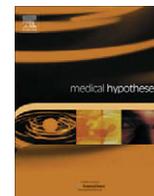




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Refined food addiction: A classic substance use disorder [☆]

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SUMMARY

Overeating in industrial societies is a significant problem, linked to an increasing incidence of overweight and obesity, and the resultant adverse health consequences. We advance the hypothesis that a possible explanation for overeating is that processed foods with high concentrations of sugar and other refined sweeteners, refined carbohydrates, fat, salt, and caffeine are addictive substances. Therefore, many people lose control over their ability to regulate their consumption of such foods. The loss of control over these foods could account for the global epidemic of obesity and other metabolic disorders. We assert that overeating can be described as an addiction to refined foods that conforms to the DSM-IV criteria for substance use disorders. To examine the hypothesis, we relied on experience with self-identified refined food addicts, as well as critical reading of the literature on obesity, eating behavior, and drug addiction. Reports by self-identified food addicts illustrate behaviors that conform to the 7 DSM-IV criteria for substance use disorders. The literature also supports use of the DSM-IV criteria to describe overeating as a substance use disorder. The observational and empirical data strengthen the hypothesis that certain refined food consumption behaviors meet the criteria for substance use disorders, not unlike tobacco and alcohol. This hypothesis could lead to a new diagnostic category, as well as therapeutic approaches to changing overeating behaviors.

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Introduction

Overeating in industrial societies is a significant problem that has been linked to an increasing incidence of overweight and obesity with their resultant adverse health consequences, including insulin resistance and diabetes mellitus, hypertension, and cardiac disease. Overeating has been attributed to the ready availability of food [1,2], sedentary lifestyle [3–8], and economic considerations [9–11]. While some or all of these ideas may have some degree of explanatory power, none of them address a critical question; namely, why do people in industrial societies persistently overeat despite considerable and repeated efforts not to do so?

We advance the hypothesis that a possible explanation is that processed foods with high concentrations of sugar or other refined sweeteners, other refined carbohydrates (such as flours), fat, salt, and caffeine are *addictive substances*, and, therefore, many people lose control over their ability to regulate their consumption of such

foods. The addictive loss of control over these foods could account for the ever-increasing global epidemic of obesity and other metabolic disorders. Further, if it is shown to be valid, this hypothesis would have major implications for potential interventions to help reverse these trends.

The model of an addiction focused on processed foods containing high concentrations of refined sweeteners, flours, fats, salt, and/or caffeine is a biologically plausible explanation for this over consumption.

A growing body of research has found a correlation between the frequent consumption of fast food and soft drinks and obesity [12–19]. The relationship between sweetened drinks, obesity, and diabetes has also been established [20]. Indeed, per capita consumption of refined carbohydrates has progressed significantly over the last 40 years, parallel to the increased incidence of the metabolic syndrome, which includes insulin resistance, overweight, hypertension, dyslipidemia [12,21]. Table 1 shows the increased per capita consumption of hypothesized addictive foods in the United States for each year listed.

If the addiction hypothesis were true, then the overall US statistics would show a steady and dramatic increase in the

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Table 1
Per capita consumption of hypothesized addictive foods in the United States [21].

Product	1970 Consumption per capita	1997 Consumption per capita	Absolute increase	Percentage increase (%)
<i>Refined products</i>				
Corn and wheat flour	122.0 lbs	172.8 lbs	+50.8 lbs	42
Total caloric sweeteners	122.3 lbs	154.1 lbs	+31.8 lbs	26
High fructose corn syrup	0.5 lbs	62.4 lbs	+61.9 lbs	1240
Carbonated soft drinks	24.3 gallons	53.0 gallons	+28.7 gallons	218
Fruit drinks ^a	5.7 gallons	9.2 gallons	+3.5 gallons	61
Frozen potatoes	28.5 lbs	59.0 lbs	+30.5 lbs	207
Chocolate liquor equivalent	3.1 lbs	4.1 lbs	+1.0 lbs	32
Ready-to-eat breakfast Cereals ^a	8.6 lbs	14.3 lbs	+5.7 lbs	66
<i>Unrefined products</i>				
Animal protein (excluding eggs)	177.3 lbs	190.3 lbs	+13.0 lbs	7
Beans	7.6 lbs	8.5 lbs	+0.9 lbs	12

^a These increases may be more significant than they appear, since the reported per capita use includes adults and children, yet most of the usage (based on the nature of advertising on the product) is most likely children.

consumption of refined foods corresponding to the steady and dramatic rise in overweight and obesity [12]. As seen in Table 1, this, in fact, is the case between 1970 and 1997 in the US.

