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Converging vulnerability factors for compulsive food and drug use

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Abstract

Highly palatable foods and substance of abuse have intersecting neurobiological, metabolic and behavioral effects relevant for understanding vulnerability to conditions related to food (e.g., obesity, binge eating disorder) and drug (e.g., substance use disorder) misuse. Here, we review data from animal models, clinical populations and epidemiological evidence in behavioral, genetic, pathophysiologic and therapeutic domains. Results suggest that consumption of highly palatable food and drugs of abuse both impact and conversely are regulated by metabolic hormones and metabolic status. Palatable foods high in fat and/or sugar can elicit adaptation in brain reward and withdrawal circuitry akin to substances of abuse. Intake of or withdrawal from palatable food can impact behavioral sensitivity to drugs of abuse and vice versa. A robust literature suggests common substrates and roles for negative reinforcement, negative affect, negative urgency, and impulse control deficits, with both highly palatable foods and substances of abuse. Candidate genetic risk loci shared by obesity and alcohol use disorders have been identified in molecules classically associated with both metabolic and motivational functions. Finally, certain drugs may have overlapping therapeutic potential to treat obesity, diabetes, binge-related eating disorders and substance use disorders. Taken together, data are consistent with the hypotheses that compulsive food and substance use share overlapping, interacting substrates at neurobiological and metabolic levels and that motivated behavior associated with feeding or substance use might constitute vulnerability factors for one another.

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Keywords

obesity; addiction; substance use disorder; binge eating disorder; cross-vulnerability; comorbidity

Introduction

Both highly palatable foods and drugs of abuse can impact the brain and behavior in ways that are relevant for understanding disorders ranging from binge eating disorder (BED) to obesity, type II diabetes and substance and alcohol use disorders (SUD, AUD). In this review we focus on the overlapping neuroscience shared between highly palatable foods and drugs of abuse and highlight preclinical and clinical data to assess the case that there are converging vulnerability factors that can predispose an individual to compulsive food or drug use. First, we highlight how both highly palatable foods and drugs of abuse impact metabolic and neural systems in similar ways, heuristically exemplified in Table 1. Second, we describe a robust literature demonstrating commonalities in the effects of palatable food and substances of abuse on behavior, focusing on reinforcement, negative affect, negative urgency, and impulse control, as well as how food itself can impact sensitivity to drugs. Finally, we consider how food or metabolic status may relate to vulnerability for SUD or AUD based on human data and finish by exploring potential therapeutic approaches that might leverage the commonalities in neuroscience and behavior described throughout this review.

SUD is diagnosed (according to the Diagnostic Statistical Manual [DSM]-V) among individuals that experience at least 2–3 symptoms including (but not limited to) craving, withdrawal, tolerance, continuing to use the substance despite interpersonal, professional or health problems (https://www.drugabuse.gov/publications/media-guide/science-drug-use-addiction-basics; accessed October 20, 2020). In contrast to SUD being the consensus diagnosis associated with drugs of abuse, compulsive eating (or "food addiction" or the somewhat preferred "eating addiction"; Burrows et al., 2017) is not a specific diagnosis in the DSM-V (see Meule and Gearhardt 2014). Instead several several quite different mental health conditions include diagnostic criteria that relate to overconsumption or "misuse" of highly palatable foods, including binge-related eating disorders (e.g., BED, bulimia nervosa [BN], anorexia nervosa [AN]-binge purge type) and obesity. As a result, the clinical populations that exhibit compulsive eating are much more heterogeneous than those identified with compulsive substance use (i.e., SUD), a mish-mash that likely has hindered the acceptance and research and clinical utility of the concept of compulsive eating.

Importantly, binge-related eating disorders and obesity are not interchangeable, and several key features, including the diagnostic process, distinguish these conditions. For example, AN and BN both fall in the DSM-V classification of "Feeding and Eating Disorders", along with BED (American Psychiatric Association, 2013). BED is diagnosed among individuals that experience a minimum of 1–3 binge-eating episodes per week, defined as either 1) "eating, in a discrete period of time, an amount of food that is definitely larger than most people would eat in a similar period of time under similar circumstances" or 2) "the sense of a lack of control over eating during the episode (e.g., a feeling that one cannot stop eating or control how much one is eating)" (Berkman, et al., 2015). In contrast to AN, BN and BED, obesity was excluded as a psychiatric disorder from the DSM-V due to its heterogeneity and incomplete understanding of whether some forms of obesity have psychiatric components (Marcus and Wildes, 2012). Obesity instead has been considered a multifactorial disease, with genetic, metabolic, endocrinological, physical activity, nutritional and medical side effect components. Obesity is therefore primarily diagnosed using a different diagnostic process, often by different types of healthcare professionals. For example, most standard definitions of obesity used in the healthcare system include some index of body weight and/or presence of certain biomarkers. Thus, body mass index (BMI) or indices of body fat composition are used alone or in combination to diagnose obesity (https://www.nichd.nih.gov/health/topics/obesity/conditioninfo/diagnosed; accessed October 14, 2020). The DSM-V is more commonly used by the broad mental health community (including counselors, psychologists and psychiatrists), whereas other diagnostic methods and processes (e.g., biomarkers, cholesterol, BMI) are used mainly by physicians to diagnose obesity and associated diseases. This fundamental difference in diagnostic process leads to differences in how the conditions are conceptualized for treatment, the stigma surrounding patients and the conditions, and the likelihood that individuals will seek out treatment or preventative strategies. Relatedly, many medications currently used to treat BED versus obesity differ and focus on different aspects of each condition. Beyond these key diagnostic and therapeutic differences, BED and obesity also differ in national prevalence, with BED affecting approximately 2% of the global population (Kessler et al., 2013) as compared to obesity which affects 36–38% of the global population (Ng et al., 2014). Because of these distinctions, the possibility that highly palatable foods might play different roles in the development or maintenance of binge-related eating disorders vs. obesity is kept in mind throughout this review.

Several human disorders related to food (e.g., obesity and BED) often show lifetime comorbidity with SUD, suggesting potential shared vulnerability factors or pathophysiologic mechanisms. For example, SUD and BED symptoms develop around similar age ranges (see Schreiber et al., 2013), and 24–27% of patients with BED also meet the diagnostic criteria for SUD at some point in their lifetime (Becker and Grilo, 2015; Grilo et al., 2009; see also Schreiber et al., 2013). Similarly, SUD is also highly comorbid among patients diagnosed with obesity (Chen et al., 2018; Stokes et al., 2019; Muller et al., 2018; Lanza et al., 2015 see also Gearhardt et al., 2018 and Pasch et al., 2013). In fact, a significant subgroup of patients that have had bariatric or gastric bypass surgery, subsequently show recurrence or *de novo* incidence of SUD (Kanji et al., 2019; Sarwar et al., 2019; Conason et al., 2013; Ivazaj et al., 2014; Ivazaj et al., 2017). Although the substances used by individuals with BED or obesity may vary, data for use and abuse of opioids (Canan et al., 2017; Stokes et al., 2019; Smith et al., 2019), alcohol (Grucza et al., 2010; Conason et al., 2013; Smith et al., 2018; see also Traversy and Chaput, 2015 and Sayon-Orea et al., 2011), nicotine (Gearhardt et al., 2018), stimulants (Ricca et al., 2009; Dutta et al., 2006; deLima et al., 1998), and polydrug use (Hu et al., 2018) suggest that the overlapping prevalence is not specific for a particular class of drugs.

2. Overlap between highly palatable foods and substances of abuse

2.1 Shared metabolic systems

Metabolic hormones and status represent a possible causal link between feeding and SUDs. Extensive data show that eating highly palatable foods can impact feeding-regulatory peptides, metabolism and energy expenditure, as well as insulin status. In animal models, for example, continuous access to a Western diet can increase adiposity in the offspring not only of obesity-prone dams, but also obesity-resistant dams, suggesting an effect of diet dissociable from obesity (Frihauf et al., 2016). The deleterious impact of diet is evident in increased plasma levels of endocrine risk markers, such as leptin, insulin, and adiponectin in weanlings, as well as decreased basal metabolic rate (Frihauf et al., 2016). Chronic intermittent access to a palatable diet, which elicits binge-like food intake, also produces major adaptations in metabolism, including increased fat accumulation and feed efficiency (Cottone et al., 2008b; Cottone et al., 2009; Parylak et al., 2012; Kreisler et a., 2017; Kreisler et al., 2018), and cyclic changes in fuel substrate utilization and energy expenditure. Of interest vis-à-vis motivational systems, a profile of lipid-sparing fuel substrate utilization correlated directly with the development of increased progressive ratio breakpoints for the palatable diet (Spierling et al., 2018). As another metabolism-motivation relation, an endocrine profile of heightened glucagon-like peptide-1 (GLP-1) and pancreatic polypeptide along with decreased ghrelin levels discriminated those rats that developed the most compulsive-like feeding behavior following intermittent access to palatable high-sucrose food (Spierling et al., 2020).

Intermittent palatable food access also decreases circulating ghrelin and growth hormone levels (Cottone et al., 2008b), and increases fasting insulinemia, glycemia (Kreisler et al., 2018), leptinemia (Cottone et al., 2008b) and levels of proinflammatory cytokines, like interleukin-1β and interleukin-6 (Cottone et al., 2009b). Plasma levels of the proinflammatory cytokine, interleukin-18 (IL-18), also were increased by chronic high fat feeding in mice (Zorrilla et al., 2007). While each of these molecules is well-known to be involved in the control of appetite and metabolism (Zorrilla et al., 2007; Zorilla and Conti, 2014; Frihauf et al., 2010), more recent data have linked each of them to SUD or AUD phenotypes (Sustkova-Fiserova et al., 2020; Wittekind et al., 2019; Farokhnia et al., 2019; Jerlhag, 2020; Pastor et al., 2017; Walter et al., 2017; Grönbladh et al., 2016; Labarthe et al., 2014; Wei et al., 2020; Bach et al., 2020; Xu, 2014; Aguiar-Nemer et al., 2013; Kebir et al., 2011).

For example, Ser^3-acylated ghrelin, a post-translationally activated gastric peptide hormone, is known to promote food intake via “anticipatory” increases prior to expected access to palatable food or mealtime as well as during energy insufficiency. Increased acyl:*des*-acyl ghrelin ratios are reported in young obese individuals (Kuppens et al., 2015; Fittipaldi et al., 2020). Manipulations that oppose actions of acylated ghrelin, including small molecule antagonists, immunoneutralization, catalytic antibodies, *des*-acyl ghrelin, and liver enriched antimicrobial peptide-2 (LEAP-2), an endogenous GHRS1A inverse agonist, have anorectic effects under many conditions (Zorrilla et al., 2006; Mayarov et al., 2008; Zakhari et al., 2012; Ge et al., 2018; Fittipaldi et al., 2020). They also are putative therapeutic approaches to address the food craving and compulsive overeating behavior seen in Prader-Willi syndrome (Allas et al., 2018; Carias et al., 2019), a developmental disorder with hyperghrelinemia. In parallel to these findings, mounting data link increased acylated-ghrelin activity to different aspects of drug or alcohol-craving behavior. For example, ghelin receptor antagonists reduced morphine-induced behavioral stimulation and sensitization, conditioned place preference and nucleus accumbens (Acb) dopamine release (Sustkova-Fiserova et al., 2014; Jerabek et al., 2017). They also reduced the acquisition and expression of methamphetamine- or fentanyl-conditioned place preference as well as methamphetamine or fentanyl self-administration (Havlickova et al., 2018; Sustkova-Fiserova et al., 2020). Higher fasting ghrelin levels also were seen in former smokers (Wittekind et al., 2019) and associate with increased craving and relapse (al'Absi et al., 2014; Lemieux and al'Absi, 2018). A burgeoning literature also links alcohol use disorder and alcohol craving to increased acylated ghrelin activity (Farokhnia et al., 2019). For example, acylated ghrelin levels increased during ethanol abstinence in relation to craving and ethanol cue-induced insula activation (Koopmann et al., 2012; Bach et al., 2019). Infusion of ghrelin to alcohol-dependent men increased intravenous ethanol self-administration on a progressive-ratio schedule and altered alcohol associated fMRI signal (Farokhnia et al., 2018). Conversely, the ghrelin receptor inverse agonist PF-5190457 reduced alcohol craving and attention to alcohol cues in people with AUD (Lee et al., 2018).

An incongruity in this regard is, as reviewed, animal models of diet-induced obesity and most forms of adult human obesity typically are associated with decreased total ghrelin levels, in contrast with the apparent evidence of a role for increased ghrelin activity in various addictive disorders. A potential understanding of this discrepancy is that the decrease in ghrelin levels seen in older obese individuals may reflect a homeostatic mechanism to prevent further weight gain, a change not present in addictive disorders.

Heritable metabolic differences also have been linked to appetite-regulatory peptides implicated in substance use. For example, obesity-prone rats show heritable deficits in central anorectic sensitivity to feeding-regulatory corticotropin-releasing factor $(CRF)_2$ receptor agonists (Cottone et al., 2007), a phenotype accompanied by deficits in postmeal satiety (Cottone et al., 2007; Cottone et al., 2013). In mouse knockout models, the same type 2 urocortin/CRF_2 receptor molecules have been linked to altered ethanol intake (Sharpe et al., 2005; Smith ML and Ryabinin, 2015) as well as changes in stress recovery (Neufeld-Cohen et al., 2010) and depressive-like behavior (Chen A et al., 2006).

Another metabolic hormone implicated in modulating addiction risk is fibroblast growth factor 21 (FGF21), a protein that regulates energy homeostasis (Ji et al., 2019) and that is induced by metabolic stresses, including ketogenic and high carbohydrate diets. Gene variants in the FGF21 gene and in the KLB gene (which encodes β-klotho) are associated with alcohol use phenotypes in people (Schumann et al., 2016, Søberg et al., 2017; Clarke et al., 2017; Zhou et al., 2020). In both mice (Staiger et al., 2017) and humans (Desai et al., 2017; Soberg et al., 2018), alcohol intake increases circulating FGF21 levels. Overexpression (Schumann et al., 2016) or administration (Talukdar et al., 2016; Soberg et al., 2018) of FGF21 markedly reduced alcohol intake and preference in mice in a manner dependent on the FGF21 co-receptor β-klotho. A β-klotho/FGFR21 complex-activating antibody also decreased alcohol intake (Chen et al., 2017).

In addition to genes that encode FGF21 and β-klotho, other gene loci commonly thought of as metabolism-related genes also are linked to excess alcohol use phenotypes, as highlighted in Table 2. These include glucokinase regulatory protein (***GCKR***), a key enzyme in glucose homeostasis that regulates the activity and intracellular localization of glucokinase (Kraja et al., 2014; Viega-da-Cunha et al., 2003); fat mass and obesity-associated protein/alpha-ketoglutarate dependent dioxygenase (***FTO***), a nuclear dioxygenase that influences global metabolism and energy homeostasis and its associated regulatory loci (Chang et al., 2018; Yang et al., 2017); alcohol dehydrogenase 1B (class I; ***ADH1B***), an enzyme that promotes metabolism of energy from alcohol, whether the alcohol is imbibed or derived endogenously from gut microbes or anaerobic respiration (Winner et al., 2015; Yokoyama et al., 2020); ISL LIM Homeobox 1 (***ISL1***), a transcription factor that binds the enhancer region of the insulin gene (Loid et al., 2020; Clément et al., 1999); and insulin like growth factor 2 MRNA binding protein 1 (***IGF2BP1***), a binding protein that regulates the translation of insulin-like growth factor 2 (Rodrigues et al., 2010; Lu et al., 2016; Zhou et al., 2020). An area of future research is to determine how exposure to and abstinence from palatable food impact the expression and function of products of these genes

Both drugs of abuse and highly palatable foods can influence similar peptides, exemplified in the role of insulin in the rewarding effects of nicotine. It has been suggested that enhanced rewarding effects of nicotine promote tobacco use among patients diagnosed with diabetes (see O'Dell and Nazarian, 2016). This hypothesis was based on work demonstrating that a disruption in insulin signaling enhanced the rewarding effects of nicotine in diabetic rats (O'Dell et al., 2014; Richardson et al., 2014; Pipkin et al., 2017, O'Dell and Nazarian, 2016). These latter studies provide evidence that insulin disruptions reliably enhance the reinforcing and rewarding effects of nicotine in self-administration and place conditioning procedures in rat models of Type 1 and Type 2 diabetes. Importantly, disruptions in insulin signaling suppress dopamine transmission and alter dopamine receptor sensitivity (O'Dell et al., 2014).

Recently, a potential link between pancreatic glucose regulation and the reinforcing effects of nicotine has been identified in the medial habenula action of Transcription factor 7-like 2 (TCF7L2; Duncan et al., 2019). This diabetes-associated transcription factor, in bipartite association with β-catenin, activates Wnt target genes, thereby regulating glucose metabolism in enteroendocrine cells of the gut and pancreas as well as in liver. Several finding suggest a novel role for TCF7L2 within a habenula-pancreas axis to regulate nicotine's reinforcing and diabetes-promoting actions. First, TCF7L2 also is highly expressed in rodent medial habenula (mHb), where it regulates nicotinic acetylcholine receptor function. Second, inhibition of medial habenula TCF7L2 action reduced nicotine intake. Third, nicotine conversely nicotine increased circulating glucose levels via TCF7L2-dependent stimulation of the medial habenula, which is polysynaptically connected to the pancreas. Finally, the ability of nicotine intake to elicit diabetes-like changes in glucose homeostasis is blunted in mutant Tcf7l2 rats. The collective work supports a relationship between insulin resistance, glucose intolerance, metabolic markers, dopamine and nicotinic acetylcholine receptor sensitivity, and the escalation of nicotine intake in diabetic-like rodent models.

Conversely, prior work also has revealed that drugs of abuse can alter an array of metabolic indices. For example, nicotine prevents the distribution of abdominal fat produced by a high fat diet in male mice (Magubat et al., 2012). Also, self-administered nicotine increases fat metabolism and suppresses weight gain in rats (O'Dell et al., 2007; Rupprecht et al., 2018) and mice (Calarco et al., 2017). Epidemiological work has shown that chronic cannabis smoking was associated with visceral adiposity and adipose tissue insulin resistance, suggesting another interaction between drug use and metabolic systems that regulate food intake (Muniyappa et al., 2013).

