

# Food Addiction: definition, measurement and prevalence in healthy subjects and in patients with eating disorders

## *Food Addiction: definizione, misurazione e prevalenza in soggetti sani e in pazienti con disturbi del comportamento alimentare*

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**SUMMARY.** The construct of “Food Addiction” (FA) has been introduced in the last decades to better understand abnormal eating patterns in obese and overweight people and in patients with Eating Disorders (EDs). Despite a substantial parallelism between drug addiction and FA, there is still no agreement in considering FA an independent ED or a useful convincing concept. Therefore, the purpose of this review is to aggregate available data, in order to increase knowledge about: 1) definition, measurement and general features of FA; 2) prevalence of FA in clinical and non-clinical samples. Available data suggest that FA seems to be a transnosografic construct and exists in all EDs, with higher prevalence in Bulimia Nervosa. Although the discussion on the autonomous diagnosis of FA within EDs remains open, studies have reported that comorbidity between FA and other EDs is associated with worse clinical conditions and symptoms, justifying, as a result, the usefulness of assessing and treating this condition.

**KEY WORDS:** food addiction, food craving, eating disorders, obesity, overweight.

**RIASSUNTO.** Il costrutto della “Food Addiction” (FA) è stato introdotto negli ultimi anni per meglio comprendere i pattern alimentari disfunzionali osservati nei pazienti obesi e in sovrappeso e nei pazienti con disturbi del comportamento alimentare (DCA). Nonostante i numerosi parallelismi tra la dipendenza da sostanze e la FA, non c'è ancora accordo nel considerare la FA come un indipendente DCA né un concetto utile. L'obiettivo della presente rassegna è stato quello di riassumere i dati disponibili al fine di aumentare le conoscenze su: 1) definizione, misurazione e caratteristiche generali della FA; 2) prevalenza della FA in campioni clinici e non clinici. I dati disponibili suggeriscono che la FA sia un costrutto transnosografico presente in tutti i DCA, con una prevalenza più elevata nella bulimia nervosa. Nonostante il dibattito sull'autonomia della FA come DCA rimanga aperto, gli studi riportati suggeriscono che la comorbidità tra FA e DCA sia associata con peggiori outcome clinici, giustificando di conseguenza l'assessment e il trattamento della FA.

**PAROLE CHIAVE:** food addiction, food craving, disturbi del comportamento alimentare, obesità, sovrappeso.

## INTRODUCTION

Obesity [body mass index (BMI)  $>30$  kg/m<sup>2</sup>] and being overweight (BMI between 25.0 and 29.9 kg/m<sup>2</sup>) are well-known conditions, caused by various factors, which appear to be spreading exponentially throughout the world. The prevalence of these conditions has increased dramatically in recent decades with estimates classifying more than a billion and a half adults as overweight and at least 400 million as obese<sup>1</sup>. This is particularly alarming because excessive adiposity is a major risk factor for several medical conditions<sup>2</sup> and several mental disorders<sup>3</sup>. The significant increase in dysfunctional coping strategies (e.g., the use of potentially toxic weight-loss products) as the “fastest” and “healthiest” ways to lose weight in both obese and non-obese individuals<sup>4,5</sup> is also alarming.

The construct of “Food Addiction” (FA) was introduced in the last decades to better understand abnormal eating pat-

terns in obese and overweight people<sup>6,7</sup>. This concept has gained increasing attention not only from the media<sup>8</sup>, but also from researchers, resulting in a significant increase in the number of published scientific articles<sup>9</sup> in recent years.

