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Molecular landscape in food addiction to mental health

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Abstract

Food addiction is widely debated to resolve various disease connectivity in the scientific community. There are significant similarities between food addiction and other addictive disorders including decreased sensitivity of the dopamine-reward system, genetic polymorphisms (DRD2 and OPRM1), and behavioral indicators of addiction. An individual's response to environmental factors can play a role in their vulnerability to food addiction. The social environment and gene-environment interactions are important considerations as to why certain individuals are more susceptible to food addiction. These interactions along with biomarkers can provide a clear picture of why a person may fall prey to addiction. Several biomarkers have been associated with food addiction. These biomarkers include bacterial genera (Bacteroides, Megamonas, Eubacterium, and Akkermansia), fumarate hydratase (FH), ATP synthase subunit alpha (ATP5a1), and transketolase (TKT) in the nucleus accumbens, and striatal D2 receptor availability. Omics technologies have been beneficial in identifying many of these biomarkers and will be necessary for future findings related to food addiction. This review discusses common environmental factors and biomarkers impacting food addiction with an emphasis on the importance of omics technologies in this field.

Keywords: Metabolomics; Food Addiction; Environmental Factors; Dopamine Receptors; Gut Microbiota

1. Introduction

Food addiction is an emerging topic in mental health that has garnered much attention in recent years and is being debated in the scientific community. Similarities have been identified in food addiction and drug addiction. Notably, the decreased sensitivity of the dopamine reward system in the brain is a commonality between the two like food and drug [1, 11]. Food addiction is accompanied by similar behavioral indicators as drug addiction. For example, questions about the loss of control over food consumption, continuous overeating, and unsuccessful attempts to reduce eating are typically asked when evaluating food addiction [1, 6, 15, 16]. Similar questions are asked with other addictive disorders as well. Environmental factors can have a significant impact on the development of food addiction in an individual. This review aims to evaluate the environmental factors associated with food addiction as well as identify omics strategies to prevent, monitor, and treat this disease.

One debate amongst scientists has been the distinction between food cravings and true food addiction. Food cravings can present similarly to addictive substances on MRI, making the distinction quite difficult to determine [12]. Along with other addictive disorders several criteria typically need to be fulfilled before a diagnosis is given. However, using data from MRIs and other biomarkers can be used in conjunction with behaviors to determine the severity of disordered eating or addiction. These behaviors are typically associated with feelings of guilt, lack of self-control, impulsivity, and continued use despite negative health or social implications [1]. The Yale Food Addiction Scale (YFAS) can be used as a guide to understand these behaviors and point out addictive behaviors toward certain foods [5].

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Ziauddeen and Fletcher (2012) argue that food addiction may not be a valid or useful concept when it comes to better understanding obesity, but it may be useful in better understanding binge eating disorder (BED) [16]. However, food addiction has a high prevalence among other mental disorders, especially other eating disorders.[6]. Incorporating the YFAS may be beneficial in evaluating a person's disordered eating and understanding of the behaviors exhibited are related to food addiction or another eating disorder[8]. The social environment plays an important role in paving the way for food addiction. Life events and stressful situations can lead to changes in eating habits. For example, the likelihood of developing BED is positively associated with the frequency of negative events in a person's life [9]. Children often model the behavior of their parents which can lead to changes in self-esteem and repeating comments the parents make about their own bodies. Media also plays a role in shaping a person's behaviors. The prevalence of thin, athletic individuals in media can promote disordered eating or body image issues [9]. The social environment is not the sole influence on a person's likelihood of developing food addiction. Gene-environment interactions can influence the likelihood of exposure to environmental factors as well as influence the vulnerability of the response to those environmental factors [9]. Providing an answer to individuals struggling with compulsive eating could take away some of the stigmas or moral failings often associated with obesity or being overweight [16]. However, others fear that this will lead to a reduction in corporate responsibility for selling and promoting highly processed foods.

Several studies have identified biomarkers associated with food addiction. Differences in the gut microbiota of obese females compared with overweight and normal-weight females [4]. In fact, females were found to have food addiction at a higher prevalence than men. This study found that the genera Bacteroides, Megamonas, Eubacterium and Akkermansia were associated with food addiction [4]. Decreases in Bacteroides have been associated with obesity, while higher levels of Megamonas have been associated with prediabetes. Akkermansia has also been found to have protective factors against obesity [4]. Dysbiosis of the gut has been associated with dysregulated short-chain fatty acid metabolism and can increase the impulse to eat for pleasure rather than for maintaining energy [10].

Pérez-Ortiz et al., (2016) found upregulation of fumarate hydratase (FH), ATP synthase subunit alpha (ATP5a1), and transketolase (TKT) in the nucleus accumbens of mice that were fed a high-fat diet after being deprived of food [13]. Increased reactivity in the gustatory and somatosensory regions of the brain was also found after individuals were presented with a stimulus or desirable food [1].

Dopamine levels play a significant role in addiction. It has been found that chronic consumption of addictive substances (food or drugs) may lead to the downregulation of dopamine receptors [7]. Striatal D2 receptor availability was found to be negatively correlated with BMI, which has been suggested to exacerbate compulsive eating due to reduced reward sensitivity [1]. Another study led by Rada et. al, (2005) found that sucrose-dependent rats released higher amounts of dopamine and had a delayed acetylcholine satiation response during meals [14].