2.2 Shared addiction constructs

2.2.1. Reward and mesolimbic dopamine—In addition to impacting and being conversely regulated by metabolic systems, intake of drugs and highly palatable foods can have similar acute and chronic effects on brain reward pathways. For example, under acute conditions, highly palatable food (Hernandez and Hoebel, 1988) and drugs of abuse (Di Chiara and Imperato, 1988) both result in an initial increase in release of dopamine. The neurochemical mechanism of action by which many drugs of abuse produce their rewarding effects involves activation of a primarily dopaminergic pathway in the brain, the mesolimbic pathway (Wise and Bozarth, 1985). This pathway is normally activated by so called "natural" rewards, such as food and sex, and the fact that drugs of abuse also activate this pathway has been the subject of scientific exploration for decades (Volkow et al., 2007; Volkow et al., 2011; Taber et al., 2012; see also Nutt et al., 2015).

Similarly, palatable foods likewise initially promote increased intake and weight gain in people through positive reinforcement (Bray et al., 2017; Cobb et al., 2015; Pereira-Lancha et al., 2010). Thus, neuroimaging studies of healthy weight adolescents without disordered eating find that greater reward region activation in response to palatable foods predicts short-term weight gain (Shearrer et al., 2018; Stice et al., 2015; Stice and Yokum, 2016a, 2016b; Winter et al., 2017). In normal weight individuals with healthy eating patterns, palatable carbohydrate-rich food and drink also increase emotional well-being and calmness within 1–2 hr of consumption (Reid and Hammersley, 1999; Gibson, 2006; Strahler and Nater, 2018). Reward enhancement, defined by intake of palatable food for "pleasure, excitement, or increased fun" (Boggiano, 2016; Boggiano et al., 2015) is 1 of 4 motives identified by Boggiano and colleagues for eating palatable food.

2.2.2. Within-system, opponent process adaptation—While drug use initially elicit pleasurable states, such as contentment or well-being, both human and preclinical studies show these are followed in opponent-process fashion by worse mood and increased vigilance/tension (Ettenberg et al, 1999; Jhou et al., 2013; Knackstedt et al., 2002; Radke et al., 2011; Vargas-Perez et al., 2009; Vargas-Perez et al., 2007; Wenzel et al., 2011). With repeated drug use, this counter-regulatory opponent process predominates, such that more rewarding substance is needed to maintain euthymia. Negative emotional signs (e.g., irritability, anxiety, dysphoria and subjective feelings of need) result when use stops. This deficit emotional state persists with repeated use, leading to negative emotional behavior, hyperarousal, and increased stress responses despite prolonged abstinence. Behaviorally, the anhedonia and negative affective state that result from the opponent-process drive continued drug use via negative reinforcement (Koob and Le Moal, 2005). Anhedonia (Hatzigiakoumis et al., 2011) and other aspects of this "dark side" of addiction (Koob and Le Moal, 2005) have been associated with drugs of abuse from every major drug class, including stimulants (Leventhal et al., 2010), opiates (Garfield et al., 2017), nicotine (Cook et al., 2015), alcohol (Martinotti et al., 2008), and cannabinoids (Leventhal et al. 2017). Within-system impairment of normal mesolimbic pathway function is one putative mechanism underlying the long-term drug use-induced opponent process. Thus, chronic drug use is characterized by downregulation of dopamine D_2 receptors; decreases in production of tyrosine hydroxylase, the rate limiting factor for dopamine synthesis; decreases in dopamine release; and upregulation of dopamine D_1 receptors (Koob and Le Moal, 2005).

Similarly, long term consumption of high fat diets can disrupt mesolimbic dopamine systems. Several human and animal studies demonstrate decreases in basal or food-stimulated striatal dopamine release; dopamine D_2 receptor binding and expression (Dunn et al., 2012; Haltia et al., 2007; Johnson and Kenny, 2010; Lindgren et al., 2018; Stice et al., 2011; Tomasi and Volkow, 2013; although see also South and Huang, 2008); and decreased function and membrane expression of dopamine transporters (Speed et al., 2011; Cone et al., 2013). Daily access to sucrose can similarly reduce striatal dopamine D_2 receptor binding (Bello et al., 2002) and mRNA expression (Spangler et al., 2004; Bello et al., 2003), and prolonged access to a high-sucrose/high-fat "junk food" mash reduced Acb D_2 mRNA expression (Robinson et al., 2015). Long term access to cafeteria diets (which typically contain both high fat and high sugar/carbohydrate items) also decreases basal levels of extracellular dopamine in the nucleus accumbens, and leads to lower stimulation-evoked dopamine release in the nucleus accumbens and dorsal striatum (Geiger et al., 2009). During cyclic access to palatable, high-sucrose food, rats show blunted locomotor, reward-potentiating, place preference conditioning, and Acb mesolimbic function. Similar to reviewed models, they also show reduced basal extracellular dopamine in no-net flux *in vivo* microdialysis analysis (Moore et al., 2020).

While these studies demonstrate largely consistent changes in dopamine systems following long term exposure to highly palatable foods and drugs, there may be differences in their impact on dopamine D_1 receptor expression. Opposite to chronic drug use (Koob and Le Moal, 2005), long term access to highly palatable foods may result in a decrease in dopamine D_1 receptor gene expression (Aisio et al., 2010; though see also Ramos et al., 2020), a possible difference worth future study.

The above-described effects of chronic palatable food on brain reward neurocircuitry, similar to drugs of abuse (see Table 1), have been hypothesized to promote compulsive eating via opponent-process affective dysregulation and negative urgency (Cottone, et al., 2009; Cottone et al., 2008a, 2008b 2009; Kreisler et al., 2017; Parylak et al., 2012; Parylak et al., 2011; Spierling et al., 2018; Zorrilla and Koob, 2019; Zorrilla and Koob, 2020). Below, we separately consider human and animal findings in key behavioral domains to evaluate support of this opponent-process model for palatable food and whether food-induced addiction-like adaptations might increase risk for substance use and relapse behavior.

2.2.3. Tolerance.

2.2.3.1. Human findings.: Similar to substances of abuse, chronic intake of palatable foods may result in food reward tolerance due to opponent-process adaptation. Thus, 2 items on the Yale Food Addiction Scale (YFAS) 2.0 measure hypohedonic tolerance ("did not give me as much enjoyment", "needed to eat more...to get the feelings I wanted"; Gearhardt et al., 2016). Consistent with this view, the ability of a preferred beverage to improve mood diminishes with repeated use (Spring et al., 2008).

This putative food reward tolerance is hypothesized to reflect reviewed adaptations in mesolimbic dopaminergic reward circuitry that drive compensatory overeating of palatable food in a vicious circle (Bello and Hajnal, 2010; Blum et al., 2014; Blum et al., 2018; Gold et al., 2015; Gold et al., 2018; Volkow et al., 2008a). Consistent with this opponent-process "reward deficiency" hypothesis and similar to chronic palatable fed animal models, obese subjects show addiction-like reductions in striatal dopamine D_2 receptors and decreased basal or food-stimulated dorsal striatal extracellular dopamine responses (Dunn et al., 2012; Haltia et al., 2007; Lindgren et al., 2018; Stice et al., 2011; Volkow et al., 2009; Volkow et al., 2007; Volkow et al., 2008a; Volkow et al., 2013; Wang et al., 2009; Wang et al., 2011) as compared with lean subjects (Volkow et al., 2002). The degree of reduction in striatal dopamine D_2 receptor levels correlates directly with greater BMI (Volkow et al., 2008a; Wang et al., 2001). Furthermore, the degree to which caudate activation responses of obese subjects to a milkshake are reduced (Stice et al., 2008) also predicts greater subsequent increases in BMI.

In SUD, tolerance is typically accompanied by adaptive escalation of intake of the substance of abuse to achieve the same level of hedonic reward. Findings in this regard have been mixed in humans with palatable food. On the one hand, several findings suggest a similar tolerance-motivated increase in palatable food intake in humans. Indeed, a YFAS item explicitly measures this ("needed to eat more...to get the feelings I wanted") (Gearhardt et al., 2016), Similarly, volunteers who showed blunted fMRI BOLD caudate activation responses to an ice-cream milkshake drank milkshakes more frequently (Burger and Stice, 2012) and showed greater subsequent increases in BMI (Stice et al., 2010). On the other hand, women who received a macaroni-and-cheese meal daily for 5 weeks <u>decreased</u> their intake more than did those with weekly access (Avena and Gold, 2011; Epstein et al., 2011).

2.2.3.2. Animal models.: Animal models also support the hypothesis that palatable food elicits allostatic decrements in reward function that manifest as tolerance. Intracranial lateral hypothalamic self-stimulation thresholds increase in rats provided extended access to a palatable cafeteria diet (Johnson and Kenny, 2010; but see Iemolo et al., 2012) that reduced striatal dopamine D_2 receptor levels. Elevated self-stimulation thresholds, an index of reduced brain reward function, developed with obesity and persisted despite forced abstinence from the cafeteria diet for two weeks (Johnson and Kenny, 2010). Mimicking the dopamine D_2 receptor downregulation by knocking down dopamine D_2

receptor expression with a lentiviral construct accelerated diet-induced increases in reward thresholds, supporting a causal role for striatal dopamine D_2 receptor deficiency in impaired brain reward function (Johnson and Kenny, 2010). As in humans, dampened mesolimbic dopaminergic transmission may promote weight gain, because obesity-prone rats have lower basal and lipid-stimulated extracellular dopamine levels in the nucleus accumbens than do obesity-resistant rats (Geiger et al., 2008; Rada et al., 2010).

Similar to substances of abuse, palatable food-induced changes in mesolimbic circuitry also blunt neurochemical and behavioral responses to alternative reinforcers. For example, cafeteria diet eliminated the normal ability of standard chow to increase dopamine efflux (Geiger et al., 2009). Rats that received chronic, intermittent extended access to a chocolate-flavored, sucrose-rich diet showed reductions in progressive ratio break points for a less preferred, but otherwise palatable, diet (Cottone et al., 2009a; Cottone et al., 2009b). Likewise, access to highly preferred diets led to underconsumption of otherwise acceptable chow even when it was the only food available, leading to voluntary weight loss (Cottone et al., 2009a; Cottone et al., 2008a, 2008b; Cottone et al., 2009b; Iemolo et al., 2013; Johnson and Kenny, 2010; Pickering et al., 2009; Rossetti et al., 2014). The chow hypophagia increased with longer durations of access to palatable food (24 hr vs. 30 min/day) and is persistent (Kreisler et al., 2017); rats that received chronic *ad lib* access to a highly preferred diet continued to undereat standard, grain-based chow for at least 2 weeks after it was the only diet available, despite having returned to normal body weight and adiposity (Kreisler et al., 2017). Intake of and breakpoints for moderately sweet solutions also decreased in rats with a history of access to sweet foods or solutions (Iemolo et al., 2012; Vendruscolo et al., 2010). Both the chow hypophagia and the motivational deficits to obtain less preferred food are mitigated by pretreatment with a CRF_1 receptor antagonist (Cottone et al., 2009a), perhaps analogous to the ability of a CRF receptor antagonist to reverse blunted reward function during drug withdrawal (Bruijnzeel et al., 2009; Bruijnzeel et al., 2010).

Continuous access to palatable sucrose solutions diminishes striatal dopamine responses to sucrose, but intermittent access does not (Rada et al., 2005). The latter neurochemical finding may explain why rats with intermittent, extended access to a palatable diet show profoundly elevated daily intake and operant self-administration of palatable food, whereas those with *ad libitum* access decrease their palatable food intake to that of chow controls (Kreisler et al., 2017; Spierling et al., 2018; Spierling et al., 2020). This finding resembles the above-described pattern in humans wherein daily access to macaroni and cheese reduces intake unlike weekly access and seems to contrast from findings that extended access to substances of abuse typically leads to compensatory increases in intake with tolerance. However, it also has been observed that escalation of nicotine self-administration only develops with intermittent, extended access to nicotine and not with daily extended access (Cohen et al., 2012), which can even decrease self-administration with daily, extended access at some unit doses (O’Dell et al., 2007).

Similarly, Hoebel, Avena and colleagues similarly observed dramatic increases in glucose intake over successive days of intermittent access to sugar, including increased consumption during the first hour of access (Colantuoni et al., 2002). Such binge-like escalation of intake and operant self-administration has been seen across many laboratories using diverse palatable diets and schedules of intermittent access (Bello et al., 2009; Cooper, 2005; Corwin and Babbs, 2012; Cottone et al., 2009a; Cottone et al., 2008b; Cottone et al., 2009b; Kreisler et al., 2017; Parylak et al., 2012; Rossetti et al., 2014; Spierling et al., 2018). Rats with intermittent, extended access (24 hr/day) to a palatable diet developed increased binge-like intake and first 30-min operant self-administration to a similar degree as highly time-restricted rats (30 min/day). Thus, similar to substances of abuse, intermittent access to, and not only restrictedness, of palatable diet can escalate consumption (Kreisler et al., 2017; Spierling et al., 2018).

The uncertain escalation of intake with the development of tolerance upon continuous access to palatable food differs from what is seen for most substances of abuse. Perhaps, as with nicotine, intermittency, such as occurs with dieting or dietary restraint, is key in the development of reward-compensatory increases in intake of palatable food as tolerance develops. Alternatively, feeding-elicited orosensory- or energy-related satiety factors may oppose further food intake eve though tolerance develops. Such factors that would not impede the reward-compensatory intake of most substances of abuse. Future studies may assess these hypotheses by by testing 1) whether tolerance to palatable food is associated with cross-escalation of intake of dissimilar rewarding food (Treesukosol et al., 2015) or substances of abuse, 2) whether tolerance to palatable, low-energy tastants (e.g., sugar-saccharin mixtures; Valenstein et al., 1967; Spierling et al., 2017) leads to escalated self-administration of those and other palatable tastants, and 3) whether sham-fed subjects continuously fed a palatable diet escalate their self administration to a greater degree than real-fed subjects (Weingarten, 1982; Nissenbaum and Sclafani, 1987; Treesukosol et al., 2015).

2.2.4. Opponent-process affective dysregulation.

2.2.4.1. Human findings.: Several items on the YFAS measure negative emotional and somatic symptoms during abstinence from palatable food (Zorrilla and Koob, 2019), akin to opponent-process symptoms seen during drug withdrawal. Headache, irritability and flu-like symptoms have been described in clinical accounts of acute food abstinence (Davis and Carter, 2009). Dieting, which often involves reduced intake of palatable food, predicts increases in self-reported ‘stress’ (Rosen et al., 1990) and depressive symptoms (Stice and Bearman, 2001) in both overweight and non-overweight individuals (Crow et al., 2006; Goldschmidt et al., 2016; Hinchliff et al., 2016; Stice, 2001). Increased depressive symptoms also are seen in some weight-management programs (Smoller et al., 1987). Individuals who habitually skip breakfast also have increased distress, depressive symptoms and suicidal ideation (Kelly et al., 2016; Khan et al., 2017; Kwak and Kim, 2018; Lee et al., 2017a; Lee et al., 2017b; Lien, 2007; Tanihata et al., 2015).

People also become irritable (“hangry”) during abstinence from food. For example, women with lower glucose levels more frequently delivered aversive noise blasts to their spouse and stabbed pins into a voodoo doll that symbolized them than did women with normal glucose levels (Bushman et al., 2014). Further, after eating a high fat diet for one month, men and women who were switched to a lower-fat diet had greater anger, anxiety and hostility during the next month than did volunteers who were kept on the high fat diet (Wells et al., 1998).

As a human analog of precipitated opioid withdrawal, a placebo-controlled trial found that oral naltrexone elicited cortisol stress responses and aversive nausea in obese women. These effects were greater in volunteers who had greater food addiction symptoms and reward-driven eating (Mason et al., 2015).

Supporting the view that these abstinence symptoms may reflect opponent-process affective dysregulation, intake of palatable food has been linked to subsequent increases in self-reports of negative emotions. Indeed, 5 items on the YFAS 2.0 (Gearhardt et al., 2016) measure aversive visceroemotional outcomes after overeating palatable food (e.g., "caused emotional problems", "distress", "felt so bad", "sluggish", "tired", "physically ill"). Higher YFAS scores in turn relate not only to greater binge eating, night eating, caloric and fat intake, and BMI (Ayaz et al., 2018; Brunault et al., 2017; Burrows et al., 2017; Hauck et al., 2017; Masheb et al., 2018; Meule et al., 2017; Nolan and Geliebter, 2017; Richmond et al., 2017; Schulte et al., 2018), but also to "dark side" symptoms such as depression, anxiety, post-traumatic stress symptoms; emotional reactivity; and insomnia (Berenson et al., 2015; Brewerton, 2017; Burmeister et al., 2013; Burrows et al., 2017; Burrows et al., 2018; Ceccarini et al., 2015; Chao et al., 2017; Davis et al., 2011; de Vries and Meule, 2016; Gearhardt et al., 2012; Granero et al., 2014; Koball et al., 2016; Masheb et al., 2018; Meule et al., 2014; Meule et al., 2015).

Likewise, high intake of processed, palatable foods, such as "crisps or savoury snacks; sweets…or chocolate; biscuits; fried food, chips, samosas or bhajis…and soft drinks" is associated with clinically significant anxiety and depression not only cross-sectionally (Jacka et al., 2010a; Jacka 2010b; Oddy et al., 2009), but also prospectively (Akbaraly et al., 2009; Baskin et al., 2017; Jacka et al., 2014; Jacka et al., 2011; Sanchez-Villegas et al., 2009; Sanchez-Villegas et al., 2012; Sarris et al., 2015). While the role of 3rd variables in these epidemiologic relations remain under debate (Lai et al., 2016; Winpenny et al., 2018), causally-oriented studies found that dietary interventions that promote long-term abstinence from such foods ultimately improve mental health (Adjibade et al., 2018) and reduce major depression more than social support controls (Jacka et al., 2017).

