictive drugs.<sup>38</sup>

Eating and the desire to eat should be viewed as two separate activities involving two separate mechanisms in the brain. While opioids give us pleasure from food, dopamine drives us to eat in the first place. Dopamine strengthens our sense of anticipation for reward and drives our desire. Because of the effects of dopamine, people often direct their attention to rewarding stimuli such as food. The more rewarding we perceive that food to be, the greater the attention we direct toward that stimuli, and the more we will continue to pursue it.<sup>39</sup>

In summary, a palatable food cue triggers dopamine-fueled pursuit of eating the food, and the actual act of eating it leads to an opioid release. The production of both dopamine and opioids stimulate further eating. It's not surprising, then, that opioids and dopamine are the most examined neurochemicals in the scientific literature examining food addiction. There's a wealth of studies on this topic; however, the majority involve animal models.

### **Food Addiction Research**

Food addiction research predominately involves animal studies; however, human research has also been conducted. Human studies are likely to continue as researchers began to learn more about food addiction and its potential link to obesity.

#### ***Animal Studies: Palatable Foods***

Animal studies investigating food addiction share common themes. The focus is generally on how food affects the brain or how symptoms of food addiction are similar to those outlined by the ***DSM-5*** criteria for SUD.

Research using rodents to explore food's effects on the brain typically examine the dopamine pathways, or, in some cases, opioid pathways. In particular, the dopamine receptors such as D1 and D2 have received attention in light of prior studies indicating that D2 receptors are downregulated in both human drug addicts and obese rats.<sup>40</sup>

Building on the idea that common hedonic mechanisms underlie both obesity and drug addiction, one study investigating the effects of extended access to a highly palatable "cafeteria-style" diet (including bacon, sausage, cheesecake, pound cake, frosting, and chocolate) and its impact on the brain reward system of rats showed a positive link between the two. The authors discovered that overstimulation of brain reward systems through access to and excessive consumption of highly palatable food induces an intense state of reward hyposensitivity and the development of compulsive eating in rats. Researchers speculated that

these behavioral maladaptations arose from a diet-induced deficit in D2 receptor signaling similar to that which occurs in overconsumption of abused drugs.<sup>40</sup>

Alsio et al discovered that D1 receptors in the nucleus accumbens were downregulated in obesity-prone rats after unrestricted access to a high-fat, high-sugar diet compared with the control group of chow-fed rats. The effect was still present after 18 days off the diet. Diet may have a lasting influence on the dopamine system, and the dopamine receptors may be implicated in addictivelike eating in those prone to obesity.<sup>41</sup>

Animal studies have even demonstrated continued propensity to eat palatable foods despite negative consequences. Compared with binge eating–resistant rats, those prone to compulsive food seeking and eating consumed significantly more palatable food while enduring high levels of foot shock to get it.<sup>42</sup> The authors stated that the animals were eating for reasons outside of metabolic need; in other words, they were engaging in hedonic vs homeostatic eating.

Preference for palatable foods may form in the earliest stages of human development. There's evidence that maternal consumption of these foods during pregnancy can increase preference for sugar and fat, upregulate dopamine reuptake transports, and increase opioid receptor expression in offspring.<sup>43</sup>

### ***Animal Studies: Addiction Criteria***

To further investigate food's impact on the brain, researchers have examined potential signs and symptoms of food addiction by using the criteria outlined by the ***DSM-IV*** regarding SUDs mentioned earlier. Criteria such as dependence, craving, and withdrawal have been considered. Selectively bred rats are often used in such studies.

