Examining the Connection between Food Addiction and Human Obesity

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Abstract: Worldwide, obesity prevalence has increased substantially over the past two decades. Obesity is partly explained by genetic factors and is strongly influenced by individual's habitual lifestyle. Investigating factors that may affect the development of obesity and their mechanisms of action is highly significant; one of these factors includes energy-dense foods with high-fat and sugar. Although these foods play an important role in development of obesity, the basic mechanisms of their pathogenesis remain poorly understood. In this regard, the classical view has been that dietary fat and sugar modulate body's energy efficiency and consequently the adipose tissue lipogenesis. Recently, the relationship between dietary fat, sugar, and obesity has entered a different level due to introduction of the food addiction concept that refers to pattern of overeating because of similarities between compulsive overeating and chemical dependence. In essence, this provides new ways by which dietary fat and sugar exert their cellular effects, especially the brain's reward pathway that is central to development and maintenance of chemical addiction. This article critically evaluates current literature dealing with the connection between dietary fat and sugar addiction, and the pathogenesis of human obesity, and suggests future avenues of research. The evidence that links high fat and high sugar foods to addiction-like eating behaviours in humans is limited. However, no causal relationship is already established. Further controlled human studies are required for better evidence-based links between the addiction of energy-dense foods and obesity development, a matter that is important for obesity prevention, treatment and its dietetic management.

[Mousa Numan Ahmad, Ruba M. Mushrbash. **Examining the Connection between Food Addiction and Human Obesity.** *Nat Sci* 2018;16(10):102-110]. ISSN 1545-0740 (print); ISSN 2375-7167 (online). http://www.sciencepub.net/nature. 15. doi:10.7537/marsnsj161018.15.

Keywords: Food addiction, obesity, dietary fat, sugar, energy-dense foods, Yale food addiction scale (YFAS)

1. Introduction

Worldwide, the prevalence of obesity is increasing in both developed and rapidly developing countries (Gearhardet et al., 2016). The number of obese individuals has been doubled since 1980; 1.9 billion adults are overweight and 600 million are obese, and it is estimated that the percentage of obesity will reach 57.8% of the global population in 2030 (Dimitrijevic et al., 2015; Ruddock and Hardman, 2018). In the United States, it is reported that 63% of American females are obese (Berenson et al., 2015) and more than 85% of adults are supposed to be overweight or obese by 2030 (Schulte et al., 2015). In the Middle East, Kuwait, Bahrain, Saudi Arabia, and United Arab Emirates are among the top ten countries worldwide in terms of prevalence of obesity (ALNohair, 2014). In Jordan, obesity prevalence in adults is about 50%, and it is higher in women than men (Ahmad and Haddad, 2015; Obeidat et al, 2015).

It is well known that obesity results from interplay between genetic and environmental factors (Wang et al., 2002). However, the dramatic increase in obesity rates over the past few decades suggests that environmental rather than genetic factors are the main contributors of such increase. Abnormal eating behaviours, physical inactivity, early life experiences and dietary indiscretion such as increase in potion size of meals, increase in energy intake, dependence upon energy dense foods and shifting to westernized dietary patterns are among the environmental factors that contribute to development of obesity (Ahmad et al., 2006; Abbas et al., 2014; Morris et al., 2015; Atay and Bereket, 2016).

There has been much behavioural work conducted concerning pathology of human obesity particularly those related to food addiction. Overeating triggered by sound, smell and sights associated with palatable foods are one of the contributing factors to obesity (Ferrario, 2017). Similarities between aberrant eating behaviours and substance dependence have provided some support for food addiction hypothesis (Gearhardt et al., 2013). Behavioural researches also show similarities among certain patterns of overeating and other compulsive behaviours such as drinking too much alcohol, addictive drugs and gambling. These behaviours are reported to activate brain circuitry mechanisms involving reward, motivation, decision-making, learning, and memory (Volkow and Wise, 2005; Chiara and Bassareo, 2007; Wang et al., 2009). Corn, wheat, coffee, milk, eggs and potatoes are among frequently eaten foods first reported to be addictive; however, this view has recently changed