Binge-like eating, long linked to negative emotional states and traits (Womble et al., 2001), also involves eating of palatable foods (Singh, 2014), including breads/pasta, sweets, high-fat meat items, and salty snacks (Allison and Timmerman, 2007). Similarly, the Nurses' Health Studies (n = 123,688 women) found that YFAS-defined food addiction, which associates strongly with binge eating, was associated with an increased frequency of eating hamburgers and other red/processed meats, French fries, pizza, and other palatable foods, such as snacks and candy bars (Lemeshow et al., 2018). Consistent with opponent-process theory, ecological momentary assessment studies have observed that high levels of negative affect progressively develop post-binge (Haedt-Matt and Keel, 2011; Berg et al., 2017). Data also suggest that binge eating may prospectively increase subsequent depression (Spoor et al., 2006; Stice, 1998, 2001). Consistent with a transdiagnostic, opponent-process view, individuals with BED and BN have increased rates of major depression, bipolar disorder, anxiety disorders, and alcohol or drug abuse (Hudson et al., 2007; Mitchell and Mussell, 1995; Swanson et al., 2011). About 30–80% of BED patients have comorbid depression and anxiety disorders over their lifetime (Herzog et al., 1992), and both current (27.3% vs. 4.9%)

and lifetime rates (52.3% vs. 23.0%) of mood disorders are greater in obese patients with BED vs. obese patients without BED (Sheehan and Herman, 2015).

Suicidality also commonly associates with binge eating, with over half of teenagers diagnosed with BN and approximately one-third of those with BED report suicidal ideation; and one-third of those diagnosed with BN report attempting suicide (Brown et al., 2018; Carano et al., 2012; Swanson et al., 2011). Suicide attempts and completion are also high in BED (Runfola et al., 2014), especially with comorbid depression (Pisetsky et al., 2013).

Depression and anxiety likewise are well-reviewed comorbidities of human obesity (Singh, 2014). The high depression symptomatology is not secondary to obesity because nonobese BED patients show depressive symptoms at levels similar to those of obese BED patients (Dingemans and van Furth, 2012). Obesity also has been linked to increased suicidality in a large (n=14,497), diverse representative sample from the Collaborative Psychiatric Epidemiologic Surveys both independent of and synergistically with binge eating (Brown et al., 2018).

In sum, human data suggest that overconsuming palatable food ultimately may causally contribute in opponent-process fashion to the negative emotional disturbance seen in BED, BN and obesity. These negative emotional symptoms, in turn, are conceptualized as driving further intake, similar to negative reinforcement use of substances of abuse (Leon et al., 1999; Pearson et al., 2015; Hughes et al., 2013; Zorrilla and Koob, 2019).

2.2.4.2. Animal models.: Behavioral signs of a negative emotional state also are documented in animals following palatable food access (Sharma et al., 2013). An early report described "nippiness" during withdrawal from sucrose solutions (Galic and Persinger, 2002). Hoebel and colleagues found that rats with intermittent daily access to high sugar solutions alternated with food deprivation developed somatic and anxiogenic-like signs of opiate withdrawal when challenged with the opioid receptor antagonist naloxone (Colantuoni et al., 2002). They also showed decreased preproenkephalin mRNA expression in the nucleus accumbens (Spangler et al., 2004), as do rats with limited daily access to a sweet-fat diet (Kelley et al., 2003). Opioid-like withdrawal signs also occurred after a 24–36 hr fast (Avena et al., 2008). Hoebel and colleagues hypothesized that these effects may result from an altered balance of striatal dopaminergic vs. acetylcholinergic (ACh) signaling. Thus, similar to morphine withdrawal (Pothos et al., 1991; Rada et al., 1991), naloxone or an extended fast elicited greater Acb ACh release in rats with a cyclic glucose+chow/deprivation history than in ad lib chow rats (Colantuoni et al., 2002; Avena et al., 2008), as well as reduced extracellular Acb dopamine. The shift towards greater ACh release vs. decreased dopamine putatively underlies a shift towards harm avoidance and away from approach behaviors (Hoebel et al., 2007).

Diet-cycled rats with alternating 2-day access to a highly-preferred high-sucrose, chocolate-flavored diet vs. 5-day access to standard chow similarly showed increased anxiety-like behavior in the elevated plus-maze and defensive withdrawal tests when tested during the chow phase of their diet cycle (Cottone et al., 2009a; Cottone et al., 2009b; but see Rossetti et al., 2014). Increased forced swim immobility (Iemolo et al., 2012), a depressive-related behavior, and reduced locomotor activity in a novel open field (Rossetti et al., 2014), a measure of increased emotionality, also were reported in withdrawn diet-cycled rats. Increased aggressive-like irritability also was seen in rats withdrawn from intermittent (MWF), extended (24-hr/day) access to the same diet (Spierling et al., 2019). At least some behavioral effects of abstinence from palatable food are not unique to extended access, because female rats with more limited (10–120 min/day) access to the same diet exhibited an anxiogenic-like reduction in plus-maze open arm time (Cottone et al., 2008b; Kreisler et al., 2018) and greater bottle-brush irritability (Spierling et al., 2019) during abstinence.

During palatable food withdrawal, rats in the 5-day/2-day alternating access model showed increased expression of the stress-related neuropeptide CRF in the (central nucleus of the amygdala (CeA; Cottone et al., 2009a), a nucleus also activated in mice acutely withdrawn from high-fat diet (Teegarden and Bale, 2007). This finding is notable because CeA CRF systems also are activated during withdrawal from alcohol (Funk et al., 2007; Roberto et al., 2010; Sommer et al., 2008; Zorrilla et al., 2001), opiates (Heinrichs et al., 1995; Maj et al., 2003; McNally and Akil, 2002; Weiss et al., 2001), cocaine (Richter and Weiss, 1999), cannabinoids (Rodriguez de Fonseca et al., 1997), and nicotine (George et al., 2007; Marcinkiewcz et al., 2009). When diet-cycled animals were studied during access to the palatable diet, plus-maze behavior, forced swim immobility, and CeA CRF levels normalized, supporting the hypothesis that increased activation of the amygdala CRF system and negative emotional behavior reflected an acute abstinence-related state (Cottone et al., 2009a; Cottone et al., 2009b; Iemolo et al., 2012).

Pharmacological and electrophysiologic data also implicate the CRF_1 receptor system. Systemic pretreatment with the CRF_1 receptor antagonist R121919 blocked food withdrawal-associated anxiety at doses that did not alter behavior of chow controls (Cottone et al., 2009a). This result resembles findings that CRF_1 receptor antagonists reduce aversive- and anxiety-like states during withdrawal from alcohol (Knapp et al., 2004; Overstreet et al., 2004; Sommer et al., 2008), opiates (Skelton et al., 2007; Stinus et al., 2005), benzodiazepines (Skelton et al., 2007), cocaine (Basso et al., 1999; Sarnyai et al., 1995), and nicotine (George et al., 2007). CRF_1 receptor antagonist pretreatment also reduced the degree to which diet-cycled animals overate the preferred diet when access was renewed. This finding resembles findings that CRF_1 receptor antagonists can reduce excessive intake of alcohol (Chu et al., 2007; Funk et al., 2007; Gehlert et al., 2007; Gilpin et al., 2008; Richardson et al., 2008; Sabino et al., 2006; Valdez et al., 2002), cocaine (Specio et al., 2008), opiates (Greenwell et al., 2009), and nicotine (George et al., 2007) in animal models of dependence, while having less effect on self-administration of non-dependent animals. Also, similar to findings during alcohol withdrawal (Roberto et al., 2010), diet-cycled rats showed increased sensitivity of CeA GABAergic neurons to modulation by CRF_1 antagonism; thus, R121919 reduced evoked inhibitory postsynaptic potentials to a greater degree in diet-cycled rats. Finally, intra-CeA R121919 reduced the anxiogenic-like behavior and palatable diet intake of withdrawn diet-cycled rats (Iemolo et al., 2013), similar to the ability of intra-CeA CRF antagonist administration to reduce withdrawal-associated negative emotional symptoms and self-administration in models of substance dependence (Roberto et al., 2017). In sum, many findings in diet-cycled rats resemble the between-system adaptation of central extended amygdala CRF systems seen in animal models of addiction (see Table

1). The results also raising the possibility that the adaptations in stress-related amygdala circuitry may increase relapse or incidence risk for the other condition.

Evidence of adaptation in the endocannabinoid (eCB) system also has been seen during abstinence from palatable food. For example, the CB_1 receptor inverse agonist surinabant (SR147778) less potently reduced binge-like intake of rats with highly-limited access to sweet-fat diet than it did in *ad lib*-fed chow or palatable diet controls (Parylak et al., 2012). Withdrawal from cyclic palatable food was associated with increased levels of the eCB 2-arachidonoylglycerol and its cannabinoid receptor 1 (CB_1) in the CeA (Blasio et al., 2013). These findings have been interpreted as signs of a compensatory stress response because amygdala eCB-CB_1 signaling has been proposed to act as an anti-stress buffer (Lutz et al., 2015; Parsons and Hurd, 2015). Also suggesting adaptation, systemic or intra-CeA infusion of rimonabant, a CB_1 inverse agonist, more potently precipitated anxiogenic-like behavior and anorexia in rats withdrawn from cyclic palatable food than in chow controls (Blasio et al., 2013; Blasio et al., 2014a). The food induced-changes in eCB function may have implications for SUD and AUD vulnerability.

2.2.5. Negative cue reactivity.

2.2.5.1. Human findings.: The neurobiological basis for palatable food effects on negative emotionality is unclear, but the above results suggest that drug-like between-system adaptation in the central amygdala may be involved (Zorrilla and Koob, 2019) (see Table 1). Consistent with this hypothesis, similar to drug and alcohol cue reactivity studies of people with SUDs (Engelmann et al., 2012; Goudriaan et al., 2010; Heinz et al., 2009; Jasinska et al., 2014; Mainz et al., 2012), obesity and food addiction symptoms are each associated with increased amygdala reactivity to pictures of palatable, high-calorie foods (e.g., cheesecake, milkshake; Stoeckel et al., 2008; Gearhardt et al., 2011; Ng et al., 2011). Women with BN also show increased functional connectivity of the amygdala to the insula and putamen during a milkshake cue as compared to healthy volunteers (Bohon and Stice, 2012). Such cue-induced activation is often aversive (Carelli and West, 2014; Colechio et al., 2018; Colechio and Grigson, 2014; Colechio et al., 2014; Nyland and Grigson, 2013), and may reflect amygdala-subserved reward omission (Calu et al., 2010; Iordanova et al., 2016; Kawasaki et al., 2017; Kawasaki et al., 2015; Tye et al., 2010), negative contrast, or conditioned opponent processes (Childress et al., 1988; Childress et al., 1986; Colechio and Grigson, 2014; Colechio et al., 2014; Grigson, 2008; McLellan et al., 1986; Topp et al., 1998; see also Siegel and Ramos, 2002; Koob, 2015; Koob and Le Moal, 2008; Roberto et al., 2017; Wenzel et al., 2011). Women with a history of BN (Ely et al., 2017) and obese children (Boutelle et al., 2015) also show greater amygdala responses to tastes of sucrose than do healthy controls.

2.2.5.2. Animal models.: Consistent with the human findings of stress-like responding to “frustrative” food or drug cues (defined as previously reward-predictive, but now non-rewarded, cues), rats with cyclic palatable diet histories that were presented with the sight and smell of unobtainable palatable food showed Hypothalamic-Pituitary-Adrenal (HPA)-axis activation (Cifani et al., 2009) and more cells expressing phosphorylated extracellular signal-regulated kinases in the CeA, paraventricular nucleus of hypothalamus (PVN), and dorsal and ventral bed nuclei of the stria terminalis (BNST; Micioni Di Bonaventura et al., 2017a). When access was ultimately provided, “frustratively cued” rats ate twice as much as on days when no cues were presented (Cifani et al., 2009b; Micioni Di Bonaventura et al., 2012). The frustratively non-rewarded cue increased extended amygdala CRF_1 receptor mRNA. Antagonizing CRF_1 receptors in the CeA and BNST reduced frustrative cue-induced binge-like intake (Micioni Di Bonaventura et al., 2014; Micioni Di Bonaventura et al., 2017b). Other reports also demonstrate increases in responding for cues previously paired with high fat foods, sucrose and saccharin after abstinence (Aoyama et al. 2014; Darling et al., 2016; Dingess et al., 2017; McCue et al., 2019) mirroring similar increases in responding after abstinence when cues previously paired with drugs of abuse are presented (e.g., cue-induced reinstatement; Epstein et al., 2006; Shalev et al., 2002; see Grimm 2020 for a review). Thus, while many theorists have emphasized the role of past predictive appetitive associations in the incentive actions of these cues, the present findings support models that emphasize the role of unexpected non-reward and/or the aversive, arousing effects that occurs with unexpected omission of incentives after previously reward-predictive cues (Amsel, 1958, 1994; Papini and Dudley, 1997; Pearce and Hall, 1980; Schultz, 2016; Sutton and Barto, 1981).

Cyclic overeating of vs. restriction from palatable food also leads to binge-like ingestive responses to stress in rats. Thus, intermittent restriction alternated with access to palatable food (Nutella chow or cookies) led to increased consumption in response to a stress trigger (footshock or frustrative food cue nonreward; Boggiano and Chandler, 2006; Cifani, Polidori, et al., 2009a; Hagan et al., 2002). These adaptations to cyclic palatable food access involve changes in feeding responses to mu/kappa, nociceptin/orphanin FQ, CRF_1 and orexin receptor ligands (Boggiano et al., 2005; Piccoli et al., 2012).

2.2.6. Negative reinforcement motivational factors.

2.2.6.1. Human findings.: In an addiction framework, the reviewed negative emotional effects of abstinence from palatable food are viewed as motivating use via negative reinforcement (“coping-like”) mechanisms, a shift away from positive reinforcement motive. As in substance use, negative affect is recognized to precede binge eating (Berg et al., 2017; Berg et al., 2015; Dingemans et al., 2017; Fischer et al., 2018; Haedt-Matt and Keel, 2011) and is a putative trigger of overeating (Carels et al., 2004; Razzoli et al., 2017) and selecting (Wallis and Hetherington, 2009; Zellner et al., 2006) palatable food in vulnerable populations. Several human laboratory studies have found that negative mood and stressful inductions increase palatable food intake in vulnerable populations (Stice, 2002; Fay and Finlayson, 2011) (e.g., obese binge eaters; Chua et al., 2004).

These relations may reflect that palatable carbohydrate-rich food and drink reduce anger and tension in negative reinforcement fashion within 1–2 hr of intake (Benton and Owens, 1993; DeWall et al., 2011). Sweets reduce “feelings of being stressed out” in emotional eaters (Strahler and Nater, 2018). A palatable carbohydrate-rich food also prevented stress-induced increases in depressive symptoms in stress-prone subjects (Markus et al., 1998). Finally, a preferred high-carbohydrate beverage reduced mood induction-induced dysphoria to a greater degree than did isocaloric intake of a less-preferred, high-protein drink (Corsica and

Spring, 2008; Spring et al., 2008). The collective results indicate negative reinforcing actions of palatable food (Agras and Telch, 1998). Accordingly, global negative affect initially decreases after binges in obese adults (Berg et al., 2015) and patients with AN (Engel et al., 2013) and BN (Smyth et al., 2007).

Consistent with the negative reinforcement perspective, people high in YFAS scores more often reported using food to self-soothe (Berenson et al., 2015; Brewerton, 2017; Burmeister et al., 2013; Burrows et al., 2017; Burrows et al., 2018; Ceccarini et al., 2015; Chao et al., 2017; Davis et al., 2011; de Vries and Meule, 2016; Gearhardt et al., 2012; Granero et al., 2014; Koball et al., 2016; Masheb et al., 2018; Meule et al., 2014; Meule et al., 2015) and anticipated less positive reinforcement from eating (Meule and Kubler, 2012). Individuals who self-identify as having food addiction also reported using food to self-medicate their feelings of being tired, anxious, depressed or irritable (Ifland et al., 2009). The Palatable Eating Motives Scale documents that eating palatable food to “cope” with problems, worries and negative feelings is a primary motive for why people eat palatable food (Burgess et al., 2014; Boggiano, 2016; Boggiano et al., 2015b). Eating palatable food “to cope” predicts binge eating (Boggiano et al., 2015a; Boggiano et al., 2014), BMI, and class 3 obesity (Boggiano et al., 2015b; Burgess et al., 2014).

2.2.6.2. Animal findings.: A large body of preclinical data also support the hypothesis that palatable food has “comforting” effects that ultimately may promote its intake and relapse (Avena et al., 2008; Cottone et al., 2009a; Dallman et al., 2003; Ulrich-Lai et al., 2010). For example, palatable food attenuated the exogenous activation of behavioral, autonomic, neuroendocrine and neurochemical stress responses (Christiansen et al., 2011; Dallman et al., 2005; Fachin et al., 2008; Kinzig et al., 2008; Krolow et al., 2010; Maniam et al., 2016; Maniam and Morris, 2010a, 2010b, 2010c; Nanni et al., 2003; Pecoraro et al., 2004; Teegarden and Bale, 2008; Ulrich-Lai et al., 2010; Ulrich-Lai et al., 2011; Ulrich-Lai et al., 2007; Warne, 2009).

2.2.7. Negative urgency.

2.2.7.1. Human findings.: Palatable food intake also interacts with and may promote negative urgency, the tendency to act impulsively and rashly when in extreme distress that has been implicated in pathological food, alcohol and substance use (Cyders and Smith, 2008; Zorrilla and Koob, 2019). Neurobiologically, negative urgency involves impaired “top-down” cortical-amygdala/striatal processing, yielding reduced inhibitory control over potentially detrimental actions, as well as heightened “bottom-up” amygdala-cortical/striatal processing, yielding greater attention to, incentive salience of and cognitive resource interference by emotion-evoking stimuli. These biases are thought to reflect altered structure, function and connectivity of bidirectional amygdala–orbitofrontal (OFC)/ventromedial prefrontal cortical (vmPFC) projections (Cyders and Smith, 2008; Smith and Cyders, 2016; Robbins et al., 2012; Zorrilla and Koob, 2019).