Rapid overconsumption of high-calorie foods in rats bred to be prone to bingeing has been detected. Withdrawal symptoms such as teeth chattering and shaking during avoidance of sugary foods were observed in rats prone to experience withdrawal.<sup>44</sup> Pickering et al noted not only symptoms of withdrawal but also craving in obesity-prone rats exposed to a free-choice high-fat, high-sugar diet consisting of a 30% sucrose solution, lard, standard rat chow, and water. The rats displayed an obvious increase in lever pressing for the palatable food and exhibited measurable anxiety upon withdrawal of the diet. They concluded these behaviors were equivalent to the withdrawal and craving similar to that induced by addictive drugs.<sup>45</sup>

Other studies have shown that removal of sugar from the diet can cause symptoms of withdrawal and dependence similar to those experienced during opioid withdrawal. Rats deprived of food for 12 hours were then given access to a 10% sucrose solution and chow for a total of 28 days. After fasting for 36 hours, the rats demonstrated symptoms of anxiety, suggesting withdrawal. Microdialysis also revealed altered neurochemical balance similar to that seen in opioidlike withdrawal.<sup>46</sup>

In an earlier investigation examining symptoms of opioidlike withdrawal from sugar, rats were food deprived for 12 hours and then given a 25% glucose solution and chow for 12 hours. Withdrawal was induced either by the drug naloxone or by simple food deprivation. The



primary finding was that the rats had become sugar dependent, as evidenced by both behavioral and neurochemical signs of opioidlike withdrawal.<sup>47</sup>

In animal models, it appears that sugar exerts that largest impact in terms of addictive behaviors. In a study assessing signs of opioidlike withdrawal in rats allowed to binge on a fat-rich diet, withdrawal was not observed.<sup>48</sup> Further scientific research is needed to assess individual components of the diet in addition to sugar. Limited research is available on the addictive qualities of fat and salt, which are two dietary components often present in highly palatable foods.

### ***Human Studies***

It's difficult to examine food addiction in humans when considering the diet as a whole. Food consists of more than just a single component such as sucrose. Most of the human research relies on brain imaging studies to determine how food affects the brain. Research using functional or metabolic brain imaging supports the existence of innate alterations in neural circuits that control reward seeking in subjects with obesity.<sup>14</sup>

Gearhardt et al used magnetic resonance imaging (MRI) to determine whether high YFAS scores would correlate with certain patterns of neural activations similar to those identified in substance dependence. Forty-eight healthy young women, both lean and obese, were observed during MRI studies after anticipation of and receipt of a chocolate milkshake. In this cohort, food addiction scores correlated with greater activation in the areas of the brain associated with reward, and those with higher food addiction scores showed greater activation in several of those areas.<sup>49</sup>

Though there's a wealth of animal studies on this topic, more human studies are needed. Most studies focus on its role in obesity, its neurobiological manifestations, and similarities to other forms of addiction. Research points to neural and cognitive alterations in the appetitive and reward pathways that likely involve more than dopamine and opioids. Epidemiological surveys have also shown a link between growing availability of highly palatable food and the obesity epidemic.<sup>8</sup>

### **Conclusion**

The evidence that food addiction exists continues to accumulate. Although the current evidence appears strong, there are limitations to account for. They include, but are not limited to, the inability to generalize animal studies to humans, small sample sizes, design inferiority, exclusion of patients with other forms of addiction or disordered eating, lack of consideration for confounding measures such as hunger, infeasibility of an isolated diet, and lack of a standardized definition of food addiction.

Scientists agree that food addiction warrants further exploration. Continued insight into the many facets of this complicated and compelling topic may be helpful in addressing and managing obesity. In the meantime, nutrition professionals can help.

## Putting It Into Practice

Prior to assessing clients, it's important for RDs to remember that food addiction is not yet approved by the American Medical Association or described in the **DSM-5** as a SUD. Evidenced-based nutrition guidelines have not yet been developed. However, nutrition professionals are uniquely qualified to address the issue and are in a position to increase awareness of food addiction among clients and health care professionals.

Following are suggestions that may be helpful to clients suspected of exhibiting addictive eating behaviors and should be considered on an individual basis.