High fructose corn syrup and flour show the most dramatic increase in consumption, with 61.9 lbs and 50.8 lbs, respectively, between 1970 and 1997. Although many other factors besides a potential addiction mechanism contributed to the observed increases, these data are consistent with the hypothesis of a clinical disorder of addiction to refined foods. Similar increases were seen in the use of tobacco when coupled with reduced prices and heavy advertising. Between 1880 and 1920, cigarette consumption increased from 50 cigarettes per adult to 500 [22].

Comparisons between overeating behavior and addictive drug behavior have been made. However, the comparison was difficult because it was presumed that the compulsive element associated with eating stems from appetite mechanisms while the compulsive element of drug use is derived initially from pleasure seeking and the powerful reinforcing properties of drugs of abuse in later stages of addictive disease [23]. Separating the elements of a healthy appetite from harmful addiction is further challenged by findings in rat studies that the neuropathways of appetite and addiction (pleasure and reward) extensively overlap [24]. Kalra and Kalra have identified a number of neuropeptide elements that are active in both reward and appetite pathways including neuropeptide Y (NPY), Y1 receptors, leptin, endocannabinoids CB1, anandamide 2-arachidonoyl glycerol, orexigenic (ORX) signaling, and endogenous opioid peptides (EOP) [24]. Numerous review articles have also established a connection between the neuropathways activated in the consumption of palatable food and the key reward pathways activated in drug and alcohol use [24–36].

Under the framework that we are proposing in this article, the hypothesis could be that the very same mechanisms—pleasure seeking followed by mindless behavioral reinforcement—that are operative in the loss of control over drug use are also operative in the loss of control over certain foods.

Our hypothesis of addiction to refined foods is based on a fundamental distinction between two general categories of food: refined vs. unrefined. The first category includes ingredients that are refined by an industrial process, such as sugar, other sweeteners, flour, salt, caffeine, and certain fats. The second category comprises foods found in nature, such as meat, poultry, fish, beans, grains, vegetables, and fruit. In our model, we hypothesize that humans can become addicted to foods in the refined category, but not to foods in the unrefined category, however prepared. Although, there is not yet sufficient evidence to assert that any of the refined ingredients may act as psychoactive drugs, our observations strongly suggest that foods containing these ingredients, or composed entirely from them, are consumed in a manner consistent with generally understood concepts of addictive behavior found

in the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) [37].

Like drugs of abuse, sugars and flours are substances found in nature, where they exist in much smaller concentrations than in food and in combination with fiber, water, vitamins, and minerals. We propose that, like drugs, they are not addictive until extracted and concentrated by modern industrial processes. Examples from the world of drugs include cocaine extracted from cocoa leaves, opium extracted from poppies, ethanol distilled from grains, fruits, and potatoes or nicotine smoked from dried tobacco. Importantly, there is good evidence that carbohydrate preference (and likely fat preference and salt preference) is ‘hard-wired’ into humans because it plays a crucial role in attracting people to eat safe and nutritious foods such as fruits. Whereas small concentrations of these substances contained in natural foods also have significant amounts of fiber, vitamins, and trace minerals that serve the useful purpose of directing us to eat such foods, large concentrations of these substances contained in refined foods may subvert this adaptation and lead some people to compulsively seek and consume refined foods.

In addition, a factor in the development of refined food addiction is the practice in industrial cultures of combining these substances with each other in ways which are entirely unnatural but which may enhance their potentially addictive force. Examples of these artificial combinations include soft drinks, which contain sugar and caffeine; doughnuts, which contain refined flours, sugar, salt, fat and sometimes caffeine from chocolate; and French fries, which contain fat, salt, and, often, dextrose. The combinations are in concentrations much larger than those found in nature, and are dissociated from foods with nutritional value such as meats and fruits.

The refined food addiction hypothesis

The DSM-IV defines substance dependence as three or more of the following seven symptoms occurring within 1 year: tolerance, withdrawal symptoms, substance taken in larger amounts or for a longer duration than intended, attempts to cut back, excessive time spent pursuing, using or recovering from use, reduction or discontinuation of important activities because of use, and continued use despite adverse consequences.

