



# Food addiction: A new form of dependence?

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## Abstract

Food addiction is a behavioral dependency that is characterized by the compulsive consumption of palatable foods (for example, foods high in fat and sugar) - the types of food that markedly activate the reward system in humans and in other animals - despite the negative consequences. The psychological dependence has also been observed with the presence of withdrawal symptoms when the consumption of these foods is interrupted by the replacement of low fat or sugar foods. In the compulsive eater, the ingestion of trigger foods causes the release of the neurotransmitters serotonin and dopamine. This could be another indicator that neurobiological factors contribute to the addiction process. On the contrary, abstinence from addictive foods can trigger withdrawal symptoms. The subsequent decrease in serotonin levels in the individual can promote higher levels of depression and anxiety. Therefore, the Food addiction may be considered a "new dependence" related to compulsive consumption of food. In particular, as regards food addiction and eating disorders, there is still no precise definition, but the interest in this problem is very strong. As reported in the DSM-V, substance dependence is characterized by physiological, cognitive and behavioral symptoms, demonstrating that the subject continues to use it despite being aware of the problems arising from it. A few decades ago, the thought that food could be a substance that creates "addiction" and that its excessive consumption could be defined as Food Addiction on a par with "Drug Addiction" was considered heresy. There are numerous evidences that allow us to "consider food as a drug", above all if it is manipulated refined food (Fast-Food, snack bars, chips...). Food Addiction is a new hypothesis to explain the growing phenomenon of obesity, a global problem that is affecting our era and which brings with it serious consequences for health.



## Short Review

The term Food Addiction means a “new dependence”: that of food. There is not yet a precise definition, but the interest in this problem is very strong. The Anglo-Saxon expression “addiction” comes from the Latin “addictus”, indicating who was sold as a slave to pay a debt and therefore who suffers a submission by someone or something or becomes a slave, employee. There are chemical dependencies related to the use of opiates (morphine and heroin), psychostimulants (cocaine and amphetamines), cannabinoids (marijuana and hashish), nicotine or alcohol. There are also non-chemical addictions such as those related to pathological gambling, physical exercise, surfing the internet, sex or compulsive work. Finally, there is a form of dependence linked to food. The characteristics of some types of eating behavior are very similar to the abuse substances. An important change is observed with the publication of DSM V, where the diagnosis of “substance-related disorders” has been replaced with that of “addiction and related disorders”; this will allow a diagnosis of dependence not so closely linked to substance abuse and that includes those forms that concern for example the game, internet and even food [1,2]. In DSM-V, substance dependence is characterized by physiological, cognitive and behavioral symptoms, demonstrating that the subject continues to use it despite being aware of the problems deriving from it [1]. As for the other addictions, the food addiction is also characterized by the compulsion to consume the food object of addiction (for example, you can not start the day if you have not consumed one or more doses of the desired food), loss of control, continuous use of the substance in question despite negative consequences [3].

Talking about food addiction seems trivial, in some ways we are all dependent on food. However, there are ways of assumption that deviate from the main task and change themselves by assuming particular ways that become pathological. The behavior is marked by a sort of ritual that is always the same: everything springs from the idea of a compulsion and at the same time from the awareness of being unable to resist this impulse. Then, there is a growing emotional tension, typical of the moment preceding the beginning of the compulsive act. The anticipatory phase of a new assumption of the substance is characterized by an intense desire and motivation in the search for drugs or, in the case of food addiction, food; this desire is commonly called craving and involves the precipitation of the binge [2]. The next step is the unfolding of the act with the tension gradually loosening as the fulfillment is achieved. The conclusion of the ritual is characterized by the awareness of having lost control once again. Substantially, the person is not able to stop bingeing or overfeeding, regardless of the knowledge of the negative consequences determined by this behavior, with interference in the performance of daily activities and quality of life [3]. The difference between food and substances of abuse is linked to the difference in power of the stimulus that they manage to evoke. The activity of drugs of abuse is so strong and over-maximal that it usually results in faster, more lasting and devastating effects over time. The important point is that when we talk about nutrition we are talking about primary needs that must be satisfied and it is therefore necessary that the satisfaction of the need be linked to pleasure.

Originally, there are the simple food needs and the desire to respond to the needs of the body by feeding. The sensations caused by satiety, the aromas and flavors of food are then transformed into pleasure. The memory preserves both the sensa-

tions and the pleasure and so the first ones will be promised by the second. What we pursue, in fact, is the pleasure that derives from the satisfaction of these needs and the astuteness of evolution consists in proposing some pleasant objectives to reach deeper and more essential goals. The obvious attractor that is at the center of every fundamental motivation is precisely the achievement of a pleasure [4]. Most brain circuits that drive hunger and pleasure formed before the primates appeared. The pleasure that comes from eating is not just an accessory to the mechanisms of nutrition is an element of our affectivity. In our organism are adapted provisions that seem to have survived the conditions in which they originally proved effective [5]. There are many similarities between food addiction and drug addiction. The use of cocaine determines the release of dopamine in the neurons of striated nuclei of the brain, the same phenomenon was detected after ingesting food. People who consume drugs have a reduced sensitivity of dopaminergic systems, the same that has also been found in obese individuals. Since food and drugs activate overlapping pleasure circuits in the brain, well-known behavioral interactions exist between them, which are probably the result of shared central cabling [5].