A growing body of literature has detected similarities between excessive and uncontrolled consumption of hyperpalatable foods and drug addiction, both on a behavioral and neurobiological level<sup>6,7,10-17</sup>. For example, different studies reported a dysregulation in the brain's dopamine pathway of obese patients<sup>18-22</sup> similar to that previously observed in drug addiction<sup>23,24</sup>. Furthermore, other studies observed an overlap between the Diagnostic and Statistical Manual of Mental Disorders 4th edition, text revision (DSM-IV-TR)<sup>25</sup> criteria for drug addiction, and some dysfunctional eating patterns observed in obese and in Eating Disorders (EDs) patients<sup>8,12,26</sup> such as “persistent desire or repeated unsuccessful attempts to quit”. Moreover, Food Craving (FC), defined as

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the intense desire to consume a specific food which is difficult to resist<sup>27-29</sup>, seems to be another important overlapping symptom. Although FC was only recently added to the 5th edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5)<sup>30,31</sup>, it has been considered an essential component of drug addiction since the 50s and 60s<sup>32</sup>. Like substance abuse, FC was found to be a crucial component of FA<sup>33</sup> and was also found to be associated with: 1) Bulimia Nervosa (BN)<sup>34-37</sup>; 2) Anorexia Nervosa (AN)<sup>36,38</sup>; 3) overweight and obesity<sup>39,40</sup>; 4) Binge Eating Disorder (BED)<sup>41,42</sup>; 5) Night Eating Syndrome (NES)<sup>43</sup>.

Other significant equivalencies between drug addiction and FA come from animal and clinical neurosciences studies. Research mainly on animal models documented neurobehavioral changes related to intermittent sugar availability, similar to those associated with drug abuse (e.g., withdrawal symptoms)<sup>15,44,45</sup>. Likewise, clinical neuroscience studies detected various alterations of the reward circuit in EDs patients<sup>46-48</sup> and in obese individuals<sup>18,19,49,50</sup>.

Although there are substantial overlaps, there is still no agreement in considering FA as an independent ED<sup>51</sup> or a valid and useful concept<sup>52</sup>. For example, opponents of the FA construct have argued that certain core symptoms of substance dependence, such as tolerance and withdrawal, are restricted to animal models and require careful thought when translated to humans<sup>52</sup>. Furthermore, it is also observed that neuroimaging data on reward deficit in obese subjects as well as in BED patients are still limited and sometimes controversial<sup>52,53</sup>. Therefore, the purpose of this review is to aggregate available data and increase knowledge about: 1) definition, measurement and general features of FA; 2) prevalence of FA in clinical and non-clinical samples.

### **FOOD ADDICTION: DEFINITION, MEASUREMENT AND GENERAL FEATURES**

The idea that compulsive and dysregulated intake of high-calorie food can produce abnormal consumption patterns, similar to those observed in patients with substance-related and addictive disorders, has been proposed since the mid-50s<sup>54</sup>. Nevertheless, concrete attempts to operationalize this construct are quite recent.

FA refers to specific food related behaviors characterized by excessive and dysregulated consumption of high calorie food<sup>12,55</sup> (i.e., foods with high sugar and/or fat)<sup>56</sup>. While some behavioral addictions, such as Gambling Disorder, were recently identified as addictive disorders in DSM-5<sup>30</sup>, there is still no agreement in considering FA as an independent ED nor as a universally accepted definition<sup>51</sup>.

FA has been defined as a chronic and relapsing condition caused by the interaction of many complex variables that increase cravings for certain specific foods in order to achieve a state of high pleasure, energy or excitement, or to relieve negative emotional or physical states<sup>7,57</sup>. To date, the most widely employed definition<sup>12,26,58,59</sup> derives from the overlay with the DSM-IV-TR criteria<sup>25</sup> for drug addiction. These criteria include: 1) substance taken in larger amount and for longer period than intended; 2) persistent desire or repeated unsuccessful attempts to quit; 3) a large amount of time/activity necessary to obtain, to use or to recover; 4) important social, occupational, or recreational activities dismissed or

reduced; 5) continuative use despite knowledge of adverse consequences; 6) tolerance; 7) withdrawal symptoms.