Our hypothesis is that overeating can be described as an addiction to refined foods that conforms to the DSM-IV criteria for substance use disorders. The DSM-IV criteria have been validated extensively across substances and cultures [38–44]. The DSM-IV criteria have been established through an arduous process of consensus building among experts and are considered the best operational definition of addiction (substance abuse and dependence) currently available. Further, if our hypothesis is true, we expect that individuals with the disorder would meet the DSM-IV criteria for a substance use disorder.

The hypothesis evolved in the context of our lay experience with self-identified refined food addicts, and our critical reading of the literature on obesity, eating behavior, and addiction to drugs. In this paper, we will discuss how these observational and scientific data support our hypothesis. For organizational and heuristic purposes, the body of the paper will be structured according to the 7 DSM-IV substance dependence criteria. We will present qualitative data from our observations under each criterion, followed by a discussion of the literature relevant to the criteria.

Source of observations

Ms. Joan Iffland, a lay educator, developed observations over 12 years of experience working with self-identified food addicts. She attracted students from her popular writings and workshops. She also made generic observations in a recovery group.

In addition, the specific illustrations described in this article, which are illustrative of the shared experience of hundreds of others with whom our lay educator has interacted, were collected from students at an adult education class on the ill effects of sugars and flours held on May 6, 2008 in Houston, Texas. Most of the respondents were overweight or obese, middle-aged, middle class women. Half of the respondents were of white, non-Hispanic race, 33% were African-American, and the remaining 17% was comprised of members of other races. The students were given the survey questions shown below, which were adapted from the Structured Clinical Interview for the DSM-IV. After a discussion period, students were invited to write down their own experiences. They signed a statement at the bottom of the form giving the researcher permission to use the quotes without attribution. Twelve forms were collected; one form from a minor was deleted.

The comments pertain to products containing sugars, caffeine, fat, and salt such as soft drinks, sweetened coffee, cake, cookies, hard candy, mints, chocolates, ice cream, pasta, bread, cornbread, crackers, and pie. In the discussion of loss of control, students did not reference problem behavior with unrefined fruits, vegetables, starches, or proteins.

Method of literature review

The literature review took place over 3 years in the course of a doctoral program in the development a new interdisciplinary field, addictive nutrition. Searches were conducted using key words food addiction, addictive properties, neurophysiology, obesity, weight loss, pharmaceuticals, diabetes, food addiction, and validation.

Articles retrieved and reviewed included studies of the addictive properties of individual foods, cross over studies where food is substituted for drugs, brain imaging studies in the obese, studies describing the overlap of CNS pathways between appetite and reward, animal studies of addictive behavior in the use of refined foods, addiction assessment studies, and epidemiological studies of the spread of obesity. Relevant chapters from standard nutrition and addiction textbooks were also included. The literature was re-evaluated and re-interpreted in light of the DSM-IV criteria for substance dependence. In this article, we highlight those studies that provide empirical support for specific criteria as discussed under each DSM-IV substance dependence criterion.

Applying DSM-IV substance dependence criteria to refined foods: observation data

Criterion 1. Progressive use over time

DSM-IV language

- (1) Tolerance, as defined by either of the following:

- (a) A need for markedly increased amounts of the substance to achieve intoxication or desired effect.
- (b) Markedly diminished effect with continued use of the same amount of the substance [37].

Observations from interactions with self-identified refined food addicts

The compulsive need to consume larger quantities of particular foods in order to obtain the desired effect was a recurrent theme among almost all people that comprise the observed population. The desired effects reported are similar to other drugs of abuse, including numbness, satiety, calm, and high. The types of foods that people needed to consume include foods that are commonly offered in a variety of increasing portion sizes, such as fast food regular to super size, pint to quart of ice cream, small bag to large bag of chips and salty snacks, 8 oz to 64 oz of soda, larger buckets of popcorn and more refills. People said that they were not satisfied with the amounts that had previously satisfied them.

Adaptation of DSM-IV language for the class survey

Have you found that you need to eat a lot more than you used to in order to get the feeling you want?

Responses to Criterion 1

"If I tell myself I will only eat 1 cookie, then that leads to another and another until I make myself stop at 5 or 6. I used to be able to eat only one or two."