(Meule, 2015; Burrows et al., 2017). Energy dense foods and ingredients in palatable foods that are high in fat and sugar are shown to be a subject to compulsive consumption (Davis et al., 2011; Gearhardt et al., 2013; Oginsky et al., 2016). These foods or ingredients are known to cause changes in the reward pathway in the brain that are central to the development and maintenance of drug addiction (Carter et al., 2016). They are also known to display symptoms equivalent to those of drug abuse such as loss of control, withdrawal, continual use despite negative impacts, and incapability to cut down problematic habit and use cravings for addictive foods (Wang et al., 2009; Meule and Kubler, 2012; Gearhardt et al., 2012; Pedram et al., 2013; Hebebrand et al., 2014; Westwater et al., 2016). In fact, food addiction describes this pattern of overeating due to similarities found between compulsive overeating and drug dependence (Gearhardt et al., 2009; Lerma-Cabrera et al., 2016).

The first use of the scientific term of food addiction has been tracked back to 1890 followed by random interest in the subject dating from 1950s and the years after (Rogers, 2017). In 1949, Donald Hebb first suggested that hunger can be viewed as an addiction, an idea he attributed to the physiologist AJ Carlson in 1916. Hebb proposed that hunger is a learned behaviour and eating is initially reinforcing because it reverses an unpleasant bodily signal due to changes in nutrients in the circulation including hunger hormones and stomach contractions; with time behaviour becomes organized and food cues such as sight and smell of foods develop the ability to induce craving, approach and consumption much as drug associated cues will do (Dagher., 2009).

Utilizing brain specialized centres for reward roles, studies started in 1954, where electrical stimulation of specific brain sites showed to be highly rewarding in the sense that rats responded to electrical stimulation of these brain sites (Spanagel and Weiss, 1999). In 1956, Theron Randolph described food addiction as situation of specific adaptation to one or more types of regularly consumed foods to which a person is highly sensitive and produces a pattern of symptoms similar to those of other addictive processes (Meule, 2015). Later, Roy Wise explained the role of dopamine and its receptor blockage with a neuroleptic in attenuating the reinforcing effects of foods, as it does for stimulant drugs and electrical brain stimulation; this led him to conclude that addictive drugs act on the brain circuitry that controls feeding (Dagher, 2009). Dopamine is a neurotransmitter that plays a central role in motivation, cognition, and reward seeking behaviours. Dysfunction of the dopaminergic system have been involved in numerous neurological and psychiatric disorders such as affective disorders, drug abuse, schizophrenia, attention deficit hyperactivity disorder, pathological gambling, post-traumatic stress disorder, and obesity (Kamkar., 2013).

The Yale food addiction scale (YFAS) is a newly-developed validated tool for diagnosis of food addiction in humans (Meule and Gearhardt, 2014). It has been developed based on the Diagnostic and Statistical Manual of Mental Disorders criteria for substance dependence (Carter et al, 2016). Version 2 of the scale has been recently developed, upgraded and documented (Gearhardt et al., 2016). It is worth mentioning that this scale is now the basic tool used by many researchers for investigating food addiction and eating behaviours and their role in the pathogenesis of obesity (Magyar et al., 2018; Nunes-Neto et al., 2018; Masheb et al., 2018).

2. Scientific Evidence: Literature Search

An up-to-date literature search was conducted on the connection between dietary fat and sugar addiction and the development of obesity. The search was limited to English publications from a 20-year period (1999–2018). Relevant articles were principally identified through online search of PubMed, Science Direct and PsycINFO. Google Scholar and other databases were also used.

The search process was done using the following keywords or their combinations: food addiction, obesity, overweight, fat addiction, sugar addiction, Yale scale, Yale food addiction scale, YFAS version 2, prevalence of food addiction. Included articles were mainly original experimental, clinical, intervention and cross-sectional researches in humans from both genders and any age group. For further search accuracy, the reference lists of works were checked for additional publications from the major databases.

The majority of reported studies were cross sectional that used the basic YFAS English version or translated it into different languages and its reliability was tested. Study samples included males and females from various populations and ethnic origins, and with a wide range of age groups and body mass index categories, as well as individuals with some eating or psychological disorders. Prevalence of food addiction and its symptom score and their connection with obesity were investigated. Table 1 presents descriptive summary of the major documented food addiction studies in humans.