FA seems to have significant psychopathological overlaps with other EDs, especially with BED and BN. Consistently, addiction models of AN and BN have already been proposed<sup>60,61</sup>. Reduced control over eating, continued use despite negative consequences, elevated levels of impulsivity and psychopathology are several overlaps between FA and both BED and BN<sup>62,63</sup>. However, there are also some crucial differences between FA and other EDs. First, contrary to FA, BED is associated with elevated concerns with shape or weight<sup>62</sup>. In the same way BN and AN are characterized by body image disturbance, an overvaluation of body weight and shape that drives dysfunctional eating and related behaviors (i.e., restrained eating and/or compensatory behaviors)<sup>30</sup>. This crucial psychopathological core is not considered in patients with FA<sup>63,64</sup>. Furthermore, contrary to FA, BED and BN diagnoses specify that binge eating episodes must occur during a discrete period of time<sup>30</sup>. Finally, FA diagnosis assesses criteria such as withdrawal or tolerance, which are not included in any ED<sup>62</sup>.

In the last 15 years numerous psychometric questionnaires have been developed to investigate the general aspects of FA, such as impulsivity, disinhibition and craving.

Merlo et al.<sup>65</sup> developed the Eating Behaviors Questionnaire (EBQ) to investigate, in a pediatric sample, the three crucial components of FA, the so-called “3 Cs” of addiction: compulsive use, attempts to cut down (quitting attempts) and continued use despite consequences. Regardless of the good psychometric properties of the questionnaire, attempts to adapt this self-report to the adult population have not yet been pursued.

In the same year, Gearhardt et al.<sup>59</sup> developed a specific questionnaire for FA evaluation and diagnosis, the Yale Food Addiction Scale (YFAS). The YFAS is a 25-items self-report that investigates eating behaviors concerning hyper-palatable food consumed in the previous 12 months. The 25 YFAS items were developed in accordance with the DSM-IV-TR diagnostic criteria<sup>25</sup> for drug addiction, and also according to self-reports assessing behavioral addictions, such as pathological gambling or sexual addiction. The YFAS provides two scoring alternatives: a symptom count version and a diagnostic version. A categorical diagnostic cut off is met when three symptoms, together with a clinically significant impairment or distress from eating, are present<sup>59</sup>. The YFAS was initially validated in US undergraduate students showing a single factor structure and satisfying psychometric properties (e.g. Cronbach's alpha= 0.86)<sup>59</sup>. Furthermore, supporting its construct validity, YFAS' total score was positively associated with neural activation of the brain regions involved in the reward system (i.e., amygdala, anterior cingulate cortex) in response to anticipated intake of palatable food<sup>20</sup>. The one-factor structure and the good psychometric properties have been replicated in bariatric patients<sup>66</sup>, in obese BED patients<sup>67</sup> and in obese and overweight patients attending weight loss treatment<sup>68</sup>. YFAS has also been translated and validated in several European countries including Germany<sup>69</sup>, France<sup>70</sup>, Spain<sup>71</sup> and Italy<sup>68</sup>. Lastly, a short version of YFAS<sup>72</sup> and a version for children have recently been developed<sup>73</sup>.

Gender and age differences were reported for both FA and FC. FA diagnosis appears to be more frequent in women than men<sup>72,74</sup> and more frequent in middle-aged adults (45-

64 years) compared to elderly ones (62-88 years)<sup>72</sup>. Similarly, FC is more recurrent in younger than older adults<sup>75,76</sup> and in women than men<sup>76-81</sup>. According to recent neuroimaging studies<sup>82,83</sup> sex differences in FA could reflect the presence of some differences in the female brain's reward system such as the lower ability to suppress appetite<sup>83</sup>. Nevertheless, sex differences in FA could also be due to differences in the hormonal system or to the presence of endocrine disorders in women, such as polycystic ovary syndrome (PCOS). In fact, different studies have shown that the same addictive eating-patterns (i.e., compulsive overeating, food craving) are associated with the different phases of menstrual cycle<sup>84-86</sup> and with PCOS<sup>87-89</sup>.