"My coffee mug holds 3 servings of coffee every morning. Now I'm even adding real sugar and flavored cream. . . 5 years ago, I used to drink ½ cup of black coffee and chase it with 2 glasses of water."

"I kept a bag of dark chocolate candy in the pantry. I started out eating one serving per day. Then, I started putting an extra serving in my lunch bag. Then I would add another piece or two at breakfast. It just got worse and worse."

"When I used to buy groceries, I would take them home, eat a snack and go on with my day. Now I buy groceries and I eat all day long until I have gone through half of what I bought."

These responses support Criterion 1 by showing a pattern of tolerance in greater use of specific substances. The comments refer to sugar, caffeine, and fat in the use of coffee and chocolate. The reference to groceries and cookies raises the possibility of a role for flour. The progressive use of ice cream brings up the question of the use of high-fat food.

Criterion 2. Withdrawal symptoms

DSM-IV language

Withdrawal, as manifested by either of the following:

- (a) The characteristic withdrawal syndrome for the substance.
- (b) The same (or a closely related) substance is taken to relieve or avoid withdrawal symptoms [37].

Observations from interactions with self-identified refined food addicts

Self-identified refined food addicts report that they eat when they feel tired, anxious, depressed, and/or irritable. The hypothesis would posit that this is ingesting refined foods to avoid a withdrawal characterized by fatigue and negative moods. Refined food addicts eat certain refined foods for a pick-me-up. They are aware that they are not hungry and that it is irrational to eat to correct fatigue. They compulsively browse the break-room/kitchen at

mid-morning. They report repeat behaviors such as always going to the vending machines for refined foods in the afternoon, and grazing the home kitchen for refined snacks and ice cream in the evening. Based on this pattern of irrational ingestion approximately 2 h after a meal, we can extend the hypothesis to include a withdrawal syndrome characterized by restless, insatiable cravings, accompanied by fatigue and poor mood.

Adaptation of DSM-IV language for class survey

Have you ever had any withdrawal symptoms when you cut down or stopped overeating certain foods such as sweating or racing heart, hand shakes, trouble sleeping, trouble thinking, feeling depressed, feeling agitated, feeling anxious, feeling tired? Do you eat to alleviate any of these feelings?

Responses to Criterion 2

“Cutting down on breads makes me shaky. When I try to avoid coffee for one day, I feel agitated and because I work with children, I will grab a Pepsi so I don’t appear to be mean.”

“I eat sugar to alleviate the feeling of depression, anxiety, and agitation. I use Kona coffee, coffee candy, baked goods, and coffee cake to stop a headache, depression, fatigue, stress, and sadness.”

“I eat sugar filled foods to correct being tired and/or depressed. To fix anxiety, I eat something crunchy, like chips or crackers to calm myself. . . . I am afraid if I stop using food to correct my emotions, I will feel tremendous fear and anger.”

Many, if not most, of the comments in this section are about how food use provides temporary relief from negative feelings. What we posit here is that the negative feelings that are being described are *psychological manifestations of withdrawal* that are corrected by use, just like with cigarettes, where it is psychological withdrawal that is more prominent than physical withdrawal.

Criterion 3. Use more than intended

DSM-IV language

The substance is often taken in larger amounts or over a longer period than was intended [37].

Observations from interactions with self-identified refined food addicts

Self-identified refined food addicts have many examples of this behavior. They visit the cookie kiosk or donut shop to get one cookie or donut, but get a dozen and eat them all within a few hours or less. They promise themselves only a few chips, but the contents of the bag disappear. They have a feeling of disbelief: “I can’t believe I ate the whole thing!”

Adaptation of DSM-IV language for class survey

Have you often found that when you started eating you ended up eating more than you were planning to?

Responses to Criterion 3

“It seemed like one bite of chocolate led to uncontrolled, frantic shoveling of chocolate into my mouth. It was like trying to put out a fire.”

“If my elbow is bending my mouth is flying OPEN to eat cookies and my elbow bending seems to be involuntary.”

“One bowl of ice cream turns into 2 bowls, then 3 bowls. I start with one hand-full of chips and end up eating the whole bag.”

Criterion 4. Tried to cut back

DSM-IV language

There is a persistent desire or unsuccessful efforts to cut down or control substance use [37].