3. Food Addiction and Brain Reward

Both drug or chemical abuse and hyperpalatable foods especially those high in fat, sugar and salt are deemed to act on the dopaminergic reward pathway in.

Table 1. Descriptive summary of the major documented food addiction studies in humans *

Reference	Study design	Study population	FA prevalence	Mean symptom score	Most endorsed symptom score	FA diagnosis tool	Main findings
Magyar et al., 2018	Cross sectional	N:191 x̄ age: 15 yrs Males: 57 % Females: 43%	8.9 %	1.7	N/A	YFAS-C: Hungarian version	FA is higher in females than males and are associated with BMI, but not with age
Masheb et al., 2018	Cross sectional	N:126 x̄ age: 61.8 yrs Men: 89.7 % Women: 10.3%	10 %	N/A	I feel sluggish or fatigued from overeating	mYFAS: version 2	m-YFAS validity is confirmed with FA contributing to excess weight in patients seeking weight reduction beyond effects of disordered eating
Nunes-Neto et al., 2018	Cross sectional	N: 7639 Age: ≥ 18 yrs Men: 28.7 % Women: 71.3%	4.32 %	N/A	N/A	mYFAS version 2	FA is more common in women and is associated with co-occurring mood disorders, skin picking disorder and early life psychological abuse
Schulte and Gearhardt, 2018	Cross sectional	N: 986 Age: ≥18 yrs Men:48.8 % Women: 51.2%	15 %	1.81	N/A	mYFAS: version 2	FA is higher in underweight or obese than normal and overweight subjects and is associated with higher BMI in women and in older, white and low-income subjects
Ahmed and Sayed, 2017	Cross sectional	N: 801 Age:11-18 yrs Men: 46.5% Women: 53.5%	15.7%	N/A	Tolerance	YFAS_C: Arabic version	FA symptoms rather than FA differ in different BMI categories in adolescents
Burrows et al., 2017	Cross sectional	N:1344 Age: ≥18 yrs Men:19.3 % Women: 80.7%	22.2 %	N/A	N/A	YFAS version 2	FA is higher in women than men and increases across weight categories with a clear overlap between BED and FA
Hauck et al., 2017	Cross sectional	N: 1034 Age:18-65 yrs Men: 51% Women: 49%	7.9%	N/A	Loss of control	YFAS: German version	FA is high in obese and underweight persons reflecting an overlap with eating disorders, and does not relate to gender, education and residence place
Tompkins et al., 2017	Cross sectional	N=26 Age: 12-18 yrs Men: 46 % Women: 54 %	30.7%	2.4	-Continual use despite problems -Inability to cut down	YFAS-C: Children version	Obese adolescents with FA or high FA symptom score may require additional resources to support their adherence to weight management program
Ouellette et al., 2017	Clinical study	N: 146 Age: 18-50 yrs Men: 23 % Women: 77 %	N/A	2.16	Persistent desire or repeated unsuccessful attempts to quit	YFAS: French version	Results of FA in clinical sample of obese subjects awaiting bariatric surgery are consistent with those of previous studies
Torres et al., 2017	Cross sectional	N:278 Age: > 18 yrs Men: 33.5% Women: 66.5%	2.2%	1.55	N/A	YFAS: Portuguese version	Low FA is seen in clinical and non-clinical cases suggesting that YFAS is a sensitive tool to cultural food habits and food preferences