People with BN and YFAS-defined food addiction are high in negative urgency (Murphy et al., 2014; Pivarunas and Conner, 2015; Rose et al., 2018; VanderBroek-Stice et al., 2017). Negative urgency more strongly associates with binge eating and uncontrolled eating than do other facets of impulsivity, such as sensation seeking, lack of planning, or lack of persistence (Booth et al., 2018; Fischer et al.; Pearson et al., 2014). It prospectively predicts binge eating symptoms in elementary, middle school and college students (Pearson et al., 2015b) and relates to increased snacking in adolescents (Coumans et al., 2018; G. T. Smith and Cyders, 2016). Transdiagonstically, negative urgency also is implicated in compulsive smoking (Billieux et al., 2007a), alcohol use (Fischer et al., 2007; Stautz and Cooper, 2013), cell phone use, shopping and gambling (Billieux et al., 2008; Billieux et al., 2007b; Maclaren et al., 2011).

While negative urgency is often thought of as a stable antecedent (e.g., Engel et al., 2007; Fischer et al., 2018), feeding status impacts its underlying circuitry (Silbersweig et al., 2007). For example, skipping breakfast, which increases the appeal of high (vs. low) calorie foods, increases fMRI BOLD activation in the amygdala, orbitofrontal cortex (OFC), and anterior insula (Ely et al., 2017; Goldstone et al., 2009). Conversely, a high-protein intervention in “breakfast skippers” reduced post-meal craving for sweet and savory foods (Hoertel et al., 2014) and reduced pre-dinner amygdala and insula activation (Leidy et al., 2013). Palatable food (or its metabolic consequences) also may alter urgency circuits, because decreased striatal dopamine D_2 receptor availability in obese subjects, but not non-obese subjects, correlates with reduced glucose metabolism in frontal cortical regions that subserve inhibitory control, including dorsolateral prefrontal, orbitofrontal, and anterior cingulate cortices (Michaelides et al., 2012; Tomasi and Volkow, 2013; Volkow and Baler, 2015; Volkow et al., 2008b). Similar change have been observed in individuals with alcohol use disorder (Volkow et al., 2007). Reduced striatal dopamine D_2 receptor availability also relates to increased negative urgency in pathological gamblers (Clark et al., 2012). Within-subject increases in negative urgency predict increased symptoms of BN (Anestis et al., 2007) and may similarly predict substance use.

The increased food cue reactivity seen in the amygdala, OFC, cingulate cortex, vmPFC and dlPFC, and anterior insula of people with compulsive eating may reflect adaptations within negative urgency circuits, and not (only) reward processing as is often interpreted (e.g., Schulte et al., 2016; Stice et al., 2015; Winter et al., 2017). YFAS scores correlate directly with milkshake picture-induced activation of the amygdala, medial OFC and anterior cingulate; individuals with categorically higher YFAS scores also showed greater dlPFC activation (Gearhardt et al., 2011). As compared to lean women, obese women showed greater activation of the amygdala, vmPFC and inhibitory frontal operculum (Higo et al., 2011) in response to pictures or taste of a palatable milkshake (Ng et al., 2011). They also showed increased amygdala, OFC, anterior cingulate, insula, and mPFC responses to pictures of palatable, high-calorie, but not less preferred, low-calorie foods (Stoeckel et al., 2008). Resting-state functional connectivity of the amygdala to the insula also is increased in obese patients (Lips et al., 2014; Wijngaarden et al., 2015). Graph theory analysis found reduced nodal-degree/efficiency in the amygdala, medial OFC, rostral anterior cingulate, and insula of obese subjects. Further, greater BMI correlated with decreased global efficiency (Eglob) and decreased nodal-degree/efficiency of the medial OFC (Meng et al., 2018). Structurally, obese patients had decreased gray matter densities in the OFC, inferior and superior frontal gyri, rostral anterior cingulate, insula and dmPFC. The reduced OFC gray matter/white matter ratios correlated with greater BMI and YFAS scores. Many cortical structural differences normalized after bariatric surgery, suggesting maintenance by overeating or metabolic factors (Zhang et al., 2016b).

2.2.7.2. Animal findings.: As alluded to earlier, animal models based on intermittent access to palatable food show adaptations in the amygdala, frontal cortex and insula (Blasio et al., 2014; Cottone et al., 2009a; Iemolo et al., 2013; Spierling et al., 2020). This plasticity may increase negative urgency and contribute to the risky eating-directed behaviors that develop in these models. For example, some rodents in these models exhibit palatable food-seeking and self-administration despite threat or contingent receipt of footshock punishment. They also rapidly emerge into unsheltered open spaces when palatable food is present and persistently (high progressive ratio [PR] breakpoints) and urgently (very short latencies and rapid eating) seek palatable food despite decreasing reinforcement (Johnson and Kenny, 2010; Moore et al., 2017; Oswald et al., 2011; Parylak et al., 2012; Parylak et al., 2011; Rossetti et al., 2014; Spierling et al., 2018; Teegarden and Bale, 2007). Supporting a functional role, optogenetic inhibition of a projection from the insula to the ventral striatum reduced the elevated PR breakpoints for palatable food of rats with punishment- and PR-resistant self-administration (Spierling et al., 2020). For future study is whether food-related increases in negative urgency and impulsivity also increase relapse and incidence of compulsive substance and alcohol use.

3. Shared vulnerability and sex differences.

3.1 Cross-vulnerability to alcohol and drug addiction.

3.1.1. Human findings.—Given the reviewed neurobiological and motivational effects of exposure to and abstinence from palatable food as well as palatable food's ability to moderate effects of substances of abuse, it is unsurprising that feeding status and metabolic consequences of palatable food have been explored as possible vulnerability factors for addiction. Indeed, adolescents with YFAS-defined food addiction symptoms are more likely also to have used alcohol, cannabis and cigarettes (Mies et al., 2017), and conversely, food addiction is more prevalent in men with heroin use disorder (Canan et al., 2017). These comorbidities may reflect transdiagnostic substrates for food and substance use disorders (Gold et al., 2015; Parylak et al., 2011; Zhang et al., 2011).

Drug treatment programs recognize that hunger, which occurs during abstinence or dieting from palatable food, is a cross-relapse risk factor for substance use, including smoking relapse (Leeman et al., 2010). Indeed, the H.A.L.T. mnemonic in 12-step addiction recovery programs recognizes the role of Hunger as a relapse trigger (Nowinski et al., 1999). Consequently, palatable food, especially sweets, are often provided at Alcoholic Anonymous meetings (Edge and Gold, 2011) and recommended to in the Big Book to keep handy to relieve relapse craving ("Many…have noticed a tendency to eat sweets and have found this practice beneficial; One of the many doctors… told us that the use of sweets was often helpful; occasionally… a vague craving arose which would be satisfied by candy"; Alcoholics Anonymous, 2001). Perhaps accordingly, rats withdrawn from high fat diet show increased alcohol intake, an effect that appears to relate to an imbalance in dopamine transmission in the mesolimbic pathway (Martins de Carvalho et al. 2019).

These effects of abstinence from palatable food may explain why some bariatric surgery patients subsequently show increases in addictive behaviors, including gambling, spending, exercise, sexuality, smoking, and alcohol, narcotic or psychostimulant use (Azam et al., 2018; Bak et al., 2016; Conason et al., 2013; Dutta et al., 2006; Steffen et al., 2015; Wendling and Wudyka, 2011). They also may account for why there is an inverse cross-sectional, but not lifetime, relationship of obesity (Warren and Gold, 2007) and BMI (Gearhardt et al., 2018) on the one hand with SUDs on the other. Significant inverse genetic correlations also have been reported between AUDIT-C scores for alcohol use, which identify at-risk drinkers (e.g., binge drinking), and BMI ($r_g = -0.350$, $p = 3.25 \times$ 10E-19) (Kranzler et al., 2019a, 2019b, 2019c).

The findings have led to the substance of abuse-food competition hypothesis (Gearhardt and Corbin, 2009; Cummings et al., 2017) whereby substances of abuse and food are proposed to compete within the same neurobiological substrate to elicit positive reinforcing and rewarding effects. Others have similarly, but conversely, proposed that the findings suggest a shared negative reinforcement substrate through which foods or substances of abuse can comfort relief craving (Zorrilla and Koob, 2019). In both models, food and substances of abuse would be expected to be misused successively (e.g., alternatively or as substitutes), rather than concurrently, consistent with the reviewed lifetime comorbidities seen between eating disorders or obesity on the one hand with SUD on the other.

Also consistent with shared vulnerability factors, human genome-wide association study (GWAS) data suggest shared genes in obesity and addiction risk (see Table 2) (Clarke et al., 2017; Kranzler et al., 2019; Schumann et al., 2016; Xu et al., 2015; Zhou et al., 2020). For example, many genes jointly implicated in problematic alcohol use and obesity phenotypes encode key molecules commonly studied in brain reward, stress and executive control circuitry, including genes for the dopamine D_2 receptor (***DRD2***; Lancaster et al., 2018; Jenkinson et al., 2000; Col Araz et al., 2012; Kvaløy et al, 2015); ankyrin repeat and kinase domain containing 1 (***ANKK1;*** Bauer 2014; Yamada et al., 2017); corticotropin-releasing hormone type 1 receptor (***CRHR1***; Curtis and UK10K Consortium 2015; Lu et al., 2015); brain-derived neurotrophic factor (***BDNF***; Rios et al., 2001; Akbarian et al., 2018); phosphodiesterase 4b (***PDE4B***; Zhang et al., 2009; Lee et al., 2011); and cell adhesion molecule 2 (***CADM2***; Morris et al., 2019). Future research should further determine how exposure to and abstinence from palatable food impact the expression of these genes as well as others that jointly associate with risk for eating-related disorders and addictive disorders, including BRCA1 associated protein (***BRAP***); proteasome 26S subunit, ATPase 3 (***PSMC3***); Spi-1 Proto-Oncogene (***SPI1***); keratinocyte associated protein 3 (***KRTCAP3***); solute carrier family 39 member 13 (***SLC39A13***); solute carrier family 39 member 8 (***SLC39A8***); fibronectin type III domain containing 4 (***FNDC4***); and transducin beta like 2 (***TBL2***) (Zhou et al., 2020).

3.1.2. Animal findings.—In addition to the aforementioned similarities shared by highly palatable foods and substances of abuse, preclinical studies also show that feeding condition (e.g., type and amount of food consumed) influences drug sensitivity. For example, food restriction (i.e., access to a restricted amount of food, such that weight loss is promoted) enhances sensitivity of rodents to drugs of abuse (Carroll et al., 1979; Branch et al., 2013; de la Garza et al., 1981; Deroche et al., 1993; Stamp et al., 2008; Carroll and Meisch, 1984; Carroll 1985; Shalev et al., 2000; 2003) and other drugs that act on dopamine systems (Carr et al., 2003; Collins et al., 2008).

Further, rats eating a high fat or high sugar diet are also more sensitive to some of the behavioral effects of drugs of abuse, including cocaine (Baladi et al., 2012; Blanco-Gandia et a., 2017a, 2017b, 2018; Clasen et al., 2020; Gosnell 2004; Serafine et al., 2015a; Serafine et al., 2015b; Puhl et al., 2011; though see also Wellman et al., 2007), amphetamine (Avena and Hoebel, 2003; Robinson et al., 2015; Fordahl et al., 2016; though see also Davis et al., 2008), methamphetamine (McGuire et al., 2011; Ramos et al., 2020), alcohol (Avena et al., 2004) and nicotine (Richardson et al., 2014, 2020). In some reports, the term "cross-sensitization" is used to describe that a prior history with highly palatable foods can increase sensitivity to the behavioral effects of drug of abuse upon subsequent exposure (Avena and Hoebel, 2003; Avena et al., 2004; see Avena et al., 2007 for a review) and in some cases, vice versa (Avena and Hoebel, 2003; Barson et al., 2009; see also Karatayev et al., 2009). Although many reports have demonstrated that eating highly palatable foods can enhance sensitivity to drug-induced locomotion or sensitization (Avena and Hoebel, 2003; Baladi et al., 2012; Serafine et al., 2015a; Serafine et al., 2015b; McGuire et al., 2011; Ramos et al., 2020) others have shown increased cocaine self-administration (Clasen et al., 2020; Puhl et al., 2011; though see also Wellman et al., 2007) suggesting that a history of eating highly palatable foods might enhance vulnerability to addiction, at least in animal models. In addition to drugs of abuse, feeding condition has also been studied in the context of other dopaminergic drugs, including agonists like quinpirole and antagonists like raclopride. In general most of these assessments have demonstrated that high fat or high sugar diets can result in an increased sensitivity of rats and mice to drugs that act directly on dopamine receptors (Baladi and France, 2010; Baladi et al., 2012; Foley et al., 2006; Serafine et al., 2015b; but see Geiger et al., 2009; van de Giessen et al., 2014).

Consistent with the notion of shared antecedent vulnerability factors, rats that are vulnerable to palatable diet-induced obesity also show drug use-relevant altered mesolimbic dopamine function and susceptibility to appetitive cues even before they have received obesogenic access to palatable food. This is evident as increased locomotor (Vollbrecht et al., 2015; Oginsky et al., 2016; Vollbrecht et al., 2016) and neurochemical (Vollbrecht et al., 2018) responses to cocaine; increased cue-induced food motivation and seeking behavior (Alonso-Caraballo and Ferrario, 2019; Derman and Ferrario, 2020) in relation to Acb core calcium permeable-AMPARs (Derman and Ferrario, 2018); increased excitability of Acb core medium spiny neurons (Oginsky et al., 2016; Alonso-Caraballo and Ferrario, 2019) in relation to a lower fast transient potassium current (I_A) (Oginsky and Ferrario, 2019); and increased sensitivity to the D_2/D_3 receptor agonist quinpirole (Vollbrecht et al., 2016).

3.2. Sex differences.

3.2.1. Human findings.—Epidemiological evidence suggests that the mechanisms that motivate food and drug intake vary in females versus males. Indeed, females are generally more susceptible to eating disorders; however, sex differences in SUD can vary depending on the drug that is being considered. Although more females meet the diagnostic criteria for BED than males, males with a confirmed BED diagnosis are more likely also to have a concurrent diagnosis of SUD than are females (Schrieber et al., 2013). Similarly, lifetime prevalence for SUD among patients diagnosed with BED is greater among males as compared to females (Grilo et al., 2009). However, greater use of certain types of drugs among female patients with BED (as compared to males) including cocaine and alcohol have been described (Merikangas and McClair, 2012).

Obesity also is more prevalent among women than men (Chooi et al., 2018; though see also Kim and Shin, 2020) and when mental health comorbidities are taken into consideration, females diagnosed with obesity appear to experience more depression (Luppino et al., 2010; Muhlig et al., 2016). However, sex difference data regarding drug and alcohol use among obese individuals have been more mixed (Yeomans, 2010; Traversy and Chaput, 2015; Barry and Petry, 2009). For example, light-to-moderate regular alcohol consumption was not associated with obesity among women; however, heavy or binge drinking was more strongly associated with obesity and weight gain regardless of sex (Trioneri et al., 2017). Fewer studies have evaluated sex differences in SUD vis-à-vis obesity, and none appear to show substantial sex differences (Barry and Petry, 2009; Mather et al., 2009; Simon et al., 2006; though see also Pickering et al., 2011).

3.2.2. Animal findings.—Prior authors have suggested that females may be more susceptible to eating and/or drug addiction versus males, due to greater reinforcing effects and/or stronger withdrawal responses that motivate continued use and/or relapse behavior. A study examining sex differences in the reinforcing efficacy of food and compulsive eating revealed that female rats display higher levels of operant responding for palatable food (Spierling et al., 2018). Further, the latter report revealed that high-responding females with intermittent access to food had elevated respiratory exchange ratios, indicating a fat-sparing phenotype that was absent in males.

Few pre-clinical studies have assessed sex differences with regard to the impact of feeding condition or metabolic status on the behavioral effects of drugs of abuse (Collins et al., 2015; Ibias et al., 2018; Ramos et al., 2019). One report examining sex differences in the behavioral effects of nicotine, revealed that place preference produced by nicotine is enhanced in hypoinsulinemic male, but not female, rats (Ibias et al., 2018). This finding suggests that mechanisms by which diabetes enhances the reinforcing effects of nicotine are sex-dependent. Prior rodent studies also have revealed diet-induced changes in dopamine systems that are sex-dependent. For example, eating a high fat diet increased sensitivity of male rats to yawning induced by the dopamine D_2/D_3 receptor agonist, quinpirole (Ramos et al., 2019). However, other effects of this drug (hypothermia) remained unchanged. In contrast, female rats yawned significantly less than male rats, and eating a high fat diet had no effect in female rats. Eating a high fat diet also reduced pAkt (aka phosphorylated protein kinase levels in male, but not female, rats. Subsequent work revealed that eating a high fat diet enhanced the stimulant effects of a dopamine D_1 receptor agonist in female, but not male rats (Ramos et al., 2019; see also Speed et al., 2011). This suggests that a high fat diet enhances sensitivity to dopamine D_1 receptor agonist only among females. Together, these data demonstrate the importance of studying drug sensitivity in both male and female subjects. Importantly, this work has also revealed that certain behavioral measures in rats may be limited to a particular sex. For example, behavioral assessments of dopamine receptor sensitivity based on yawning behavior cannot be tested in female rats, as females do not display robust quinpirole-induced yawning, an androgen-mediated behavior (Berendsen and Nickolson, 1981). Moreover, chronic high fat diet consumption enhances quinpirole-induced yawning in male, but not female, rats making this screen for dopamine sensitivity useful in males only.