Observations from interactions with self-identified refined food addicts

Every refined food addict reports a series of attempts to cut back on eating. They have used a variety of techniques including eating less, hypnosis, meal replacements, therapy, 12-step groups, surgery, pharmaceuticals, acupuncture, special foods, prayer groups, and exercising in hopes of decreasing food consumption. The consistent theme is that all of these techniques have failed.

Adaptation of DSM-IV language for class survey

Have you tried to cut down or stop overeating certain foods? Do you want to stop or cut down? Is this something you kept worrying about?

Responses to Criterion 4

“Yes, I have tried to cut down or stop, but it is always on my mind and I find way to defeat myself. Even making a special trip to get a candy bar or chips.”

“I wanted to be able to eat desserts normally. I listed all my favorite restaurants with my favorite desserts. I made a plan to have one dessert one day per week at one special restaurant. The plan only lasted two weeks before I was eating more desserts than that.”

“I will decide to cut back on sodas and sometimes it will last as long as two or three days.”

Criterion 5. Spend time pursuing, using, or recovering from use

DSM-IV language

A great deal of time is spent in activities necessary to obtain the use of the substance, or recover from its effects [37].

Observations from interactions with self-identified refined food addicts

Refined food addicts report that they are in and out of the kitchen, the break-room and the bathroom all day. They even report that they get up at night to eat. They consistently report that they are sleepy after a meal. They may spend entire weekends buying, eating, and sleeping off use of food.

Adaptation of DSM-IV language for class survey

Have you spent a lot of time eating, being groggy from eating, or tired/hung over from eating?

Responses to Criterion 5

“I can get a hangover from chocolate. I get behind in my student grading when I’m eating the chocolate.”

“I have a to-do list that never changes because I can’t get to it. I nap all the time after eating.”

“I will have a list of chores to do on Saturday. I will go to the store and buy groceries and spend the rest of the day eating what I bought and sleeping.”

Because food is readily available, as compared to illegal drugs, the first portion of the criterion is not particularly applicable. This would also be the case with other legal, socially acceptable, readily available substances such as cigarettes in the 1950s. Illegal drugs would show this feature of the addiction more prominently as

users would need to spend time avoiding detection from legal authorities. However, the emphasis on the time spent recovering from use is similar to alcohol use where sleeping off use is a feature or with heroin use where nodding off is a feature [37].

Criterion 6. Missed important activities

DSM-IV language

Important social, occupational, or recreational activities are given up or reduced because of substance use [37].

Observations from interactions with self-identified refined food addicts

Consistent with the illustrations given below, refined food addicts seem to isolate because of shame over being too fat, or from fatigue. Another reported reason for missing events is that refined food addicts do not like to eat in front of other people.

Adaptation of DSM-IV language for class survey

Have you had times when you would eat so often that you started to eat instead of working or spending time at hobbies or with family or friends?

Responses to Criterion 6

“I don’t go anywhere any more because I don’t like my size and I don’t have the energy. I have not danced in years.”

“I come home and eat. Then, I’m too full to exercise.”

“I don’t read, clean, walk the dog, or be loving to my boyfriend. I didn’t go to a boat party because I was too fat in my swimsuit.”

As seen in the comments, overweight and obesity are prominent features of the hypothesized refined food addiction and play a role in missing important activities. Such a prominent distortion in physical appearance is not found in other addictions. In fact, the reverse may be true, since other addictions replace food use for the addictive substance, as can be seen in weight gain during drug and alcohol recovery [45]. Nonetheless, we suggest that overweight as a deterrent to participation in life or as the cause of exclusion from important life events due to discrimination, could be considered support for Criterion 6 in determining whether refined food use constitutes an addiction under the DSM-IV diagnosis.

Criterion 7. Eating in spite of knowledge of consequences

DSM-IV language for Criterion 7

The substance use is continued despite knowledge of having a persistent or recurrent physical or psychological problem that is likely to have been caused or exacerbated by the substance [37].

Adaptation of DSM-IV language for class survey

Has your eating caused any psychological problems, like making you depressed or anxious, making it difficult to sleep, or causing disruptive fatigue? Has your eating ever caused significant physical problems?

Responses to Criterion 7

“I have had the thought that I shouldn’t eat something but I go ahead anyway. I rationalize eating. For example, I might think that I should eat something (a.) because someone made it just for me; (b.) Just this once won’t hurt; (c.) I’ll start the diet tomorrow; (d.) It’s good value; (e.) It’ll be used up.”

“Oh yes, I think of excessive weight and laziness and eat anyway.”