Yang et al., 2017	Cross sectional	N: 624 Age: 20-59 yrs Men: 53.2% Women: 46.8%	8.6%	3.6	Persistent desire or repeated unsuccessful attempts to quit	YFAS: Chinese version	Newly diagnosed Chinese subjects with type 2 DM are more likely to have FA particularly those who are young and have high uric acid
Chao et al., 2016	Cross sectional	N:178 Age: 21-65 yrs Men:11.8% Women: 88.2%	6.7 %	2.3	Persistent desire or repeated unsuccessful attempts to quit	YFAS	Low FA in obese subjects seeking weight reduction, thus addictive like eating behavior is unlikely to be a cause, but psychological help is needed
Pursey et al., 2016	Cross sectional	N:93 Age: 18-35 yrs Women only	22.3 %	2.6	N/A	YFAS	FA is associated with visceral fat deposition and increased risk of CVD
Ceccarini et al., 2015	Cross sectional	N: 88 Age: ≥ 18 yrs Men: 28.5 % Women: 71.5%	34.1	2.7	N/A	YFAS-16: Italian version	Obese adults with FA have high BED levels, dysregulation, negative feelings refuse, lack of oriented behaviors and inability to concentrate
Karandish et al., 2015	Cross sectional	N: 49 Age: ≥ 22 yrs Women only	70% in MS;12% in normal women	5.2 in MS; 2.6 in normal women	Desire or repeated attempts to reduce or stop consumption	YFAS: Persian version	High FA in women with MS and subjects with FA show marked BED, depression, attention deficit hyperactivity, and emotional reactivity
Schulte et al., 2015 (Study I)	Cross sectional	N:120 Age:18-23 yrs Men: 32.5 % Women: 67.5%	N/A	1.85	Persistent desire or repeated unsuccessful attempts to quit	YFAS	Highly processed foods show relations with FA and share properties with drug abuse such as high rate of absorption and high doses are associated with FA
Schulte et al., 2015 (Study II)	Cross sectional	N: 384 Age:18-64 yrs Men: 59.4% Women: 40.6%	N/A	2.38	Persistent desire or repeated unsuccessful attempts to quit	YFAS	Highly processed foods show relations with FA and share properties with drug abuse such as high rate of absorption and high doses are associated with FA
Gearhardt et al., 2014	Cross sectional	N:815 Age: ≥ 18 yrs Men: 11.9% Women:88.1%	25.7%	3.05	N/A	YFAS	FA is linked with BMI, weight cycling and eating pathology, and FA to highly palatable foods may contribute to obesity and eating disorders
Lent et al., 2014	Clinical trial	N: 178 x̄ Age: 55.6 yrs Men: 25.3 % Women: 74.7%	15.2 %	2.6	N/A	YFAS	92.1% of subjects are obese; no effect of FA or FA symptom score on 6 months weight loss intervention is seen
Burmeister et al., 2013	Clinical trial	N:57 x̄ age: 47.4 yrs Men: 31.6% Women: 68.4%	19 %	3.13	N/A	YFAS	Individuals with high levels of FA are more likely to have psychological distress, and those with high levels of FA symptom score have depression
Pedram et al., 2013	Cross sectional	N: 652 Age: > 19 yrs Men: 36.3% Women: 63.7%	5.4%	N/A	N/A	YFAS	FA is higher in women than men and subjects with FA have higher obesity and body measures than controls
Davis et al., 2011	Case control study	N:72 Age: 25-46 yrs Men: 32 % Women: 68%	25 %	12.8 in FA group	N/A	YFAS	Subjects with FA have greater co-morbidity with BED, depression and attention deficit hyperactivity disorder and food craving than obese controls.