The dependence on substances and the over-consumption of food share similarities both from a physiological and behavioral point of view, which can lead to the hypothesis of a commonality of the underlying neuronal mechanisms. Indeed, studies of micro dialysis and PET studies show that both the substance of abuse and the food activate the mesolimbic dopaminergic system and that the level of pleasure experienced subjectively is correlated with the amount of dopamine released in the striatum, especially in the nucleus accumbens (NAc). The subjective sensation of pleasure varies among individuals relative to the baseline level of dopaminergic activity and the increase in the release of this neurotransmitter is a crucial element in the phenomena of reinforcement, dependency, hedonism, motivation [6,7].

In this perspective, the reward system (amygdale, insula, thalamus, ventral and dorsal striatum, ventral regions of the cingulate cortex and of the frontal orbit and of the prefrontal cortex) seems to be primarily called into question. The common mechanisms between food and drug abuse are to be found in the complex interaction between hypothalamic nuclei, in particular lateral, influencing the reward mechanism, and the mesolimbic circuit, which is crucial in the reinforcement mechanism; moreover, the hypothalamus would be central to research and consumption mechanisms [6,7].

The main neurotransmitters of the reward system are dopamine (DA), endocannabinoids (eCB) and endogenous opioids. Opioids give food its connotation of gratification and pleasure and encourage us to eat it again. The DA instead is the neurotransmitter used for the behavior that stimulates us to research and therefore to pleasure. All functions that increase the production of DA, in some brain regions, increase the sense of pleasure and its research. Such mechanisms are also at the root of dependence on certain drugs [8-12]. Dopamine is therefore a fundamental neurotransmitter in order to talk about “addiction” and its increase in the organism favors the probability of “addiction”, being central in the mechanisms of learning new signals and regulating behavior [13]. Important studies on animals have confirmed alterations of these systems in conditions of excessive intake of foods, especially rich in sugars. The animals showed behaviors similar to substance addiction and marked compulsiveness towards food, as well as changes to the

indicated brain areas, especially with respect to D2 receptors in the accumbens [8]. The eCB system instead is involved not only in the control of appetite but also in the modulation of the stress response (immune, inflammatory, proliferative, cardiac, respiratory, etc.). The activation of eCB, which can be induced by the sensation of pleasure caused by the vision or by the brief taste of a food with high palatability, reduces the feeling of satiety caused by GABA and consequently stimulates the tendency to resume food. The activation of eCB can be defined as an “ancestral” protection system, so much so that eCBs are present in breast milk, with a key role in the early stages of lactation [9-16].

Furthermore, again at the limbic level, the existence of a relationship between the eCB system and the opioid system in the drive towards nutritional intake has been demonstrated.

Over stimulation of the eCB system also interacts with various hormones involved in feeding control such as ghrelin, insulin, leptin, adiponectin and resistin; glucocorticoids, at the hypothalamic level, appear to have a stimulatory effect on eCB [10,16]. The eCB role as appetite stimulators was further supported by data showing that CB1 antagonist and inverse agonist suppressed food intake and the motivation to work for palatable sucrose pellet or chocolate-flavored food, blocking the compulsive eating of palatable food, in rats [17].

The result of stimulation of these circuits is to repeat the pleasant experience just experienced and continue eating. It is a real vicious circle in which the food transmits to the brain the message of eating again and again. The experiences of gratification and well-being, as well as of tension reduction, are similar to that of an astonishing substance, albeit in an order of lesser magnitude.

Intermittent, but not chronic, access to a high calorie diet and high palatability as the “cafeteria diet” promotes the search for this type of food [18] and “binge-like” feeding patterns [19].

More and more evident evidence suggests that the consumption of calorically rich and highly palatable foods leads to changes in cognitive control that make subsequent changes in eating behavior more difficult [20].

The association between psycho-active addiction, including food, and eating disorders and obesity, is a frequent condition, a “convergence”, due to the contiguity of the causes and to the numerous clinical and symptomatic characteristics that are associated. A pathogenetic model that is increasingly receiving experimental confirmations is that which identifies one of the possible mechanisms in the development of eating disorders [11] in the dysfunction of the “reward” regulatory systems. The damage of food misuse is cyclical and the knowledge of neurobiological overlaps between eating disorders and addictions can lead to advantageous operational strategies. Although the respective differences are important, the food addiction model can provide important information for the prevention, treatment and monitoring of eating disorders and obesity.

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