Several studies observed a moderate association between BMI and FA in adults<sup>69,71,74,90</sup> and children<sup>65,73</sup>. Pedram et al.<sup>74</sup>, assessing the prevalence of FA in the general population, reported that FA symptoms were significantly correlated not only with BMI, but also with body weight, waist and hip circumferences, body fat and trunk fat percentages which suggests that FA contributes to obesity's severity. However, it is also possible to hypothesize that obesity contributes to FA's severity. Indeed, it is known that obesity is strongly associated with hormonal alterations, for example insulin resistance, which may play a crucial role in promoting "hedonic" responses to hyper-palatable food<sup>91</sup>. Additionally, it has been observed that FA symptoms are negatively associated with weight loss in overweight and obese patients seeking weight loss treatments<sup>92</sup>.

FA is also strongly associated with psychopathology<sup>11,59,67,71,92,93</sup>. Gearhardt et al.<sup>67</sup> reported that FA symptoms positively correlate with high emotional dysregulation, low self-esteem and high negative affective states in BED patients. The authors have also documented that FA patients were more likely to have a lifetime diagnosis for mood disorders, particularly major depression. No significant relationship was observed between FA and anxiety disorders or substance dependence<sup>67</sup>. The association between FA and depression was also observed in obese and overweight patients by Davis et al.<sup>11</sup> and Burmeister et al.<sup>92</sup> who respectively reported a relationship between FA and Attention Deficit Hyperactivity Disorder (ADHD) in children, and between FA and eating psychopathology (i.e., weight bias, body preoccupation, binge eating).

The association between addictive eating patterns and general psychopathology could be interpreted by referring to the self-medicate hypothesis<sup>94-96</sup>, which emphasizes that addictive behaviors are people's attempt «to medicate themselves for a range of psychiatric problems and painful emotional states»<sup>95</sup> (p. 1263). Following this hypothesis, patients with FA would use food to prevent or relieve negative emotional states which arise from withdrawal symptoms and/or from a reaction to stressful life events, similar to what is observed in drug addiction<sup>97</sup>. Compulsive and uncontrolled overeating in FA patients could reflect a dysfunctional coping strategy consisting of "comfort food" used to escape from unpleasant state and/or to self-regulate emotions<sup>17,98-101</sup>. Similarly, from a neurobiological point of view, it was suggested<sup>102-104</sup> that the natural reward of highly palatable food can reduce the activity of the Hypothalamic-Pituitary-Adrenal (HPA) axis and the production of cortisol. The constant repetition of this pattern could lead to neurobiological and behavioral adaptations promoting compulsive overeating<sup>102-104</sup>.

## FOOD ADDICTION PREVALENCE IN CLINICAL AND NON-CLINICAL SAMPLES

To date, YFAS is the most commonly used tool to assess FA in clinical and non-clinical samples<sup>51,105</sup>. Using YFAS, 11.4% of American students were diagnosed as addicted to food<sup>59</sup>. Comparable percentages were observed in non-clinical samples in France (8.7%)<sup>70</sup> and Germany (8.8%)<sup>69</sup>. Lower prevalence was reported in Italy (1.7%)<sup>68</sup> and Spain (2.7%)<sup>71</sup>, suggesting, as already hypothesized for FC<sup>80,106</sup>, the possibility of cross-cultural differences. Finally, a recent Canadian study<sup>74</sup> on 652 adults (415 women and 237 men) recruited from the general population, reported a prevalence of FA in 5.4% of the sample. In all these studies, the most reported symptom was "persistent desire or repeated unsuccessful attempts to quit".

A small amount of research has investigated FA in children and adolescents. Using EBQ, Merlo et al.<sup>65</sup> found that 15.2% of overweight children declared either "often", "frequently" or "always" as an answer when asked if they believed themselves to be dependent on food. A qualitative study conducted by Pretlow<sup>107</sup> on overweight and obese children detected that 29% of them felt addicted to food and that the most common symptoms were: 1) consumption of high quantities of food for long periods; 2) unsuccessful quitting attempts; 3) continued use despite consequences. Finally, Gearhardt et al.<sup>73</sup>, using a modified version of YFAS, investigated FA in 75 children (mean age= 8.32 years) recruited from the general population, and showed that 7.2% of participants met the diagnostic criteria for FA.