Prior work also has found sex differences in the efficacy of adiposity hormones to control food intake. For example, the brains of female rodents are more sensitive to the catabolic actions of low doses of leptin, whereas the brains of males are more sensitive to the catabolic action of low doses of insulin (Clegg et al., 2003). Also, female rats are less sensitive to insulin actions in the brain as compared to males (Clegg et al., 2003). The latter study also revealed that effect of insulin on food intake is observed in male, but not female rats. Future studies are needed to characterize the parameters of insulin resistance and changes in drug intake in both female and male rats. This will be important towards understanding the complex interplay of insulin, ovarian hormone systems, and drug abuse in females versus males. This pre-clinical work has important implications for understanding sex differences in the propensity for metabolic syndrome disorders, such as type-2 diabetes, cardiovascular disease, and certain cancers, in addition to SUD.

4. Treatment Implications

Because highly palatable foods and drugs of abuse impact the same brain reward and stress pathways, recent research has sought to evaluate whether some treatments might be beneficial for both food-related conditions (e.g., BED, obesity, diabetes) and SUD. In this section and summarized in Table 3, we explore the literature on these medications, including current and previously approved medications for obesity (lorcaserin, buproprion/naltrexone, rimonabant; phentermine and topiramate) and BED (lisdexamfetamine dimesylate) and selected compounds in clinical trials.

4.1. Pharmacological interventions.

In 2012, the FDA approved a serotonin (5-HT)$_{2C}$ receptor agonist for the treatment of obesity, lorcaserin, which reduces feeding in animals and humans (Thomsen et al., 2008; Perez Diaz et al., 2019). In preclinical studies, lorcaserin also reduced drug intake in self-administration procedures (Anastasio et al., 2020; Collins et al., 2016; Collins and France, 2018; Gannon et al., 2018; Harvey-Lewis et al., 2016; Neelakatan et al., 2018; Perez Diaz et al., 2019; see also Howell and Cunningham, 2015; though see also Banks and Negus, 2017), attenuated reinstatement of responding for drug (Gerak et al., 2016; Gerak et al., 2019; for relevant reviews see Collins et al., 2018 and Higgins et al., 2020), and blocked sensitization and withdrawal (Zhang et al., 2016a). Although these promising preclinical data prompted experiments in humans (Pirtle et al., 2019) as well as clinical trials (cocaine: https://clinicaltrials.gov/ct2/show/NCT03007394, accessed October 14, 2020; nicotine: https://clinicaltrials.gov/ct2/show/NCT02044874, accessed Octoboer 14, 2020) to explore the potential of lorcaserin for the treatment of SUD, these trails were largely unsuccessful. Further, lorcaserin, previously FDA-approved for the treatment of obesity https://

www.accessdata.fda.gov/drugsatfda_docs/nda/2016/208524Orig1s000TOC.cfm; accessed October 14, 2020) was recently removed from the market due to risks related to cancer (https://www.fda.gov/drugs/drug-safety-and-availability/fda-requests-withdrawal-weight-loss-drug-belviq-belviq-xr-lorcaserin-market, accessed October 14, 2020; https://www.fda.gov/drugs/drug-safety-and-availability/safety-clinical-trial-shows-possible-increased-risk-cancer-weight-loss-medicine-belviq-belviq-xr, accessed October 14, 2020).

Besides lorcaserin, a serotonergic drug, several other anti-obesity medications also have shown promise for the treatment of SUD. For example, rimonabant a CB_1 receptor inverse agonist was approved in the UK for the treatment of obesity since it suppresses feeding, and showed promise in animal models for other conditions, including SUD (Galaj and Xi, 2019). Unfortunately, rimonabant was associated with high rates of depression, anxiety (Blasio et al., 2013) and suicidal ideation, leading to its removal from the European market in 2008 (Sam et al., 2011). Current, related drug development efforts exploring CB_1 receptors as potential therapeutic mechanisms for both obesity and SUD are ongoing (Nguyen et al., 2019).

A combination of buproprion and naltrexone is currently FDA-approved for the treatment of obesity (Sherman et al., 2016). Buproprion is a dual dopamine and norepinephrine transporter inhibitor, while naltrexone is an opioid receptor antagonist, and this combination has been shown to reduce feeding in animals and humans (Apovian, 2016; Wang et al., 2014; Sinnayah et al., 2007). Although the combination of naltrexone with buproprion is not currently on-label approved for SUD, naltrexone has a long history as a treatment for opioid use disorder (Martin et al., 1973) and AUD (Anton 2008), and bupropion is FDA-approved for the treatment of depression. Bupropion formulated with naltrexone has also been found to reduce the severity of binge eating and depressive symptoms in open-label trials of obese patients with suspected BED (Guerdjikova et al., 2017; Halseth et al., 2018), and clinical trials are ongoing (NCT03045341, NCT03047005, NCT03063606).

Tesofensine, like buproprion, also has monoamine reuptake inhibition as a main mechanism of action (Astrup et al., 2008a; Astrup et al., 2008b; Nielsen et al., 2009; Sjodin et al., 2010; Appel et al., 2014; Axel et al., 2010; Hansen et al., 2013; van de Giessen et al., 2012), and is currently being investigated for the treatment of obesity (Bonamichi et al., 2017); however, this drug might have cardiac effects that could be problematic (George et al., 2014). Another monoaminergic drug, lisdexamfetamine dimesylate, which is FDA approved for the treatment of BED (Citrome, 2015; Gasior et al., 2017; Hudson et al., 2017; McElroy, Hudson, et al., 2016; McElroy et al., 2017; McElroy et al., 2015) and in Phase 2 trials for BN (NCT03397446; Keshen and Helson, 2017) is a prodrug of *d*-amphetamine, and therefore also inhibits reuptake of monoamines (Guerdjikova et al., 2016). Lisdexamfetamine elicits sustained increases in striatal dopamine efflux (Rowley et al., 2012) that may remediate within-system deficits in mesolimbic function. Lisdexamfetamine elicits mild positive affective responses and appears to have less abuse potential than other stimulant drugs (Jasinski and Krishnan, 2009; Kaland and Klein-Schwartz, 2015). It has been (NCT00573534, NCT02034201; NCT01490216;

NCT00958282) and continues to be explored as a possible substitution treatment for psychostimulant use disorders (Ezard et al., 2018; Levy, 2016).

A combination of phentermine plus topiramate was FDA approved in 2012 (https://www.fda.gov/consumers/consumer-updates/medications-target-long-term-weight-control; accessed October 14, 2020) for the treatment of obesity (in combination with a reduced calorie diet and exercise; https://www.accessdata.fda.gov/drugsatfda_docs/nda/2012/022580orig1s000_qsymia_toc.cfm; accessed October 14, 2020). Phentermine hydrochloride is also FDA approved in a low dose formulation for obesity (since 2016; https://www.healio.com/news/endocrinology/20161115/fda-approves-lowdose-phentermine-for-obesity#:~:text=The%20FDA%20has%20approved%20phentermine,announced%20in%20a%20press%20release; accessed October 14, 2020). Phentermine has a long and somewhat controversial history as part of Fen-Phen, an anti-obesity medication that included the combination of phentermine along with fenfluramine (a serotonin releaser) which was FDA approved in 1959 (Coulter et al., 2018) but was removed from the market in 1997 due to toxicity. Phentermine is a stimulant and an agonist at the TAAR1 receptor site, stimulating release of epinephrine and norepinephrine (Nguyen and Clements, 2017; Coulter et al., 2018). Phentermine suppresses appetite even when taken intermittently (Munro et al., 1968). In animal models, phentermine (typically in combination with other drugs) has been shown to decrease cocaine self-administration (Glowa et al., 1997; Glatz et al., 2002; Wojnicki et al., 1999; though see also Stafford et al., 2001) and ethanol intake (Yu et al., 1997; see also Halladay et al., 2006). Topiramate (prescribed in combination with phentermine for obesity) was originally FDA approved as an antiepileptic drug. The mechanism of action of topiramate includes facilitating GABA transmission, and inhibition of glutamate transmission via AMPA/kainate glutamate receptors (Siniscalchi et al., 2015). There are several reports demonstrating the potential of topiramate as a SUD treatment (Kampman et al., 2013; Kranzler et al., 2014; Johnson et al., 2013 see also Siniscalchi et al., 2015) as well as a recently completed clinical trial investigating topiramate-phentermine combinations for cocaine use disorder (https://clinicaltrials.gov/ct2/show/NCT02239913; accessed October 14, 2020).

Consistent with the abovementioned findings of between-system neuroadaptations related to CRF systems, a double-blind placebo-controlled trial in individuals with restrained eating found that the selective CRF_1 receptor antagonist pexacerfont reduced food craving and stress-induced eating in a laboratory setting (Epstein et al., 2016). Unfortunately, this study was halted by the NIH IRB due to reasons unrelated to adverse drug effects or efficacy (reinterpretation of the Common Rule for human subject protection under HHS, 45 CFR 46A). As such, it only had ~30% power to detect *a priori* effects of interest. Still, pexacerfont showed modest effect sizes to reduce stress-induced eating in a laboratory setting and craving for sweet foods. In bogus taste tests, pexacerfont reduced palatable food intake across all imagery scripts. Finally, YFAS food addiction symptoms were lower in subjects that received pexacerfont. A caveat to this last finding is that the reduction of YFAS scores within 24 hours might be faster than pexacerfont's predicted time course of CNS action. Overall, the results provide rationale for well-powered trials of CRF_1 receptor antagonists to reduce compulsive eating (Epstein et al., 2016; Spierling and Zorrilla, 2017).

Negative emotional and sleep disturbance symptoms of alcohol withdrawal involve a hyperglutamatergic state for which acamprosate, a neuromodulator of glutamatergic tone, has been suggested (Higuchi and Japanese Acamprosate Study, 2015; Mason and Heyser, 2010; Mason and Lehert, 2012; Perney et al., 2012). Given reviewed withdrawal-like findings, anti-glutamatergic treatments also have been explored for binge eating. A small, placebo-controlled open-label study of outpatients with BED found that acamprosate yielded improvements in binge day frequency and measures of compulsiveness of binge eating and food craving in endpoint analysis; these effects were not significant in longitudinal analysis, however (McElroy et al., 2011). Memantine, a low-affinity, voltage-dependent, NMDA receptor antagonist also has shown evidence of reducing binge-type eating in open-label trials (Brennan et al., 2008; Hermanussen and Tresguerres, 2005) and animal models (Popik et al., 2011; Smith et al., 2015).

Many promising psychotropics, including lisdexamfetamine, tesofensine, and dasotraline (NCT03107026, NCT02684279; Heal et al., 2016; Hopkins et al., 2016; Koblan et al., 2015; McElroy, Mitchell, et al., 2016b; Vickers et al., 2017) may improve outcomes not only by targeting hypohedonia and negative affect, but also by increasing inhibitory control during distress (Yarnell et al., 2013).

4.2. Metabolic interventions.

Although diabetes and insulin function are not a main focus of this review, treatments that are focused on improving insulin status might also be effective for treating SUD, and are therefore relevant to describe. For example, GLP-1 receptor agonists, which have been primarily used as treatments for Type 2 diabetes (Drucker et al., 2017), might also be beneficial for the treatment for SUD (Brunchmann et al., 2019). GLP-1 activity is important within the mesolimbic dopamine system (Alhadeff et al., 2012; Cork et al., 2015; Heppner et al., 2015; Merchenthaler et al., 1999) and GLP-1 receptor agonists have been found to decrease ethanol (Abtahi et al., 2018; Thomsen et al., 2017; Sorensen et al., 2016; Sirohi et al., 2016) and drug self-administration in animal models (Hernandez et al., 2018; Hernandez et al., 2019; Sorensen et al., 2015; Schmidt et al., 2016; Tuesta et al., 2017). At least one investigation exploring the potential of GLP-1 receptor agonists in humans with AUD is currently ongoing (Antonsen et al., 2018; NCT03232112).

With regard to insulin, recent work suggests that insulin replacement normalizes the strong reinforcing effects of nicotine and dopamine deficits observed in diabetic rats (Cruz et al., 2020). These findings have led to the suggestion that glucose normalization is an important aspect to consider when considering drug cessation approaches in persons with diabetes (see O'Dell and Nazarian, 2016 for a review). The literature has not reached a consensus regarding the potential efficacy of diabetes medications for treating SUD; however, there are emerging concerns with the potential abuse liability of diabetic medications, such as metformin that appears to have abuse liability in persons suffering from eating disorders (Geer et al., 2019). Also, the dopamine receptor agonist (bromocriptine) is a drug that has been used to treat insulin resistance in persons with Type 2 diabetes; however, the literature does not support the use of dopamine receptor agonists, such as bromocriptine for treating cocaine misuse (Minozzi et al., 2015). Indeed, there is a need for research to better understand the efficacy of pharmacotherapeutic agents that may help reduce the vulnerability to drug use produced by diabetes. For example, the FDA approval of Cycloset, a dopamine receptor agonist, for the treatment of insulin resistance attests to the importance of understanding the role of dopamine in treating co-morbid conditions such as diabetes and drug use. A recent report illustrated that glucophage (i.e., Metformin) reduces nicotine withdrawal signs in mice (Brynildsen et al., 2018; see also Smith and George, 2020 for a review). Given that glucophage improves metabolic function, it is possible that this drug may also have the benefit of reducing withdrawal states that promote nicotine use and relapse behavior. Future studies are needed to address whether insulin regulation is a key aspect to improving substance use outcomes in diabetic persons with co-morbid drug use.

4.3. Non-pharmacologic interventions.

Several non-pharmacologic approaches that target negative emotions show promise to mitigate the impact of palatable food on eating behavior. Cognitive therapy to reduce emotional eating in response to negative emotions promoted weight loss and reduced relapse to obesity (Jacob et al., 2018; Werrij et al., 2009). Others with evidence of promoting healthy eating behaviors and improving weight management by improving mood include exercise, acupuncture, mindfulness, emotion reappraisal, and the relaxation response (Dunn et al., 2018; Katterman et al., 2014; Laraia et al., 2018; Masih et al., 2017; Peckmezian and Hay, 2017; Yeh et al., 2017). Finally, cognitive-behavior therapy, dialectical behavior therapy and integrated cognitive-affective therapy may improve eating behavior by increasing self-regulation as well (Cancian et al., 2017; Chen et al., 2008; Murray et al., 2015; Wallace et al., 2014; Wonderlich et al., 2014).

5. Conclusion

In this review, we have described the overlapping neuroscience shared between highly palatable foods and drugs of abuse, which demonstrates converging vulnerability factors that may predispose an individual to compulsive food or drug use. Specifically, we have described the similar impact of both highly palatable foods and drugs of abuse on metabolic and neural systems; highlighted commonalities in implicated genes and behavior, focusing on reinforcement, negative affect, negative urgency and impulse control; and summarized how food itself can impact sensitivity to drugs and potentially increase individual vulnerability for SUD. Given this overlap, we explored how therapeutic interventions that have been successful for disorders related to food might be effective for the treatment of SUD and vice versa. Taken together, this review highlights the variety of overlapping factors that may increase individual vulnerability to compulsive food or drug use and demonstrate a critical need for continued investigation on the mechanism(s) that underlie their singular and shared disease susceptibility.

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REFERENCES

Adjibade M, Lemogne C, Julia C, Hercberg S, Galan P, Assmann KE, Kesse-Guyot E. Prospective association between adherence to dietary recommendations and incident depressive symptoms in the French NutriNet-Santé cohort. Br J Nutr2018;120(3):290–300. doi: 10.1017/S0007114518000910. [PubMed: 29789039]

Abtahi S, Howell E, Currie PJ. Accumbal ghrelin and glucagon-like peptide 1 signaling in alcohol reward in female rats. Neuroreport2018815;29(12):1046–1053. doi: 10.1097/WNR.0000000000001071. [PubMed: 29927808]

Agras WS, Telch CF. Effects of caloric deprivation and negative affect on binge eating in obese binge eating disordered women. Behav Ther1998;29:491–503.

Aguiar-Nemer AS, Toffolo MC, da Silva CJ, Laranjeira R, Silva-Fonseca VA. Leptin influence in craving and relapse of alcoholics and smokers. J Clin Med Res2013;5(3):164–7. doi: 10.4021/jocmr1159w. [PubMed: 23671541]

Akbaraly TN, Brunner EJ, Ferrie JE, Marmot MG, Kivimaki M, Singh-Manoux A. Dietary pattern and depressive symptoms in middle age. Br J Psychiatry2009;195(5):408–13. doi: 10.1192/bjp.bp.108.058925. [PubMed: 19880930]

Akbarian SA, Salehi-Abargouei A, Pourmasoumi M, Kelishadi R, Nikpour P, Heidari-Beni M. Association of brain-derived neurotrophic factor gene polymorphisms with body mass index: A systematic review and meta-analysis. Adv Med Sci2018;63(1):43–56. doi: 10.1016/j.advms.2017.07.002. [PubMed: 28818748]

al'Absi M, Lemieux A, Nakajima M. Peptide YY and ghrelin predict craving and risk for relapse in abstinent smokers. Psychoneuroendocrinology201411;49:253–9. doi: 10.1016/j.psyneuen.2014.07.018. [PubMed: 25127083]

Alhadeff AL, Rupprecht LE, Hayes MR. GLP-1 neurons in the nucleus of the solitary tract project directly to the ventral tegmental area and nucleus accumbens to control for food intake. Endocrinology2012 Feb;153(2):647–58. doi: 10.1210/en.2011-1443. Epub 2011 Nov 29. [PubMed: 22128031]

Allas S, Caixàs A, Poitou C, Coupaye M, Thuilleaux D, Lorenzini F, Diene G, Crinò A, Illouz F, Grugni G, Potvin D, Bocchini S, Delale T, Abribat T, Tauber M. AZP-531, an unacylated ghrelin analog, improves food-related behavior in patients with Prader-Willi syndrome: A randomized placebo-controlled trial. PLoS One2018; 13(1):e0190849. doi: 10.1371/journal.pone.0190849. [PubMed: 29320575]

Allison S, Timmerman GM. Anatomy of a binge: food environment and characteristics of nonpurge binge episodes. Eat Behav2007;8(1):31–8. doi: 10.1016/j.eatbeh.2005.01.004. [PubMed: 17174849]

Alonso-Caraballo Y, Ferrario CR. Effects of the estrous cycle and ovarian hormones on cue-triggered motivation and intrinsic excitability of medium spiny neurons in the Nucleus Accumbens core of female rats. Horm Behav201911;116:104583. doi: 10.1016/j.yhbeh.2019.104583. Epub2019 Sep 10. [PubMed: 31454509]

Alsiö J, Olszewski PK, Norbäck AH, Gunnarsson ZE, Levine AS, Pickering C, Schiöth HB. Dopamine D1 receptor gene expression decreases in the nucleus accumbens upon long-term exposure to palatable food and differs depending on diet-induced obesity phenotype in rats. Neuroscience2010;171(3):779–87. doi: 10.1016/j.neuroscience.2010.09.046. [PubMed: 20875839]

American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders, 5th edition. American Psychiatric Publishing, Washington DC, 2013.