“This weekend I wanted to take my family downtown and then to the antique and flea markets, but at lunch I ate a huge bowl of cake and ice cream even knowing that it would make me sleepy. I fell asleep which made me sad.”

“I eat in spite of horrible knee and leg pain. I’m so uncomfortable after a binge that I can’t lay down without regurgitation coming up into my esophagus. I’m miserable. I have embarrassment and fear about being in social situations but I overeat anyway.”

Summary of observational data

The illustrations from the class survey and reports from self-identified food addicts seem to comprise behaviors that conform to the DSM-IV criteria. The pathology of behavior and the elements of loss of control and distress that are prevalent in other addictions also appear in this qualitative data.

Applying DSM-IV substance dependence criteria to refined foods: literature review

We note that there is much missing scientific data supporting the food addiction hypothesis, particularly empirical research in humans. That would be expected at the early stage of new disease identification. That is why the observational data is so critical at this stage of hypothesis generation. Nonetheless, if the hypothesis proves to be correct, it would be expected that researchers engaged in the study of obesity and addiction would have generated evidence for the disease of refined food addiction.

Literature review for Criterion 1: progressive use

There are three sources of evidence for progressive use of food: animal studies, neurotransmitter studies, and national consumption statistics.

Animal studies

Laboratory rat studies have shown that rats exhibit tolerance in the use of glucose [28,46]. In one study, rats increased their consumption of glucose from none to 60 ml per day in 30 days [46]. In a second study, rats increased their consumption of glucose from 5 ml to 16 ml in 8 days [28]. These studies also found evidence for the underlying neurochemical changes indicative of tolerance.

Neurotransmitter studies

Evidence for the progressive use of food also comes from studies of neurotransmitter functioning related to eating. The disease mechanism for progressive use is purported to be the down-regulation of neurotransmitter receptors in response to excessive stimulation resulting from the drug use [47]. A neurotransmitter study in humans examined D2 dopamine receptors in the obese and in methamphetamine abusers using MRI [48]. Strikingly similar down-regulation of these receptors was found, thereby identifying a potentially common underlying neurochemical basis for tolerance in these groups.

In order for progressive use of refined foods to be attributed to down-regulation of receptors known to play a role in the addictive process, it must also be established that ingestion of refined foods results in stimulation of these receptors. In this regard, studies in rats have found release of dopamine in response to sucrose cues [49] and the release of opiates in response to coffee use [50].

Another study in rats showed that a 5-HT(1B/1A) receptor agonist extinguished both cocaine and sucrose-seeking behavior [51].

This implicates serotonin in the neurotransmitter mechanisms that may contribute to the addiction. An additional finding in rats is that opioid and cannabinoid antagonists significantly diminish their food seeking behavior [52].

Consumption statistics

As previously outlined, consumption patterns for foods reportedly used in addictive behavior show significant increases in use over foods that are not mentioned in descriptions of addictive behavior. As seen in Table 1, increases in sweetener use (26%), flour use (42%), and cocoa liquor use (32%) use are much higher than increases in bean (7%) and animal protein (12%) consumption in the years of the development of the obesity epidemic. Increases in foods that contain combinations of potentially addictive ingredients, such as soft drinks (caffeine and sugar) (218%) and frozen potatoes for use in French fries (fat and salt) (207%) are also very high.

Literature review for Criterion 2: use to avoid withdrawal

The evidence for withdrawal symptoms comes from animal studies in which rats are provided increasing amounts of sugar and then abruptly returned to a sugar-free diet. The animals exhibit symptoms similar to morphine withdrawal, including paw shaking, teeth chattering, head shaking, and anxiety [28] and a drop in body temperature [53]. There is also some evidence in humans for a salt withdrawal syndrome consisting primarily of nausea [54] and a caffeine withdrawal syndrome consisting of headache, fatigue, and drowsiness [55–60].

Literature review for Criterion 3: use more than intended

There is ample evidence in the literature for the existence of binge eating which might initially appear to be out of control eating. However, bingeing is not necessarily a match for this criterion because binges can be planned and deliberately executed. A better source of evidence might be the studies in which diet interventions for weight loss are frequently followed by a weight regain [61]. Presumably, the participants in these studies did not plan to overeat and regain the weight.