Higher prevalence of FA has been reported in clinical samples. Studies were initially focused on the relationship between BED and FA, and between FA and obesity to understand if FA could be considered an independent ED. Using the YFAS, FA prevalence has been reported to oscillate between: 1) 41.5%<sup>67,108</sup> and 72.2%<sup>11</sup> in obese people with BED; 2) 15.2 %<sup>109</sup> and 53.7%<sup>66,110</sup> among patients attending weight-loss surgery programs; 3) between 15.2%<sup>68,92,93,109</sup> and 25%<sup>11</sup> among overweight and obese patients seeking weight-loss treatments. Cassin and von Ranson<sup>111</sup>, using a semi-structured interview based on the DSM-IV-TR diagnostic criteria for substance addiction, found that 92.4% of BED patients also revealed a FA diagnosis. This percentage, however, dropped to 40.5% after applying the changes to the diagnostic criteria for addiction suggested by Goodman<sup>112</sup>. A recent meta-analysis<sup>51</sup> reported that both FA diagnosis and FA symptoms explain the total variance of BED symptomatology. The incomplete overlap between BED diagnosis and FA, according to a dimensional perspective rather than a categorical one, has led some scholars<sup>113,114</sup> to consider FA as a more severe variant of BED. The high co-morbidity between BED and FA, however, has led other researchers<sup>52</sup> to believe FA is more like a phenotypic clinical manifestation rather than an independent ED, characterized by the overlap between several dysfunctional eating behaviors.

In addition to the widely investigated relationship between BED and FA, recent studies assessed the co-morbidity between FA and BN, Anorexia Nervosa Restrictive-type (AN-R) and Anorexia Nervosa Purging-type (AN-P). Using Goodman's<sup>112</sup> diagnostic criteria for addiction, Speranza et al.<sup>115</sup> reported FA prevalence rates in 65% of BN patients, in 48% of AN-P patients and in 35% of AN-R patients. Using



# Food Addiction: definition, measurement and prevalence in healthy subjects and in patients with eating disorders

YFAS, Granero et al.<sup>71</sup> observed a FA prevalence in 60% of AN patients, in 81% of BN patients, in 76.9% of BED patients and in 72.2% of Eating Disorders Not Otherwise Specified (EDNOS) patients. Gearhardt et al.<sup>63</sup> recently investigated the relationship between FA, EDs and BMI in a large non-clinical sample (815 subjects). The authors reported that participants with BN showed FA criteria more frequently than individuals with BED (83.6% vs 47.2%). Authors showed that, compared to BN and BED, FA is associated with a current higher BMI, a greater lifetime BMI and more severe eating disorders psychopathology (for example, concerns about body weight and food). Lastly, co-morbidity between FA and other EDs is associated with a more severe eating disorder, with a greater current and lifetime BMI, compared to healthy controls and compared to the “singular” forms of EDs.

The strong association between BN and FA was also detected by Meule et al.<sup>64</sup> who, through YFAS, observed that 100% of women with a current BN diagnosis also exhibited a FA diagnosis, compared with 30% of BN patients in remission.

## CONCLUSIONS

The reported data seem to suggest that FA is a transnosographic construct and exists in all EDs (with higher prevalence for BN) as well as in obese and overweight patients. Therefore, the debate on the independent diagnosis of FA within EDs remains open. However, it seems to be clear that the comorbidity between FA and other EDs is associated with worse clinical conditions and symptoms<sup>63</sup>. Thus, clinicians should carefully assess specific addictive eating patterns in EDs as well as obese and overweight patients. For these patients, FA symptoms should be a target of specific psychotherapeutic interventions. For instance, like for drug and substance addiction treatments<sup>116,117</sup>, new therapeutic approaches focused on the neurobehavioural correlates of self-regulation, such as neurofeedback, should be developed and implemented in patients with FA.

Finally, future neuroscience studies are needed in order to understand the differences and similarities between FA and other EDs and to determine whether, in addition to the psychopathological level FA, on a neuro-physiological level, can also be considered an independent ED.

*Conflict of interests:* the authors declare they have no competing interests.

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*Food Addiction: definition, measurement and prevalence in healthy subjects and in patients with eating disorders*

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