Anastasio NC, Sholler DJ, Fox RG, Stutz SJ, Merritt CR, Bjork JM, Moeller FG, Cunningham KA. Suppression of cocaine relapse-like behaviors upon pimavanserin and lorcaserin co-administration. Neuropharmacology2020;168:108009. doi: 10.1016/j.neuropharm.2020.108009. [PubMed: 32145488]

Anestis MD, Selby EA, Joiner TE. The role of urgency in maladaptive behaviors. Behav Res Ther2007;45(12):3018–29. doi: 10.1016/j.brat.2007.08.012. [PubMed: 17923108]

Antonsen KK, Klausen MK, Brunchmann AS, le Dous N, Jensen ME, Miskowiak KW, Fisher PM, Thomsen GK, Rindom H, Fahmy TP, Vollstaedt-Klein S, Benveniste H, Volkow ND, Becker U, Ekstrøm C, Knudsen GM, Vilsbøll T, Fink-Jensen A. Does glucagon-like peptide-1 (GLP-1) receptor agonist stimulation reduce alcohol intake in patients with alcohol dependence: study protocol of a randomised, double-blinded, placebo-controlled clinical trial. BMJ Open2018716;8(7):e019562. doi: 10.1136/bmjopen-2017-019562.

Aliasghari F, Nazm SA, Yasari S, Mahdavi R, Bonyadi M. Associations of the ANKK1 and DRD2 gene polymorphisms with overweight, obesity and hedonic hunger among women from Northwest of Iran. Eat Weight Disord202024. Doi:10.1007/s40519-020-00851-5.

Alcoholics Anonymous. Alcoholics Anonymous: The Story of How Many Thousands of Men and Women Have Recovered from Alcoholism, 4th ed. New York: Alcoholics Anonymous World Services, 2001.

Amsel APrécis of Frustration Theory: An Analysis of Dispositional Learning and Memory. Psychon Bull Rev19949;1(3):280–96. doi: 10.3758/BF03213968. [PubMed: 24203511]

Amsel A, The role of frustrative nonreward in noncontinuous reward situations. Psychol Bull19583;55(2):102–19. doi: 10.1037/h0043125. [PubMed: 13527595]

Anton RF. Naltrexone for the management of alcohol dependence. N Engl J Med2008;359(7):715–21. doi: 10.1056/NEJMct0801733. [PubMed: 18703474]

Aoyama K, Barnes J, Grimm JW. Incubation of saccharin craving and within-session changes in responding for a cue previously associated with saccharin. Appetite2014;72:114–22. doi: 10.1016/j.appet.2013.10.003. [PubMed: 24161592]

Apovian CM. Naltrexone/bupropion for the treatment of obesity and obesity with Type 2 diabetes. Future Cardiol2016;12(2):129–38. doi: 10.2217/fca.15.79. [PubMed: 26679384]

Appel L, Bergström M, Buus Lassen J, Långström B. Tesofensine, a novel triple monoamine reuptake inhibitor with anti-obesity effects: dopamine transporter occupancy as measured by PET. Eur Neuropsychopharmacol2014;24(2):251–61. doi: 10.1016/j.euroneuro.2013.10.007. [PubMed: 24239329]

Astrup A, Madsbad S, Breum L, Jensen TJ, Kroustrup JP, Larsen TM. Effect of tesofensine on bodyweight loss, body composition, and quality of life in obese patients: a randomised, double-blind, placebo-controlled trial. Lancet2008a;372(9653):1906–1913. doi: 10.1016/S0140-6736(08)61525-1. [PubMed: 18950853]

Astrup A, Meier DH, Mikkelsen BO, Villumsen JS, Larsen TM. Weight loss produced by tesofensine in patients with Parkinson's or Alzheimer's disease. Obesity2008b;16(6):1363–9. doi: 10.1038/oby.2008.56. [PubMed: 18356831]

Avena NM, Carrillo CA, Needham L, Leibowitz SF, Hoebel BG. Sugar-dependent rats show enhanced intake of unsweetened ethanol. Alcohol2004;34(2–3):203–9. doi: 10.1016/j.alcohol.2004.09.006. [PubMed: 15902914]

Avena NM, Carrillo CA, Needham L, Leibowitz SF, Hoebel BG. Sugar-dependent rats show enhanced intake of unsweetened ethanol. Alcohol2004;34(2–3):203–9. doi: 10.1016/j.alcohol.2004.09.006. [PubMed: 15902914]

Avena NM, Gold MS. Variety and hyperpalatability: are they promoting addictive overeating?Am J Clin Nutr2011;94(2):367–8. doi: 10.3945/ajcn.111.020164. [PubMed: 21715513]

Avena NM, Hoebel BG. A diet promoting sugar dependency causes behavioral cross-sensitization to a low dose of amphetamine. Neuroscience2003;122(1):17–20. doi: 10.1016/s0306-4522(03)00502-5. [PubMed: 14596845]

Avena NM, Rada P, Hoebel BG. Evidence for sugar addiction: behavioral and neurochemical effects of intermittent, excessive sugar intake. Neurosci Biobehav Rev2008;32(1):20–39. doi: 10.1016/j.neubiorev.2007.04.019. [PubMed: 17617461]

Avena NM, Rada P, Hoebel BG. Evidence for sugar addiction: behavioral and neurochemical effects of intermittent, excessive sugar intake. Neurosci Biobehav Rev2008;32(1):20–39. doi: 10.1016/j.neubiorev.2007.04.019. [PubMed: 17617461]

Axel AM, Mikkelsen JD, Hansen HH. Tesofensine, a novel triple monoamine reuptake inhibitor, induces appetite suppression by indirect stimulation of alpha1 adrenoceptor and dopamine D1 receptor pathways in the diet-induced obese rat. Neuropsychopharmacology2010;35(7):1464–76. doi: 10.1038/npp.2010.16. [PubMed: 20200509]

Ayaz A, Nergiz-Unal R, Dedebayraktar D, Akyol A, Pekcan AG, Besler HT, Buyuktuncer Z. How does food addiction influence dietary intake profile?PLoS One2018;13(4):e0195541. doi: 10.1371/journal.pone.0195541. [PubMed: 29677203]

Azam H, Shahrestani S, Phan K. Alcohol use disorders before and after bariatric surgery: a systematic review and meta-analysis. Ann Transl Med2018;6(8):148. doi: 10.21037/atm.2018.03.16. [PubMed: 29862237]

Bach P, Bumb JM, Schuster R, Vollstädt-Klein S, Reinhard I, Rietschel M, Witt SH, Wiedemann K, Kiefer F, Koopmann A. Effects of leptin and ghrelin on neural cue-reactivity in alcohol addiction: Two streams merge to one river?Psychoneuroendocrinology2019;100:1–9. doi: 10.1016/j.psyneuen.2018.09.026. [PubMed: 30268001]

Bach P, Koopmann A, Kiefer F. The Impact of Appetite-Regulating Neuropeptide Leptin on Alcohol Use, Alcohol Craving and Addictive Behavior: A Systematic Review of Preclinical and Clinical Data. Alcohol Alcohol2020, in press. doi: 10.1093/alcalc/agaa044.

Bak M, Seibold-Simpson SM, Darling R. The potential for cross-addiction in post-bariatric surgery patients: Considerations for primary care nurse practitioners. J Am Assoc Nurse Pract2016;28(12):675–682. doi: 10.1002/2327-6924.12390. [PubMed: 27400415]

Baladi MG, France CP. Eating high-fat chow increases the sensitivity of rats to quinpirole-induced discriminative stimulus effects and yawning. Behav Pharmacol2010;21(7):615–20. doi: 10.1097/FBP.0b013e32833e7e5a. [PubMed: 20729718]

Baladi MG, Koek W, Aumann M, Velasco F, France CP. Eating high fat chow enhances the locomotor-stimulating effects of cocaine in adolescent and adult female rats. Psychopharmacology2012;222(3):447–57. doi: 10.1007/s00213-012-2663-7. [PubMed: 22418731]

Banks ML, Negus SS. Repeated 7-Day Treatment with the 5-HT2C Agonist Lorcaserin or the 5-HT2A Antagonist Pimavanserin Alone or in Combination Fails to Reduce Cocaine vs Food Choice in Male Rhesus Monkeys. Neuropsychopharmacology2017;42(5):1082–1092. doi: 10.1038/npp.2016.259. [PubMed: 27857126]

Barson JR, Karatayev O, Chang GQ, Johnson DF, Bocarsly ME, Hoebel BG, Leibowitz SF. Positive relationship between dietary fat, ethanol intake, triglycerides, and hypothalamic peptides: counteraction by lipid-lowering drugs. Alcohol2009;43(6):433–41. doi: 10.1016/j.alcohol.2009.07.003. [PubMed: 19801273]

Barry D, Petry NM. Associations between body mass index and substance use disorders differ by gender: results from the National Epidemiologic Survey on Alcohol and Related Conditions. Addict Behav2009;34(1):51–60. doi:10.1016/j.addbeh.2008.08.008. [PubMed: 18819756]

Baskin R, Hill B, Jacka FN, O'Neil A, Skouteris H. Antenatal dietary patterns and depressive symptoms during pregnancy and early post-partum. Matern Child Nutr2017;13(1):e12218. doi: 10.1111/mcn.12218.

Basso AM, Spina M, Rivier J, Vale W, Koob GF. Corticotropin-releasing factor antagonist attenuates the "anxiogenic-like" effect in the defensive burying paradigm but not in the elevated plus-maze following chronic cocaine in rats. Psychopharmacology1999;145(1):21–30. doi: 10.1007/s002130051028. [PubMed: 10445369]

Bauer LO. Who gains? Genetic and neurophysiological correlates of BMI gain upon college entry in women. Appetite2014;82:160–5. doi: 10.1016/j.appet.2014.07.007. [PubMed: 25049133]

Becker DF, Grilo CM. Comorbidity of mood and substance use disorders in patients with binge-eating disorder: Associations with personality disorder and eating disorder pathology. J Psychosom Res2015;79(2):159–164. doi:10.1016/j.jpsychores.2015.01.016. [PubMed: 25700727]

Bello NT, Guarda AS, Terrillion CE, Redgrave GW, Coughlin JW, Moran TH. Repeated binge access to a palatable food alters feeding behavior, hormone profile, and hindbrain c-Fos responses to a test meal in adult male rats. Am J Physiol Regul Integr Comp Physiol2009;297(3):R622–31. doi: 10.1152/ajpregu.00087.2009. [PubMed: 19535681]

Bello NT, Hajnal A. Dopamine and binge eating behaviors. Pharmacol Biochem Behav2010;97(1):25–33. doi: 10.1016/j.pbb.2010.04.016. [PubMed: 20417658]

Bello NT, Lucas LR, Hajnal A. Repeated sucrose access influences dopamine D2 receptor density in the striatum. Neuroreport200227;13(12):1575–8. doi: 10.1097/00001756-200208270-00017. [PubMed: 12218708]

Bello NT, Sweigart KL, Lakoski JM, Norgren R, Hajnal A. Restricted feeding with scheduled sucrose access results in an upregulation of the rat dopamine transporter. Am J Physiol Regul Integr Comp Physiol2003;284(5):R1260–8. doi: 10.1152/ajpregu.00716.2002. [PubMed: 12521926]

Benton D, Owens D. Is raised blood glucose associated with the relief of tension?J Psychosom Res1993;37(7):723–35. doi: 10.1016/0022-3999(93)90101-k. [PubMed: 8229903]

Berendsen HH, Nickolson VJ. Androgenic influences on apomorphine-induced yawning in rats. Behav Neural Biol1981;33(1):123–8. doi: 10.1016/s0163-1047(81)92306-2. [PubMed: 7325932]

Berenson AB, Laz TH, Pohlmeier AM, Rahman M, Cunningham KA. Prevalence of Food Addiction Among Low-Income Reproductive-Aged Women. J Womens Health2015;24(9):740–4. doi: 10.1089/jwh.2014.5182.

Berenson AB, Laz TH, Pohlmeier AM, Rahman M, Cunningham KA. Prevalence of Food Addiction Among Low-Income Reproductive-Aged Women. J Womens Health2015;24(9):740–4. doi: 10.1089/jwh.2014.5182.

Berg KC, Cao L, Crosby RD, Engel SG, Peterson CB, Crow SJ, Le Grange D, Mitchell JE, Lavender JM, Durkin N, Wonderlich SA. Negative affect and binge eating: Reconciling differences between two analytic approaches in ecological momentary assessment research. Int J Eat Disord2017;50(10):1222–1230. doi: 10.1002/eat.22770. [PubMed: 28851137]

Berg KC, Crosby RD, Cao L, Crow SJ, Engel SG, Wonderlich SA, Peterson CB. Negative affect prior to and following overeating-only, loss of control eating-only, and binge eating episodes in obese adults. Int J Eat Disord2015;48(6):641–53. doi: 10.1002/eat.22401. [PubMed: 25808854]

Berkman ND, Brownley KA, Peat CM, et al. (2015). Management and outcomes of binge-eating disorder. Comparative Effectiveness Reviews, 160. https://www.ncbi.nlm.nih.gov/books/NBK338301/table/introduction.t1/

Billieux J, Rochat L, Rebetz MML, Van der Linden M. Are all facets of impulsivity related to self-reported compulsive buying behavior?Person Indiv Diff2008;44:1432–1442.

Billieux J, Van der Linden M, Ceschi G. Which dimensions of impulsivity are related to cigarette craving?Addict Behav2007a;32(6):1189–99. doi: 10.1016/j.addbeh.2006.08.007. [PubMed: 16997490]

Billieux J, Van der Linden M, D'Acremont M, Ceschi G, Zermatten A. Does impulsivity relate to perceived dependence on and actual use of the mobile phone?Appl Cogn Psychol2007b;21:527–537.

Blanco-Gandía MC, Aracil-Fernández A, Montagud-Romero S, Aguilar MA, Manzanares J, Miñarro J, Rodríguez-Arias M. Changes in gene expression and sensitivity of cocaine reward produced by a continuous fat diet. Psychopharmacology2017a;234(15):2337–2352. doi: 10.1007/s00213-017-4630-9. [PubMed: 28456841]

Blanco-Gandía MC, Cantacorps L, Aracil-Fernández A, Montagud-Romero S, Aguilar MA, Manzanares J, Valverde O, Miñarro J, Rodríguez-Arias M. Effects of bingeing on fat during adolescence on the reinforcing effects of cocaine in adult male mice. Neuropharmacology2017b;113(Pt A):31–44. doi: 10.1016/j.neuropharm.2016.09.020. [PubMed: 27666001]

Blanco-Gandía MC, Montagud-Romero S, Aguilar MA, Miñarro J, Rodríguez-Arias M. Housing conditions modulate the reinforcing properties of cocaine in adolescent mice that binge on fat. Physiol Behav2018;183:18–26. doi: 10.1016/j.physbeh.2017.10.014. [PubMed: 29050902]

Blasio A, Iemolo A, Sabino V, Petrosino S, Steardo L, Rice KC, Orlando P, Iannotti FA, Di Marzo V, Zorrilla EP, Cottone P. Rimonabant precipitates anxiety in rats withdrawn from palatable food: role of the central amygdala. Neuropsychopharmacology2013;38(12):2498–507. doi: 10.1038/npp.2013.153. [PubMed: 23793355]

Blasio A, Rice KC, Sabino V, Cottone P. Characterization of a shortened model of diet alternation in female rats: effects of the CB1 receptor antagonist rimonabant on food intake and anxiety-like behavior. Behav Pharmacol2014a;25(7):609–17. doi: 10.1097/FBP.0000000000000059. [PubMed: 25011007]

Blasio A, Steardo L, Sabino V, Cottone P. Opioid system in the medial prefrontal cortex mediates binge-like eating. Addict Biol2014b;19(4):652–62. doi: 10.1111/adb.12033. [PubMed: 23346966]

Blum K, Thanos PK, Gold MS. Dopamine and glucose, obesity, and reward deficiency syndrome. Front Psychol2014;5:919. doi: 10.3389/fpsyg.2014.00919. [PubMed: 25278909]

Blum K, Thanos PK, Wang GJ, Febo M, Demetrovics Z, Modestino EJ, Braverman ER, Baron D, Badgaiyan RD, Gold MS. The Food and Drug Addiction Epidemic: Targeting Dopamine Homeostasis. Curr Pharm Des2018;23(39):6050–6061. doi: 10.2174/1381612823666170823101713. [PubMed: 28831923]

Boggiano MM. Palatable Eating Motives Scale in a college population: Distribution of scores and scores associated with greater BMI and binge-eating. Eat Behav2016;21:95–8. doi: 10.1016/j.eatbeh.2016.01.001. [PubMed: 26826648]

Boggiano MM, Burgess EE, Turan B, Soleymani T, Daniel S, Vinson LD, Lokken KL, Wingo BC, Morse A. Motives for eating tasty foods associated with binge-eating. Results from a student and a weight-loss seeking population. Appetite2014;83:160–6. doi: 10.1016/j.appet.2014.08.026. [PubMed: 25169880]

Boggiano MM, Chandler PC, Viana JB, Oswald KD, Maldonado CR, Wauford PK. Combined dieting and stress evoke exaggerated responses to opioids in binge-eating rats. Behav Neurosci2005;119(5):1207–14. doi: 10.1037/0735-7044.119.5.1207. [PubMed: 16300427]

Boggiano MM, Chandler PC. Binge eating in rats produced by combining dieting with stress. Curr Protoc Neurosci2006;Chapter 9:Unit9.23A. doi: 10.1002/0471142301.ns0923as36.