Assess for the presence of addictivelike eating by using tools such as the YFAS or the **DSM-5** criteria applied to food instead of substances.<sup>50,51</sup>

Whether addictive eating is triggered by certain foods, behaviors, or both, counseling techniques such as motivational interviewing may be excellent tools to use when attempting to facilitate behavior change in clients.<sup>52</sup>

RDs can recommend that clients identify and eliminate trigger foods—those they are unable to stop eating.<sup>32</sup> Highly palatable foods rich in sugar, fat, and salt are frequently the culprits; clients often describe them as foods eaten in large quantities in the absence of hunger.<sup>25</sup> Practices such as mindful eating may help clients better control their eating behaviors.<sup>53-55</sup>

Suggest that clients follow a balanced, whole foods–based diet without processed foods. Based on the 12-step model of overcoming addiction, self-help organizations such as OA favor abstinence of any specific food that an individual cannot stop eating, in the same way an alcoholic is advised to completely abstain from alcohol. In addition to encouraging a healthful, whole-foods based diet, advising such clients to eat protein and fiber with every meal may help. Research has shown that these foods are effective at generating satiety, which can counteract the desire to overeat.<sup>56</sup> Following set meal plans, as well as weighing and measuring food may be helpful to many clients.<sup>57</sup> In addition, exercise, yoga, meditation, and stress management are likely beneficial practices.<sup>32</sup> Advise clients to discuss the start of any new exercise routine with their doctors.

Clients may find support through organizations such as the Food Addiction Institute ([foodaddictioninstitute.org](http://foodaddictioninstitute.org)), which can also be a good information source for professionals. Peer support and self-help organizations such as OA may be invaluable to those suffering from addictive eating behaviors.<sup>58</sup>

Finally, seeking the advice and expertise of other professionals working in the area of food addition can help nutrition professionals better advise their clients.

—*Terral Stoltz, RD, LD, is a Minneapolis-based clinical dietitian and freelance writer.*

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## Quiz

**1. In the United States, what percentage of adults is obese?**

- A. 15%
- B. 20%
- C. 35%
- D. 40%

**2. The concept of food addiction has only recently been described in the scientific literature.**

- A. True
- B. False

**3. Which of the following has been used as a definition of food addiction?**

- A. A behavioral addiction to chocolate
- B. A substance addiction to sugar
- C. An addiction to specific foods or macronutrients, such as sugar
- D. Overconsumption of all foods

**4. Which best describes The Yale Food Addiction Scale?**

- A. Ten items that assess overeating and risk of food addiction using the *Diagnostic and Statistical Manual of Mental Disorders*, fifth edition (*DSM-5*) substance use disorder criteria
- B. Twenty-five items that measures binge-eating disorder in relation to food addiction
- C. Ten items that measure presence of food addiction symptoms based on the International Classification of Diseases
- D. Twenty-five items that measure presence of food addiction symptoms based on the *DSM-IV* substance use disorder criteria

**5. Name the type of eating associated with pleasure vs survival.**

- A. Reward-based eating
- B. Hedonic eating
- C. Homeostatic eating
- D. Addictive eating

**6. According to this course, which of the following are involved in food addiction?**

- A. Dopamine and opioids
- B. Dopamine and glutamate
- C. Opioids and oxytocin
- D. Dopamine and epinephrine

**7. Which of the following have been shown to be downregulated in both human drug addicts and obese rats?**

- A. Appetite hormones
- B. Opioid receptors
- C. Lipolysis
- D. Dopamine receptors



**8. Rats fed highly palatable foods exhibit which symptoms similar to those observed in humans with substance use disorders?**

- A. Teeth chattering and shaking
- B. Compulsive food seeking and eating
- C. Withdrawal and dependence
- D. Aggression and anxiety

**9. Human studies on food addiction often look at the effect of food on the brain by using brain imaging studies.**

- A. True
- B. False

**10. Which of the following may be a useful tool RDs can use when counseling clients with signs and symptoms of addictive-like eating behaviors?**

- A. Food records
- B. 24-hour diet recall
- C. The Plate Method
- D. Individualized meal plans