*Abbreviations: N: Sample size; yrs: Years; N/A: Not applicable; YFAS: Yale food addiction scale; YFAS-C: Yale food addiction scale for children; FA: Food addiction; CVD: Cardiovascular disease; BMI: Body mass index; BED: Binge eating disorder; DM: Diabetes mellitus; mYFAS: Modified Yale food addiction scale; MS: Metabolic syndrome.

The brain, a circuit composed of dopamine cells that project from the ventral tegmental area to the nucleus accumbens and into limbic and cortical regions such as the amygdala, orbitofrontal cortex and anterior cingulate corte (Russo and Nestler, 2013). The reward pathway is involved in the processes of reward, motivation, and decision-making. Inhibition of these processes is central in the development of addiction and excessive food intake (Johnsin and Kenny, 2010; Kamkar, 2013; Carter et al., 2016).

Several factors are reported to cause dysfunction of the dopamine circuitry, a matter that impairs their

role in food control, causes overeating and thus contributes to food addiction development. One of these factors is dysfunction of the dopamine D2 receptors that leads to the substance-seeking behaviour, termed as reward deficiency syndrome (Wiss and Brewerton, 2017). A drop in the number of these receptors in the nucleus accumbens reduces the activity of the prefrontal cortex, and in turn leads to impulsivity and poor self-control in obese people; this reinforcement pathology favours unhealthy behaviours that eventually contribute to weight gain and obesity (Wiss and Brewerton, 2017). Another reason is the A1 allele of the Taq1A polymorphism which regulates dopamine D2 receptors expression (Dagher, 2009; Kamkar, 2013; Carlier et al., 2015). Individuals with the A1 allele may have reduced receptors causing them to experience a hypodopaminergic state (Kamkar, 2013). Hyper-palatable processed foods containing high sugar and fat can markedly activate dopamine reward circuitry, trigger dopaminergic responses and may show addiction like central rewarding properties (Baik, 2013; Li et al., 2017). These foods may have also a role in the dysfunction of dopamine system (Corsica and Pelchat, 2010). These biologic events are clarified and confirmed in neuroimaging studies where brain responses are similar to food and drug abuse, and both obesity and food addiction are associated with decreased dopamine D2 receptors in the brain (Lerma-Cabrera et al., 2016).

4. Yale Food Addiction Scale (YFAS)

The YFAS is the most widely used measure for examining food addiction (Torres et al., 2017), first developed in 2009 by Gearhardt et al to assess whether individuals show patterns of consumption of highly palatable foods consistent with substance dependence (Berenson et al., 2015). This diagnostic tool is a self-report measure of 25-item questionnaire of addiction like eating behaviours developed according to the Diagnostic and Statistical Manual of Mental Disorders IV (Meule and kubler., 2012). Participants are asked about their eating behaviour in the last 12 months, each question gives participant options ranging from never to every day which are scored using a symptom score from 0 to 7 indicating number of dependence symptoms (Berenson et al., 2015; Dimitrijevic et al., 2015; Burrows et al., 2017; Chao et al., 2017; Sivapriya et al., 2018).

The YFAS scale applies the seven criteria for substance dependence to food and eating behaviour (Lent et al., 2014). The seven criteria are: tolerance as defined by the need for significantly increased amount of substance to achieve intoxication or the desired effect and the reduced effect with continual use of the same substance (Gearhardt et al., 2009), withdrawal established by either the characteristic withdrawal syndrome for substance or the same substance is taken to avoid or relive withdrawal syndrome, taking the substance in large amounts or for over longer period than was intended, the insistent desire or inability to cut down and failed effort despite the desire to control substance use (Schulte et al., 2015), spending a great deal of time in actions necessary to use or seek the substance or recover from its effects, avoiding social or professional activities because of substance use, and continual use of substance despite the knowledge of physical and psychological problems that it is causing a persistent recurrent of a set of psychological or physical problems (Gearhardt et al., 2011; Lent et al., 2014).

The diagnosis of food addiction is met when at least three symptoms and a clinically significant impairment or distress is present (Meule and Kubler, 2012; Meule et al., 2016), where mild food addiction consists of (2-3) symptoms, moderate (4-5) symptoms, and severe (6 or more) symptoms (Westwater, 2016). Recently Gearhardt and colleagues (2017) have updated the scale and developed YFAS version 2 consisting of a 35-item questionnaire. This version assesses 11 symptoms of food addiction (Burrows et al., 2017; Schulte and Gearhardt, 2017). The scale provides 23 examples of certain foods that could be addictive under 5 categories which include sweets, starches, salty foods, fatty foods and sugary drinks (Finlayson, 2017). Schulte and Gearhardt (2017) have developed another briefer version of YFAS version 2 (mYFAS 2.0) which is suitable for studies and trials prioritizing specificity when assessing the addictive like eating symptoms if briefer measurement of food addiction is required.