Literature review for Criterion 4: tried to cut back

The evidence for this criterion, on a population level, comes from diet studies in which the participants indicate that they try to cut back on caloric intake in order to lose weight [62,63]. Almost by definition, those foods that dieters attempt to cut back on are the refined foods that are the subject of our hypothesis. In Kant's random sample, about half of all respondents were trying to lose weight and their caloric intake was less than those who were not trying to lose weight [62]. In Serdula's study, participants indicated that they were trying to cut back on fat [63]. Thirty percent of men and 44% of women were trying to lose weight in this 1996 study. Both studies show the attempt to cut back, and Dansinger's work shows the failure of diets to maintain weight loss presumably because of the inability to cut back on certain foods [61].

On a population level, the struggle to cut back on fat can be seen in national consumption figures that show the increase in the use

of skim milk offset by the increased use of high-fat creams and cheese. Table 2 illustrates the increase in consumption in these foods in the United States.

Literature review of Criterion 5: spend time pursuing, using, or recovering from use

The prominent feature of this criterion is the fatigue and sleepiness resulting from compulsive food consumption. Therefore, it is possible to reinterpret the literature linking obesity with a sedentary lifestyle by hypothesizing that much of the sedentary behavior is a long-lasting effect of the disordered eating. For example, literature finding that obese people exercise less than non-obese people [3–8] may support the hypothesis that they are sedentary because they are sleepy from eating large quantities of refined foods. Until now, the interpretation of this data has been that the sedentary lifestyle contributes to obesity. Similarly, the well-established connection between TV- and other screen-viewing and obesity [64,65] may be re-interpreted to suggest that people are too sleepy and tired to do anything other than watch TV or surf the Internet. Under this hypothesis, we can construct a scenario in which the refined foods make people too tired to exercise and the escalation of refined food consumption leads to the further decrease of physical activity.

Literature review for Criteria 6: missed events

Studies of obese people show that they are likely to miss social activities [66,67], become pregnant [68], engage in exercise [69], obtain quality health care [70], secure employment opportunities [71], or complete education [72]. Ashmore also found that stigmatizing events, psychological distress, and binge eating are correlated [73] which supports the hypothesis that binge-eaters isolate themselves and miss a social life.

Literature review of Criteria 7: use in spite of knowledge of consequences

Studies show people are noncompliant in diabetes, cardiovascular disease, and hypertension treatment [74–76]. Obesity itself is typically a health condition for which people presumably receive medical advice to lose weight. As several studies show, people are unable to follow this advice. Some evidence for this, as we discussed under Criterion 4, is that as many as 30% of men and 44% of women were trying to lose weight in 1996 [63]. The same study reports that the percentage of people trying to maintain their weight was 35% among both men and women. The totals of 65% of men and 79% of women indicate common knowledge of consequences as evidenced by attempting to reverse the condition or prevent worsening of the condition.

Intoxication, abuse, and relapse

In addition to the seven diagnostic criteria for dependence, the DSM-IV contains criteria for intoxication and abuse. Regarding intoxication, the DSM-IV states that, "The most common changes involve disturbances of perception, wakefulness, attention, thinking, judgment, psychomotor behavior, and interpersonal behavior" [37]. In the illustrations listed above, the prevalence of sleepiness

Table 2
Per capita consumption of skim milk and high-fat dairy products in the United States [21].

Product	1970 Consumption per capita (lbs)	1997 Consumption per capita (lbs)	Absolute increase	Percentage increase (%)
Skim milk	11.6	34.4	+22.8	197
Cream, sour cream, cheese	16.3	36.7	+20.4	226

would seem to create evidence for the criteria of wakefulness, attention, thinking, and judgment, and support the hypothesis that refined food use can lead to a state of intoxication.

Regarding abuse, the DSM-IV describes four criteria that cover a failure to fulfill major role obligations, recurrent substance use in situations in which it is physically hazardous, such as driving an automobile, substance-related legal problems, and continued use despite having recurrent social or interpersonal problems caused by the substance. Self-identified refined food addicts report being unable to care for children because they feel too fat and tired. They also report falling asleep at the wheel. They do not report legal problems because refined food use is not illegal. Many report problems with rage after use. Thus, there seems to be observations that would support the diagnosis of abuse of refined foods that falls short of a full diagnosis of dependence.