Boggiano MM, Wenger LE, Mrug S, Burgess EE, Morgan PR. The Kids-Palatable Eating Motives Scale: relation to BMI and binge eating traits. Eat Behav2015a;17:69–73. doi: 10.1016/j.eatbeh.2014.12.014. [PubMed: 25613823]

Boggiano MM, Wenger LE, Turan B, Tatum MM, Morgan PR, Sylvester MD. Eating tasty food to cope. Longitudinal association with BMI. Appetite2015b;87:365–70. doi: 10.1016/j.appet.2015.01.008. [PubMed: 25596500]

Boggiano MM, Wenger LE, Turan B, Tatum MM, Sylvester MD, Morgan PR, Morse KE, Burgess EE. Real-time sampling of reasons for hedonic food consumption: further validation of the Palatable Eating Motives Scale. Front Psychol2015;6:744. doi: 10.3389/fpsyg.2015.00744. [PubMed: 26082744]

Boggiano MM. Palatable Eating Motives Scale in a college population: Distribution of scores and scores associated with greater BMI and binge-eating. Eat Behav2016;21:95–8. doi: 10.1016/j.eatbeh.2016.01.001. [PubMed: 26826648]

Bohon C, Stice E. Negative affect and neural response to palatable food intake in bulimia nervosa. Appetite2012;58(3):964–70. doi: 10.1016/j.appet.2012.02.051. [PubMed: 22387716]

Bonamichi BDSF, Parente EB, dos Santos RB, Beltzhoover R, Lee J, Salles JEN. The challenge of obesity treatment: a review of approved drugs and new therapeutic targets. J Obes Eat Disord2018;4:2.

Booth C, Spronk D, Grol M, Fox E. Uncontrolled eating in adolescents: The role of impulsivity and automatic approach bias for food. Appetite2018;120:636–643. doi: 10.1016/j.appet.2017.10.024. [PubMed: 29066344]

Boutelle KN, Wierenga CE, Bischoff-Grethe A, Melrose AJ, Grenesko-Stevens E, Paulus MP, Kaye WH. Increased brain response to appetitive tastes in the insula and amygdala in obese compared with healthy weight children when sated. Int J Obes2015;39(4):620–8. doi: 10.1038/ijo.2014.206.

Branch SY, Goertz RB, Sharpe AL, Pierce J, Roy S, Ko D, Paladini CA, Beckstead MJ. Food restriction increases glutamate receptor-mediated burst firing of dopamine neurons. J Neurosci2013;33(34):13861–72. doi: 10.1523/JNEUROSCI.5099-12.2013. [PubMed: 23966705]

Bray GA, Kim KK, Wilding JPH; World Obesity Federation. Obesity: a chronic relapsing progressive disease process. A position statement of the World Obesity Federation. Obes Rev2017;18(7):715–723. doi: 10.1111/obr.12551. [PubMed: 28489290]

Brennan BP, Roberts JL, Fogarty KV, Reynolds KA, Jonas JM, Hudson JI. Memantine in the treatment of binge eating disorder: an open-label, prospective trial. Int J Eat Disord2008;41(6):520–6. doi: 10.1002/eat.20541. [PubMed: 18433015]

Brewerton TD. Food addiction as a proxy for eating disorder and obesity severity, trauma history, PTSD symptoms, and comorbidity. Eat Weight Disord2017;22(2):241–247. doi: 10.1007/s40519-016-0355-8. [PubMed: 28361213]

Brewerton TD. Food addiction as a proxy for eating disorder and obesity severity, trauma history, PTSD symptoms, and comorbidity. Eat Weight Disord2017;22(2):241–247. doi: 10.1007/s40519-016-0355-8. [PubMed: 28361213]

Brown KL, LaRose JG, Mezuk B. The relationship between body mass index, binge eating disorder and suicidality. BMC Psychiatry2018;18(1):196. doi: 10.1186/s12888-018-1766-z. [PubMed: 29907143]

Bruijnzeel AW, Prado M, Isaac S. Corticotropin-releasing factor-1 receptor activation mediates nicotine withdrawal-induced deficit in brain reward function and stress-induced relapse. Biol Psychiatry2009;66(2):110–7. doi: 10.1016/j.biopsych.2009.01.010. [PubMed: 19217073]

Bruijnzeel AW, Small E, Pasek TM, Yamada H. Corticotropin-releasing factor mediates the dysphoria-like state associated with alcohol withdrawal in rats. Behav Brain Res2010;210(2):288–91. doi: 10.1016/j.bbr.2010.02.043. [PubMed: 20193713]

Brunault P, Courtois R, Gearhardt AN, Gaillard P, Journiac K, Cathelain S, Réveillère C, Ballon N. Validation of the French Version of the DSM-5 Yale Food Addiction Scale in a Nonclinical Sample. Can J Psychiatry2017;62(3):199–210. doi: 10.1177/0706743716673320. [PubMed: 28212499]

Brunchmann A, Thomsen M, Fink-Jensen A. The effect of glucagon-like peptide-1 (GLP-1) receptor agonists on substance use disorder (SUD)-related behavioural effects of drugs and alcohol: A systematic review. Physiol Behav201971;206:232–242. doi: 10.1016/j.physbeh.2019.03.029. Epub2019 Apr 1. [PubMed: 30946836]

Brynildsen JK, Lee BG, Perron IJ, Jin S, Kim SF, Blendy JA. Activation of AMPK by metformin improves withdrawal signs precipitated by nicotine withdrawal. Proc Natl Acad Sci U S A2018417;115(16):4282–4287. doi: 10.1073/pnas.1707047115. Epub2018 Apr 2. [PubMed: 29610348]

Burger KS, Stice E. Frequent ice cream consumption is associated with reduced striatal response to receipt of an ice cream-based milkshake. Am J Clin Nutr2012;95(4):810–7. doi: 10.3945/ajcn.111.027003. [PubMed: 22338036]

Burgess EE, Turan B, Lokken KL, Morse A, Boggiano MM. Profiling motives behind hedonic eating. Preliminary validation of the Palatable Eating Motives Scale. Appetite2014;72:66–72. doi: 10.1016/j.appet.2013.09.016. [PubMed: 24076018]

Burmeister JM, Hinman N, Koball A, Hoffmann DA, Carels RA. Food addiction in adults seeking weight loss treatment. Implications for psychosocial health and weight loss. Appetite2013;60(1):103–110. doi: 10.1016/j.appet.2012.09.013. [PubMed: 23017467]

Burmeister JM, Hinman N, Koball A, Hoffmann DA, Carels RA. Food addiction in adults seeking weight loss treatment. Implications for psychosocial health and weight loss. Appetite2013;60(1):103–110. doi: 10.1016/j.appet.2012.09.013. [PubMed: 23017467]

Burrows T, Hides L, Brown R, Dayas CV, Kay-Lambkin F. Differences in Dietary Preferences, Personality and Mental Health in Australian Adults with and without Food Addiction. Nutrients2017;9(3):285. doi: 10.3390/nu9030285.

Burrows T, Kay-Lambkin F, Pursey K, Skinner J, Dayas C. Food addiction and associations with mental health symptoms: a systematic review with meta-analysis. J Hum Nutr Diet2018;31(4):544–572. doi: 10.1111/jhn.12532. [PubMed: 29368800]

Burrows T, Skinner J, Joyner MA, Palmieri J, Vaughan K, Gearhardt AN. Food addiction in children: Associations with obesity, parental food addiction and feeding practices. Eat Behav2017;26:114–120. doi: 10.1016/j.eatbeh.2017.02.004. [PubMed: 28236739]

Bushman BJ, Dewall CN, Pond RS Jr, Hanus MD. Low glucose relates to greater aggression in married couples. Proc Natl Acad Sci U S A2014;111(17):6254–7. doi: 10.1073/pnas.1400619111. [PubMed: 24733932]

Calarco CA, Lee S, Picciotto MR. Access to nicotine in drinking water reduces weight gain without changing caloric intake on high fat diet in male C57BL/6J mice. Neuropharmacology2017;123:210–220. doi: 10.1016/j.neuropharm.2017.06.012. [PubMed: 28623168]

Calu DJ, Roesch MR, Haney RZ, Holland PC, Schoenbaum G. Neural correlates of variations in event processing during learning in central nucleus of amygdala. Neuron2010;68(5):991–1001. doi: 10.1016/j.neuron.2010.11.019. [PubMed: 21145010]

Canan F, Karaca S, Sogucak S, Gecici O, Kuloglu M. Eating disorders and food addiction in men with heroin use disorder: a controlled study. Eat Weight Disord2017;22(2):249–257. doi: 10.1007/s40519-017-0378-9. [PubMed: 28434177]

Cancian ACM, de Souza LAS, Liboni RPA, Machado WL, Oliveira MDS. Effects of a dialectical behavior therapy-based skills group intervention for obese individuals: a Brazilian pilot study. Eat Weight Disord2019;24(6):1099–1111. doi: 10.1007/s40519-017-0461-2. [PubMed: 29197947]

Carano A, De Berardis D, Campanella D, Serroni N, Ferri F, Di Iorio G, Acciavatti T, Mancini L, Mariani G, Martinotti G, Moschetta FS, Di Giannantonio M. Alexithymia and suicide ideation in a sample of patients with binge eating disorder. J Psychiatr Pract2012;18(1):5–11. doi: 10.1097/01.pra.0000410982.08229.99. [PubMed: 22261978]

Carelli RM, West EA. When a good taste turns bad: Neural mechanisms underlying the emergence of negative affect and associated natural reward devaluation by cocaine. Neuropharmacology2014;76Pt B:360–9. doi: 10.1016/j.neuropharm.2013.04.025. [PubMed: 23639430]

Carels RA, Douglass OM, Cacciapaglia HM, O'Brien WH. An ecological momentary assessment of relapse crises in dieting. J Consult Clin Psychol2004;72(2):341–8. doi: 10.1037/0022-006X.72.2.341. [PubMed: 15065966]

Carias KV, Wevrick R. Preclinical Testing in Translational Animal Models of Prader-Willi Syndrome: Overview and Gap Analysis. Mol Ther Methods Clin Dev2019314;13:344–358. doi: 10.1016/j.omtm.2019.03.001.PMID: 30989085; PMCID: PMC6447752. [PubMed: 30989085]

Carr KD, Tsimberg Y, Berman Y, Yamamoto N. Evidence of increased dopamine receptor signaling in food-restricted rats. Neuroscience2003;119(4):1157–67. doi: 10.1016/s0306-4522(03)00227-6. [PubMed: 12831870]

Carroll ME. The role of food deprivation in the maintenance and reinstatement of cocaine-seeking behavior in rats. Drug Alcohol Depend1985;16(2):95–109. doi: 10.1016/0376-8716(85)90109-7. [PubMed: 4075974]

Carroll ME, France CP, Meisch RA. Food deprivation increases oral and intravenous drug intake in rats. Science1979;205(4403):319–21. doi: 10.1126/science.36665. [PubMed: 36665]

Carroll ME, Meisch RA. Increased drug-reinforced behavior due to food deprivation. Adv Behav Pharmacol1984;4:47–88.

Ceccarini M, Manzoni GM, Castelnuovo G, Molinari E. An Evaluation of the Italian Version of the Yale Food Addiction Scale in Obese Adult Inpatients Engaged in a 1-Month-Weight-Loss Treatment. J Med Food2015;18(11):1281–7. doi: 10.1089/jmf.2014.0188. [PubMed: 26267366]

Chang JY, Park JH, Park SE, Shon J, Park YJ. The Fat Mass- and Obesity-Associated (FTO) Gene to Obesity: Lessons from Mouse Models. Obesity2018;26(11):1674–1686. doi: 10.1002/oby.22301. [PubMed: 30311736]

Chao AM, Shaw JA, Pearl RL, Alamuddin N, Hopkins CM, Bakizada ZM, Berkowitz RI, Wadden TA. Prevalence and psychosocial correlates of food addiction in persons with obesity seeking weight reduction. Compr Psychiatry2017;73:97–104. doi: 10.1016/j.comppsych.2016.11.009. [PubMed: 27930952]

Chen A, Zorrilla E, Smith S, Rousso D, Levy C, Vaughan J, Donaldson C, Roberts A, Lee KF, Vale W. Urocortin 2-deficient mice exhibit gender-specific alterations in circadian hypothalamus-pituitary-adrenal axis and depressive-like behavior. J Neurosci2006;26(20):5500–10. doi: 10.1523/JNEUROSCI.3955-05.2006. [PubMed: 16707802]

Chen E, Yu T, Miller GE, Brody GH. Substance Use and Obesity Trajectories in African Americans Entering Adulthood. Am J Prev Med2018;55(6):856–863. doi:10.1016/j.amepre.2018.07.004. [PubMed: 30337234]

Chen EY, Matthews L, Allen C, Kuo JR, Linehan MM. Dialectical behavior therapy for clients with binge-eating disorder or bulimia nervosa and borderline personality disorder. Int J Eat Disord2008;41(6):505–12. doi: 10.1002/eat.20522. [PubMed: 18348281]

Chen MZ, Chang JC, Zavala-Solorio J, Kates L, Thai M, Ogasawara A, Bai X, Flanagan S, Nunez V, Phamluong K, Ziai J, Newman R, Warming S, Kolumam G, Sonoda J. FGF21 mimetic antibody stimulates UCP1-independent brown fat thermogenesis via FGFR1/βKlotho complex in non-adipocytes. Mol Metab2017;6(11):1454–1467. doi: 10.1016/j.molmet.2017.09.003. [PubMed: 29107292]

Childress AR, McLellan AT, Ehrman R, O'Brien CP. Classically conditioned responses in opioid and cocaine dependence: a role in relapse?NIDA Res Monogr1988;84:25–43. [PubMed: 3147384]

Childress AR, McLellan AT, O'Brien CP. Conditioned responses in a methadone population. A comparison of laboratory, clinic, and natural settings. J Subst Abuse Treat1986;3(3):173–9. doi: 10.1016/0740-5472(86)90018-8. [PubMed: 3806730]

Chooi YC, Ding C, Magkos F. The epidemiology of obesity. Metabolism2019;92:6–10. doi:10.1016/j.metabol.2018.09.005 [PubMed: 30253139]

Christiansen AM, Herman JP, Ulrich-Lai YM. Regulatory interactions of stress and reward on rat forebrain opioidergic and GABAergic circuitry. Stress2011;14(2):205–15. doi: 10.3109/10253890.2010.531331. [PubMed: 21291318]

Chu K, Koob GF, Cole M, Zorrilla EP, Roberts AJ. Dependence-induced increases in ethanol self-administration in mice are blocked by the CRF1 receptor antagonist antalarmin and by CRF1 receptor knockout. Pharmacol Biochem Behav2007;86(4):813–21. doi: 10.1016/j.pbb.2007.03.009. [PubMed: 17482248]

Chua JL, Touyz S, Hill AJ. Negative mood-induced overeating in obese binge eaters: an experimental study. Int J Obes Relat Metab Disord2004;28(4):606–10. doi: 10.1038/sj.ijo.0802595. [PubMed: 14968127]

Cifani C, Polidori C, Melotto S, Ciccocioppo R, Massi M. A preclinical model of binge eating elicited by yo-yo dieting and stressful exposure to food: effect of sibutramine, fluoxetine, topiramate, and midazolam. Psychopharmacology2009a;204(1):113–25. doi: 10.1007/s00213-008-1442-y. [PubMed: 19125237]

Cifani C, Zanoncelli A, Tessari M, Righetti C, Di Francesco C, Ciccocioppo R, Massi M, Melotto S. Pre-exposure to environmental cues predictive of food availability elicits hypothalamic-pituitary-adrenal axis activation and increases operant responding for food in female rats. Addict Biol2009b;14(4):397–407. doi: 10.1111/j.1369-1600.2009.00152.x. [PubMed: 19413564]

Citrome LLisdexamfetamine for binge eating disorder in adults: a systematic review of the efficacy and safety profile for this newly approved indication - what is the number needed to treat, number needed to harm and likelihood to be helped or harmed?Int J Clin Pract2015;69(4):410–21. doi: 10.1111/ijcp.12639. [PubMed: 25752762]

Clarke TK, Adams MJ, Davies G, Howard DM, Hall LS, Padmanabhan S, Murray AD, Smith BH, Campbell A, Hayward C, Porteous DJ, Deary IJ, McIntosh AM. Genome-wide association study of alcohol consumption and genetic overlap with other health-related traits in UK Biobank (N=112 117). Mol Psychiatry2017;22(10):1376–1384. doi: 10.1038/mp.2017.153. [PubMed: 28937693]

Clasen MM, Sanon TV, Hempel BJ, Nelson KH, Kearns DN, Davidson TL, Riley AL. Ad-libitum high fat diet consumption during adolescence and adulthood impacts the intravenous self-administration of cocaine in male Sprague-Dawley rats. Exp Clin Psychopharmacol2020;28(1):32–43. doi: 10.1037/pha0000280. [PubMed: 30998057]

Clawson RC, Dela Cruz LN, Allen S, Wolgemuth T, Maner A, Dorsett A, I'Anson H. Continuous access to snacks from weaning onwards in female rats causes weight gain, insulin insensitivity and sustained leptin resistance in adulthood. Physiol Behav2019;201:165–174. Doi: 10.1016/j.physbeh.2018.11.026. [PubMed: 30472395]

Clegg DJ, Riedy CA, Smith KA, Benoit SC, Woods SC. Differential sensitivity to central leptin and insulin in male and female rats. Diabetes2003;52(3):682–7. doi: 10.2337/diabetes.52.3.682. [PubMed: 12606509]