5. Food Addiction Symptom Score

The most common food addiction symptom as assessed with the YFAS is the "persistent desire or unsuccessful efforts to cut down or control eating" (Chao et al., 2016; Ouellette et al, 2017; Yang et al, 2017); among the obese, almost all the participants fulfil this criterion. The second commonly endorsed symptom is "continued eating despite physical or psychological problems" (Karandish et al., 2015; Tompkins et al., 2017). Other symptoms in terms of their order of endorsement among participants include "consumption of large amounts or over a longer period than intended", "spending much time obtaining food or eating or recover from its effects", "giving up important activities", and "withdrawal symptoms" (Meule and Gearhardt., 2014); whereas "tolerance" (Ahmed and Sayed, 2017), "loss of control" (Hauck et al., 2017) and "I feel fatigued from overeating" (Masheb et al., 2018) are less common. Nevertheless, some of the latter symptoms are endorsed by a considerable proportion of obese individuals, adults,

children and adolescents (Meule and Gearhardt, 2014; Tompkines et al., 2017). Mean food addiction symptom score is found to be higher in obese and those with eating disorders than controls (Burrows et al., 2018)

6. Food Addiction Prevalence Diagnosed by YFAS

The prevalence of food addiction has been repeatedly assessed in several studies using YFAS (Table1). The study groups have been adults, children and adolescents. The prevalence ranged between 2% to 34 % (Pedram et al., 2013; Ceccarini et al., 2015; Gearhardt et al., 2016; Tompkins et al., 2017; Torres et al., 2017; Schulte and Gearhardt, 2018). Using translated versions of YFAS, the food addiction prevalence has been also measured in different populations and ethnic communities. In a study by Hauck et al (2017), the prevalence of food addiction was 7.9% in Germen population using YFAS version 2. In Australian adults aged 19-35, 15 % of the subjects met the criteria for food addiction diagnosis (Pursey et al., 2015). In another study by Ahmed and Sayed (2017), the addiction prevalence was 15.7% in Egyptian adolescents, and it was 11.4% in the college students (Berenson et al., 2015).

Higher prevalence has been shown in overweight and obese subjects compared to normal weight individuals (Carter et al., 2016; Chao et al., 2016; Li et al., 2017). In obese children and adolescents, Tompkins et al (2017) used the Yale food addiction scale for children and reported a prevalence of 30 %. The prevalence of food addiction has been shown to be higher in females compared to males and in younger than older subjects (Pedram et al., 2013, Flint et al., 2014; Schulte and Gearhardt, 2017). Food addiction has been more diagnosed in subjects with eating disorders such as binge eating disorder (Gearhardt et al., 2014; Ceccarini et al., 2015; Burrows et al., 2017; Ouellette et al., 2017). In a study by Chao et al (2016), the prevalence was 57.6% among subjects with binge eating disorder, and it was 53.7% in overweight and obese patients seeking weight loss surgery (Clark and Saules, 2013; Long et al., 2015). Food addiction has been also more common in low and middle income countries (Schulte and Gearhardt, 2017; Nunes-Neto et al., 2018) and has been related to higher levels of depression and psychological problems particularly attention deficit hyperactivity disorder (Davis et al., 2011; Burmeister et al., 2013), as well as lack of concentration and the display of great emotional reactivity (Karandish et al., 2015). The lower prevalence of food addiction in certain populations has been attributed to several reasons most importantly the sampling process, small sample size and cultural food habits and preferences (Torres et al., 2017).

7. Food Addiction and Obesity

Assessment of food addiction in obese cohorts indicated that prevalence is evidently high in the obese and overweight subjects and in the obese women in particular (Pedram et al., 2013; Berenson et al., 2015; Schulte and Gearhardt, 2017). In essence, individuals diagnosed with food addiction tended to have a higher body mass index and more symptoms of depression and eating disorders than unaffected counterparts (Gearhardt et al., 2014). In a study by Davis et al (2011), obese subjects, aged 25-45 years, who met the criteria of food addiction had greater co-morbidity with binge eating disorder, depression, attention deficit hyperactivity disorder, and displayed greater food cravings and tendency to self-soothe with foods. In a cross sectional study by Berenson et al (2015), low income women who met the diagnosis of food addiction had higher levels of depression compared to women without addiction. Gearhardt et al (2013) indicated that 41.5% of patients with binge eating disorder classified as food addicts had higher levels of negative effects, emotion dysregulation and eating psychopathology, and lower self-esteem than non-addicts. Furthermore, in a study on Australian women cohort aged 18-25 years, 22.3% of them met the criteria of food addiction, and a significant association between the latter and visceral fat deposition has been reported (Pursey et al., 2016).