Although the DSM-IV does not provide a diagnostic category for relapse, it is a distinctive feature of addictions. Relapse in refined food addiction can be inferred from Criterion 4: tried to cut back. Failing a diet can be thought of as a relapse. Several of the illustrations describe the process of setting a goal of not using bread, sugar, or coffee for a period of time. The illustrations do describe attaining the goal of not using for a few days. However, the participant then describes using the substance in spite of the goal. There is a failure to extend a period of deliberately defined abstinence, which seems to fit the description of relapse.

Discussion

The intent of this paper has been to present evidence for the hypothesis that certain refined food consumption behaviors meet the criteria of the DSM-IV for substance use disorders. The observations of a lay educator in the field of sugar and flour addiction led to the creation of the hypothesis. The paper offers illustrations of the DSM-IV behaviors as applied to eating and as described by adults attracted to a class on the topic of the ill effects of sugars and flours. The paper also reinterprets existing literature that might support the hypothesis. The importance of this hypothesis is that it could lead to a new diagnostic category, which could in turn lead to a useful therapeutic approach. Such an approach would be to abstain from the substances that lead to loss of control, as is the practice with other substance use disorders.

As has been done for other addictive substances, the DSM-IV Substance Use Disorder criteria can be evaluated through validation studies. These studies are ongoing and are being carried out by the Refined Food Addiction (ReFA) Research Foundation through a self-endorsement technique in response to a questionnaire (as opposed to a diagnostic interview). The results of the self-endorsement studies using a paper and pencil instrument should be developed into a full diagnostic interview. Evaluations of abstinence from specific foods as treatment should also be conducted. Abstinence studies would lead to evaluations of the role of refined food addiction in other psychiatric disorders as well as a range of physical disorders related to overeating. The demographics of the conditions could also be established including age, gender, and socio-economics. Other much needed studies include animal studies to examine the physiological mechanisms, treatment studies to assess the efficacy of various abstinence plans, and MRI studies to identify the neuromechanisms of the disease.

It is important to place this hypothesis in the context of alcohol dependence and nicotine dependence. Each of those concepts took decades to gain acceptance. In each case, clinical observation, basic biological research, and applied clinical research gradually led to the development of our modern conception of addictive illness and effective treatment. Further empirical research is urgently re-

quired to determine the validity of the refined food addiction hypothesis.

Should the refined food addiction hypothesis be validated, it could take its place among other well-documented epidemics of addiction including alcohol use in the early 1900s, tobacco use in the mid-1900s, opium use through the sale of Laudanum in England in the late 1800s, heroin use by American soldiers in Vietnam, and the current epidemics of college binge-drinking and club drugs use. In each of these cases, researchers have labored to create the preponderance of evidence in epidemiological, basic biological, and applied clinical studies so that public health officials would be supported in their efforts to curtail access to the addictive substance at issue. Fortunately, for the study of refined food addiction, researchers have the experience with tobacco addiction to help establish the research agenda to examine the validity of the refined food addiction hypothesis. It is hoped that the experience with tobacco and nicotine addiction will also help accelerate changes in the clinical environment that may help refined food addicts to recover. Given the broad range of possible applications, such research should be considered urgent.

Conclusion

The epidemic of illness related to overweight and obesity is a public health problem of great significance. Unfortunately, patients' attempts to reduce weight have been disturbingly resistant to known treatment approaches. In this paper, we advanced the hypothesis that a fundamental reason for this failure is that many people suffer from an addiction to refined foods. The observational and empirical data in support of this hypothesis were discussed in the framework of the DSM-IV criteria for addictive disorders. Although these findings do not establish the existence of such a syndrome, they are sufficiently compelling to warrant further basic and clinical research.

The hypothesis for refined food addiction is attractive because it provides an explanatory context by which the obesity epidemic and its myriad adverse health consequences can be understood in the same framework as the epidemic of tobacco addiction and its attendant consequences. The syndrome may also be understood in the framework of addictions and evolution, "Psychoactive substances... disrupt the very emotions that evolved to regulate our behavior. They arouse reward mechanism artificially, thus stimulating the circuits that are normally fired by an events that provide a huge gain in fitness; but they provide no fitness gain, they simply create an illusion" [77].

In the absence of an addiction framework, irrational overeating of refined foods remains a puzzle without a solution. With the possible validation of the refined food addiction syndrome, the health community could move forward with recommendations of abstinence from specific substances. We sincerely hope that the addiction research community will explore this hypothesis with targeted research.

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