Finally, genetic polymorphisms have been seen in the mu-opioid receptor gene OPRM1 and the dopamine receptor gene DRD2. These are commonly seen in individuals with substance abuse and binge eating disorder [16]. This can lead to increased reward sensitivity and diminished inhibitory control [1].

2. Relevance and Discussion in food addiction

Omics technologies have been exceedingly beneficial in categorizing the gut microbiota using metabolomics [4]. Shotgun metagenomics has been used to quickly sequence and categorize all data in a sample [2]. Nuclear magnetic resonance (NMR)-based metabolomics has also been beneficial in detecting biomarkers of addictive behaviors. NMR spectroscopy can be used on blood serum to identify the metabolomic profile of small molecules that are potentially new biomarkers for compulsive eating or food addiction [3]. Further incorporation of omics technologies into mental disorders can be helpful for future studies in identifying other biomarkers and genetic factors which may influence the addiction process. Other studies focused on determining what specific proteins or alterations with other factors (e.g., epigenetic modification) make food addictive followed by an intertwining of neural networks would be a helpful addition to the literature on this subject.

3. Conclusion and Perspective

In conclusion, though the consensus about the validity and necessity of food addiction as a diagnosis is still debated throughout the scientific community, strides have been made in identifying biomarkers of compulsive eating. Omics technologies which strategies in molecular integration to understand phenotype-specific or disease-patterned responses include behavioral changes have been essential to these discoveries, namely the use of shotgun metagenomics and NMR-based metabolomics. Further studies on this topic will be beneficial to better understanding

clinical applications of monitoring these biomarkers and developing treatment plans for individuals suffering from food addiction or disordered eating.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors declare no conflicts of interest.

References

[1] Adams RC, Sedgmond J, Maizey L, Chambers CD, Lawrence NS. Food Addiction: Implications for the Diagnosis and Treatment of Overeating. Nutrients. 2019; 11(9): 2086.

[2] Butler MI, Mörkl S, Sandhu KV, Cryan JF, Dinan TG. The Gut Microbiome and Mental Health: What Should We Tell Our Patients? Le microbiote Intestinal et la Santé Mentale: que Devrions-Nous dire à nos Patients? Canadian Journal of Psychiatry. Revue Canadienne de Psychiatrie. 2019; 64(11): 706743719874168.

[3] Cifani C, Alboni S, Mucci A, Benatti C, Botticelli L, Brunello N, Micioni Di Bonaventura MV, Righi V. Serum metabolic signature of binge-like palatable food consumption in female rats by nuclear magnetic resonance spectroscopy. NMR in Biomedicine. 2021; 34(4).

[4] Dong TS, Mayer EA, Osadchiy V, Chang C, Katzka W, Lagishetty V, Gonzalez K, Kalani A, Stains J, Jacobs JP, Longo VD, Gupta A. A Distinct Brain-Gut-Microbiome Profile Exists for Females with Obesity and Food Addiction. Obesity. 2020; 28(8): 1477–1486.

[5] Gearhardt AN, Corbin WR, Brownell KD. Preliminary validation of the Yale Food Addiction Scale. Appetite. 2009; 52(2): 430–436.

[6] Horsager C, Færk E, Lauritsen MB, Østergaard SD. Food addiction comorbid to mental disorders: A nationwide survey and register-based study. International Journal of Eating Disorders. 2021; 54(4): 545–560.

[7] Johnson PM, Kenny PJ. Dopamine D2 receptors in addiction-like reward dysfunction and compulsive eating in obese rats. Nature Neuroscience. 2010; 13(5): 635–641.

[8] Levallius J, Monell E, Birgegård A, Clinton D, Forsén Mantilla E. Binge Eating and Addictive-Like Behaviours in Males and Females. Psychological Reports. 003329412097175.

[9] Mazzeo SE, Bulik CM. Environmental and Genetic Risk Factors for Eating Disorders: What the Clinician Needs to Know. Child and Adolescent Psychiatric Clinics of North America. 2009; 18(1): 67–82.

[10] Novelle MG. Decoding the Role of Gut-Microbiome in the Food Addiction Paradigm. International Journal of Environmental Research and Public Health. 2021; 18(13): 6825.

[11] Pelchat ML. Food Addiction in Humans. The Journal of Nutrition. 2009; 139(3): 620–622.

[12] Pelchat ML, Johnson A, Chan R, Valdez J, Ragland JD. Images of desire: food-craving activation during fMRI. NeuroImage. 2004; 23(4): 1486–1493.

[13] Pérez-Ortiz JM, Galiana-Simal A, Salas E, González-Martín C, García-Rojo M, Alguacil LF. A high-fat diet combined with food deprivation increases food seeking and the expression of candidate biomarkers of addiction. Addiction Biology. 2016; 22(4): 1002–1009.

[14] Rada P, Avena NM, Hoebel BG. Daily bingeing on sugar repeatedly releases dopamine in the accumbens shell. Neuroscience. 2005; 134(3): 737–744.

[15] Tang CS, Gan Y, Ko J, Kwon J, Wu A, Yan E, Yogo M. The associations among emotional factors, personality traits, and addiction-like eating: A study on university students in six Asian countries/regions. International Journal of Eating Disorders. 2020; 54(2): 125–131.

[16] Ziauddeen H, Fletcher PC. Is food addiction a valid and useful concept? Obesity Reviews. 2012; 14(1): 19–28.