The number food addiction symptom score has been also associated with increased body mass index, where overweight and obese individuals endorsed more food addiction symptoms than their lean counterparts (Westwater., 2016; Rogers., 2017). In a study by Pedram et al (2013), obesity anthropometric indexes have been significantly higher in subjects with food addiction compared to controls. Moreover, Food addiction symptoms markedly correlated with habitual experiences of food craving (Meule and Kubler, 2012). Although the majority of studies reported higher prevalence of food addiction in obese individuals, some studies indicated that percentages of food addiction symptoms score may be elevated in underweight (Tompkins et al., 2017), and in subjects with anorexia or bulimia nervosa (Schulte and Gearhardt, 2017). This notion could be explained by craving which results from the drive to eat in starved state and dieting or caloric deprivation (Schulte and Gearhardt, 2017).

Several previous research indicated great rates of binge eating disorder, psychological disturbances (Karandish et al., 2015; Ceccariri et al., 2015) and mood deteriorations (Nunes-Neto et al., 2018) in subjects who met the criteria of food addiction especially in obese or overweight individuals seeking weight loss (Masheb et al., 2018). In this context, a comprehensive management regimen or plan for these

subjects has been suggested as a means to encourage them to commit to weight loss treatment and lifestyle modification. This plan may comprise the following actions: diagnosis of food addiction by clinicians, provision of psychiatric intervention and counselling sessions, as well as reduction of exposure to addictive foods along with weight loss regimes, especially in subjects seeking weight loss (Wiss and Brewerton, 2017). This suggested regimen may be useful for guiding paediatric obesity treatment programs and could be used for obese children who are applying family addiction therapies (Mogul et al., 2014).

8. Conclusions

Changes in food composition and availability have contributed to dramatic increase in obesity over years in developed and increasingly in developing countries. The concept of food addiction can be presented as the phase where certain foods mainly the highly processed containing high fat, sugar and salt can be addictive (Gearhardt et al., 2013). The specific forms of overeating may be viewed as an addictive behaviour where the brain and dopaminergic reward pathway plays a critical role in the increased preference for these foods in a similar way to addictive drugs (Morris et al., 2015; Ivezaj et al., 2017; Meule et al., 2017). Food addiction can be easily diagnosed using the available updated and validated YFAS tool which has been used in different languages and in various populations and groups. Food addiction is now becoming important in explaining one of the most controvesial etiological forms of obesity (Chao et al, 2017). Screening for food addiction along with provision of psychiatric session and weight control treatment can help in achieving positive results in obese subjects seeking weight loss. Food addiction is found to be more prevalent in obese and overweight than lean subjects, in females than males, in younger ages, and in subjects with eating disturbance particularly binge eating disorder.

The principal limitation of the majority of studies investigating food addiction in relation to human obesity is the use of cross-sectional study designs to compare the ability of self-reported data using YFAS tool to predict disturbed eating behaviours and thus obesity. Hence, causality cannot be clearly explained. Nevertheless, the available information confirmed the high prevalence of food addiction and its related eating behaviour deteriorations in most populations and groups. It also proved that YFAS is reliable and suitable in identifying such problems in some forms of obesity.

Taken together, despite the quite difficult task of exploring the subject of food addiction and human behaviour, evidences from the current observational human studies certainly provide new understanding in mechanisms underlying the pathogenesis of obesity or at least some of its forms through suggesting a link among food addiction and its symptoms scores, eating behaviours, and body weight status; though their interconnections are not yet well elucidated. Further controlled human studies are required for better evidence-based links between food addiction and obesity development, a matter that is important for obesity prevention and its dietetic management.

Conflict of interest statement

The authors report no conflict of interest.

Acknowledgment

The authors would like to thank the Deanship of Academic Research at The University of Jordan for their financial support.

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