Clément K, Dina C, Basdevant A, Chastang N, Pelloux V, Lahlou N, Berlan M, Langin D, Guy-Grand B, Froguel P. A sib-pair analysis study of 15 candidate genes in French families with morbid obesity: indication for linkage with islet 1 locus on chromosome 5q. Diabetes1999;48(2):398–402. doi: 10.2337/diabetes.48.2.398. [PubMed: 10334320]

Cobb LK, Appel LJ, Franco M, Jones-Smith JC, Nur A, Anderson CA. The relationship of the local food environment with obesity: A systematic review of methods, study quality, and results. Obesity2015;23(7):1331–44. doi: 10.1002/oby.21118. [PubMed: 26096983]

Cohen A, Koob GF, George O. Robust escalation of nicotine intake with extended access to nicotine self-administration and intermittent periods of abstinence. Neuropsychopharmacology2012;37(9):2153–60. doi: 10.1038/npp.2012.67. [PubMed: 22549121]

Col Araz N, Nacak M, Oguzkan Balci S, Benlier N, Araz M, Pehlivan S, Balat A, Aynacioglu AS. Childhood obesity and the role of dopamine D2 receptor and cannabinoid receptor-1 gene polymorphisms. Genet Test Mol Biomarkers2012;16(12):1408–12. doi: 10.1089/gtmb.2012.0244. [PubMed: 23057570]

Colantuoni C, Rada P, McCarthy J, Patten C, Avena NM, Chadeayne A, Hoebel BG. Evidence that intermittent, excessive sugar intake causes endogenous opioid dependence. Obes Res2002;10(6):478–88. doi: 10.1038/oby.2002.66. [PubMed: 12055324]

Colechio EM, Alexander DN, Imperio CG, Jackson K, Grigson PS. Once is too much: Early development of the opponent process in taste reactivity behavior is associated with later escalation of cocaine self-administration in rats. Brain Res Bull2018;138:88–95. doi: 10.1016/j.brainresbull.2017.09.002. [PubMed: 28899796]

Colechio EM, Grigson PS. Conditioned Aversion for a Cocaine-Predictive Cue is Associated with Cocaine Seeking and Taking in Rats. Int J Comp Psychol2014;27(3):488–500. [PubMed: 25673916]

Colechio EM, Imperio CG, Grigson PS. Once is too much: conditioned aversion develops immediately and predicts future cocaine self-administration behavior in rats. Behav Neurosci2014;128(2):207–16. doi: 10.1037/a0036264. [PubMed: 24773440]

Collins GT, Calinski DM, Newman AH, Grundt P, Woods JH. Food restriction alters N'-propyl-4,5,6,7-tetrahydrobenzothiazole-2,6-diamine dihydrochloride (pramipexole)-induced yawning, hypothermia, and locomotor activity in rats: evidence for sensitization of dopamine D2 receptor-mediated effects. J Pharmacol Exp Ther2008;325(2):691–7. doi: 10.1124/jpet.107.133181. [PubMed: 18305018]

Collins GT, Chen Y, Tschumi C, Rush EL, Mensah A, Koek W, France CP. Effects of consuming a diet high in fat and/or sugar on the locomotor effects of acute and repeated cocaine in male and female C57BL/6J mice. Exp Clin Psychopharmacol2015;23(4):228–237. Doi: 10.1037/pha0000019. [PubMed: 26237320]

Collins GT, France CP. Effects of lorcaserin and buspirone, administered alone and as a mixture, on cocaine self-administration in male and female rhesus monkeys. Exp Clin Psychopharmacol2018;26(5):488–496. doi: 10.1037/pha0000209. [PubMed: 29952618]

Collins GT, Gerak LR, Javors MA, France CP. Lorcaserin Reduces the Discriminative Stimulus and Reinforcing Effects of Cocaine in Rhesus Monkeys. J Pharmacol Exp Ther2016;356(1):85–95. doi: 10.1124/jpet.115.228833. [PubMed: 26534942]

Conason A, Teixeira J, Hsu CH, Puma L, Knafo D, Geliebter A. Substance use following bariatric weight loss surgery. JAMA Surg2013;148(2):145–50. doi: 10.1001/2013.jamasurg.265. [PubMed: 23560285]

Cone JJ, Chartoff EH, Potter DN, Ebner SR, Roitman MF. Prolonged high fat diet reduces dopamine reuptake without altering DAT gene expression. PLoS One2013;8(3):e58251. doi: 10.1371/journal.pone.0058251. [PubMed: 23516454]

Cook JW, Piper ME, Leventhal AM, Schlam TR, Fiore MC, Baker TB. Anhedonia as a component of the tobacco withdrawal syndrome. J Abnorm Psychol2015;124(1):215–25. doi: 10.1037/abn0000016. [PubMed: 25384069]

Cooper SJ. Palatability-dependent appetite and benzodiazepines: new directions from the pharmacology of GABA(A) receptor subtypes. Appetite2005;44(2):133–50. doi: 10.1016/j.appet.2005.01.003. [PubMed: 15808888]

Cork SC, Richards JE, Holt MK, Gribble FM, Reimann F, Trapp S. Distribution and characterisation of Glucagon-like peptide-1 receptor expressing cells in the mouse brain. Mol Metab. 201585;4(10):718–31. doi: 10.1016/j.molmet.2015.07.008. [PubMed: 26500843]

Corsica JA, Spring BJ. Carbohydrate craving: a double-blind, placebo-controlled test of the self-medication hypothesis. Eat Behav2008;9(4):447–54. doi: 10.1016/j.eatbeh.2008.07.004. [PubMed: 18928908]

Corwin RL, Babbs RK. Rodent models of binge eating: are they models of addiction?ILAR J2012;53(1):23–34. doi: 10.1093/ilar.53.1.23. [PubMed: 23520597]

Cottone P, Sabino V, Nagy TR, Coscina DV, Levin BE, Zorrilla EP. Centrally administered urocortin 2 decreases gorging on high-fat diet in both diet-induced obesity-prone and - resistant rats. Int J Obes2013;37(12):1515–23. doi: 10.1038/ijo.2013.22.

Cottone P, Sabino V, Nagy TR, Coscina DV, Zorrilla EP. Feeding microstructure in diet-induced obesity susceptible versus resistant rats: central effects of urocortin 2. J Physiol2007;583(Pt 2):487–504. doi: 10.1113/jphysiol.2007.138867. [PubMed: 17627984]

Cottone P, Sabino V, Roberto M, Bajo M, Pockros L, Frihauf JB, Fekete EM, Steardo L, Rice KC, Grigoriadis DE, Conti B, Koob GF, Zorrilla EP. CRF system recruitment mediates dark side of compulsive eating. Proc Natl Acad Sci U S A2009a;106(47):20016–20. doi: 10.1073/pnas.0908789106. [PubMed: 19901333]

Cottone P, Sabino V, Steardo L, Zorrilla EP. Consummatory, anxiety-related and metabolic adaptations in female rats with alternating access to preferred food. Psychoneuroendocrinology2009b;34(1):38–49. doi: 10.1016/j.psyneuen.2008.08.010. [PubMed: 18842344]

Cottone P, Sabino V, Steardo L, Zorrilla EP. Intermittent access to preferred food reduces the reinforcing efficacy of chow in rats. Am J Physiol Regul Integr Comp Physiol2008a;295(4):R1066–76. doi: 10.1152/ajpregu.90309.2008. [PubMed: 18667718]

Cottone P, Sabino V, Steardo L, Zorrilla EP. Opioid-dependent anticipatory negative contrast and binge-like eating in rats with limited access to highly preferred food. Neuropsychopharmacology2008b;33(3):524–35. doi: 10.1038/sj.npp.1301430. [PubMed: 17443124]

Coulter AA, Rebello CJ, Greenway FL. Centrally Acting Agents for Obesity: Past, Present, and Future. Drugs2018;78(11):1113–1132. doi: 10.1007/s40265-018-0946-y. [PubMed: 30014268]

Coumans JMJ, Danner UN, Intemann T, De Decker A, Hadjigeorgiou C, Hunsberger M, Moreno LA, Russo P, Stomfai S, Veidebaum T, Adan RAH, Hebestreit A. Emotion-driven impulsiveness and snack food consumption of European adolescents: Results from the I.Family study. Appetite2018;123:152–159. doi: 10.1016/j.appet.2017.12.018. [PubMed: 29269316]

Crow S, Eisenberg ME, Story M, Neumark-Sztainer D. Psychosocial and behavioral correlates of dieting among overweight and non-overweight adolescents. J Adolesc Health2006;38(5):569–74. doi: 10.1016/j.jadohealth.2005.05.019. [PubMed: 16635769]

Cruz B, Carcoba LM, Flores RJ, Espinoza EJ, Nazarian A, O'Dell LE. Insulin restores the neurochemical effects of nicotine in the mesolimbic pathway of diabetic rats. J Neurochem. 2020620. doi: 10.1111/jnc.15104. Epub ahead of print.

Cummings JR, Ray LA, Tomiyama AJ. Food-alcohol competition: As young females eat more food, do they drink less alcohol?J Health Psychol2017;22(5):674–683. doi: 10.1177/1359105315611955. [PubMed: 26542418]

Curtis D, UK10K Consortium. Practical Experience of the Application of a Weighted Burden Test to Whole Exome Sequence Data for Obesity and Schizophrenia. Ann Hum Genet2016;80(1):38–49. doi: 10.1111/ahg.12135. [PubMed: 26474449]

Cyders MA, Smith GT. Emotion-based dispositions to rash action: positive and negative urgency. Psychol Bull2008;134(6):807–28. doi: 10.1037/a0013341. [PubMed: 18954158]

D'Addario C, Micioni Di Bonaventura MV, Pucci M, Romano A, Gaetani S, Ciccocioppo R, Cifani C, Maccarrone M. Endocannabinoid signaling and food addiction. Neurosci Biobehav Rev2014;47:203–24. doi: 10.1016/j.neubiorev.2014.08.008. [PubMed: 25173635]

Dallman MF, Pecoraro N, Akana SF, La Fleur SE, Gomez F, Houshyar H, Bell ME, Bhatnagar S, Laugero KD, Manalo S. Chronic stress and obesity: a new view of "comfort food". Proc Natl Acad Sci U S A2003;100(20):11696–701. doi: 10.1073/pnas.1934666100. [PubMed: 12975524]

Dallman MF, Pecoraro NC, la Fleur SE. Chronic stress and comfort foods: self-medication and abdominal obesity. Brain Behav Immun2005;19(4):275–80. doi: 10.1016/j.bbi.2004.11.004. [PubMed: 15944067]

Darling RA, Dingess PM, Schlidt KC, Smith EM, Brown TE. Incubation of food craving is independent of macronutrient composition. Sci Rep2016;6:30900. doi: 10.1038/srep30900. [PubMed: 27485660]

Davis C, Carter JC. Compulsive overeating as an addiction disorder. A review of theory and evidence. Appetite2009;53(1):1–8. doi: 10.1016/j.appet.2009.05.018. [PubMed: 19500625]

Davis C, Curtis C, Levitan RD, Carter JC, Kaplan AS, Kennedy JL. Evidence that 'food addiction' is a valid phenotype of obesity. Appetite2011;57(3):711–7. doi: 10.1016/j.appet.2011.08.017. [PubMed: 21907742]

Davis JF, Tracy AL, Schurdak JD, Tschöp MH, Lipton JW, Clegg DJ, Benoit SC. Exposure to elevated levels of dietary fat attenuates psychostimulant reward and mesolimbic dopamine turnover in the rat. Behav Neurosci2008;122(6):1257–63. doi: 10.1037/a0013111. [PubMed: 19045945]

Daws LC, Avison MJ, Robertson SD, Niswender KD, Galli A, Saunders C. Insulin signaling and addiction. Neuropharmacology2011; 61(7):1123–1128. Doi: 10.1016/j.neuropharm.2011.02.028 [PubMed: 21420985]

de la Garza R, Bergman J, Hartel CR. Food deprivation and cocaine self-administration. Pharmacol Biochem Behav1981;15(1):141–4. doi: 10.1016/0091-3057(81)90353-1. [PubMed: 7291222]

de Lima MS, Béria JU, Tomasi E, Mari JJ. Use of amphetamine-like appetite suppressants: a cross-sectional survey in Southern Brazil. Subst Use Misuse1998;33(8):1711–1719. doi:10.3109/10826089809058951. [PubMed: 9680089]

de Vries SK, Meule A. Food Addiction and Bulimia Nervosa: New Data Based on the Yale Food Addiction Scale 2.0. Eur Eat Disord Rev2016;24(6):518–522. doi: 10.1002/erv.2470. [PubMed: 27578243]

Derman RC, Ferrario CR. Affective Pavlovian motivation is enhanced in obesity susceptible populations: Implications for incentive motivation in obesity. Behav Brain Res2020217;380:112318. doi: 10.1016/j.bbr.2019.112318. Epub2019 Nov 21. [PubMed: 31760153]

Derman RC, Ferrario CR. Enhanced incentive motivation in obesity-prone rats is mediated by NAc core CP-AMPARs. Neuropharmacology2018315;131:326–336. doi: 10.1016/j.neuropharm.2017.12.039. Epub2017 Dec 29. [PubMed: 29291424]

Deroche V, Piazza PV, Casolini P, Le Moal M, Simon H. Sensitization to the psychomotor effects of amphetamine and morphine induced by food restriction depends on corticosterone secretion. Brain Res1993;611(2):352–6. doi: 10.1016/0006-8993(93)90526-s. [PubMed: 8334527]

Desai BN, Singhal G, Watanabe M, Stevanovic D, Lundasen T, Fisher FM, Mather ML, Vardeh HG, Douris N, Adams AC, Nasser IA, FitzGerald GA, Flier JS, Skarke C, Maratos-Flier E. Fibroblast growth factor 21 (FGF21) is robustly induced by ethanol and has a protective role in ethanol associated liver injury. Mol Metab2017;6(11):1395–1406. doi: 10.1016/j.molmet.2017.08.004. [PubMed: 29107287]

DeWall CN, Deckman T, Gailliot MT, Bushman BJ. Sweetened blood cools hot tempers: physiological self-control and aggression. Aggress Behav2011;37(1):73–80. doi: 10.1002/ab.20366. [PubMed: 21064166]

Di Chiara G, Imperato A. Drugs abused by humans preferentially increase synaptic dopamine concentrations in the mesolimbic system of freely moving rats. Proc Natl Acad Sci U S A1988;85(14):5274–8. doi: 10.1073/pnas.85.14.5274. [PubMed: 2899326]

Dingemans A, Danner U, Parks M. Emotion Regulation in Binge Eating Disorder: A Review. Nutrients2017;9(11):1274. doi: 10.3390/nu9111274.

Dingemans AE, van Furth EF. Binge Eating Disorder psychopathology in normal weight and obese individuals. Int J Eat Disord2012;45(1):135–8. doi: 10.1002/eat.20905. [PubMed: 22170025]

Dingess PM, Darling RA, Derman RC, Wulff SS, Hunter ML, Ferrario CR, Brown TE. Structural and Functional Plasticity within the Nucleus Accumbens and Prefrontal Cortex Associated with Time-Dependent Increases in Food Cue-Seeking Behavior. Neuropsychopharmacology2017;42(12):2354–2364. doi: 10.1038/npp.2017.57. [PubMed: 28294131]

Dorajoo R, Blakemore AI, Sim X, Ong RT, Ng DP, Seielstad M, Wong TY, Saw SM, Froguel P, Liu J, Tai ES. Replication of 13 obesity loci among Singaporean Chinese, Malay and Asian-Indian populations. Int J Obes (Lond)20121;36(1):159–63. doi: 10.1038/ijo.2011.86. [PubMed: 21544081]

Drucker DJ, Habener JF, Holst JJ. Discovery, characterization, and clinical development of the glucagon-like peptides. J Clin Invest2017121;127(12):4217–4227. doi: 10.1172/JCI97233. Epub2017 Dec 1. [PubMed: 29202475]

Duncan A, Heyer MP, Ishikawa M, Caligiuri SPB, Liu XA, Chen Z, Micioni Di Bonaventura MV, Elayouby KS, Ables JL, Howe WM, Bali P, Fillinger C, Williams M, O'Connor RM, Wang Z, Lu Q, Kamenecka TM, Ma'ayan A, O'Neill HC, Ibanez-Tallon I, Geurts AM, Kenny PJ. Habenular TCF7L2 links nicotine addiction to diabetes. Nature2019; 574(7778):372–377. [PubMed: 31619789]

Dunn C, Haubenreiser M, Johnson M, Nordby K, Aggarwal S, Myer S, Thomas C. Mindfulness Approaches and Weight Loss, Weight Maintenance, and Weight Regain. Curr Obes Rep2018;7(1):37–49. doi: 10.1007/s13679-018-0299-6. [PubMed: 29446036]

Dunn JP, Kessler RM, Feurer ID, Volkow ND, Patterson BW, Ansari MS, Li R, Marks-Shulman P, Abumrad NN. Relationship of dopamine type 2 receptor binding potential with fasting neuroendocrine hormones and insulin sensitivity in human obesity. Diabetes Care2012;35(5):1105–11. doi: 10.2337/dc11-2250. [PubMed: 22432117]

Dutta S, Morton J, Shepard E, Peebles R, Farrales-Nguyen S, Hammer LD, Albanese CT. Methamphetamine use following bariatric surgery in an adolescent. Obes Surg2006;16(6):780–2. doi: 10.1381/096089206777346646. [PubMed: 16756743]

Edge PJ, Gold MS. Drug withdrawal and hyperphagia: lessons from tobacco and other drugs. Curr Pharm Des2011;17(12):1173–9. doi: 10.2174/138161211795656738. [PubMed: 21492091]

Ely AV, Wierenga CE, Bischoff-Grethe A, Bailer UF, Berner LA, Fudge JL, Paulus MP, Kaye WH. Response in taste circuitry is not modulated by hunger and satiety in women remitted from bulimia nervosa. J Abnorm Psychol2017;126(5):519–530. doi: 10.1037/abn0000218. [PubMed: 28691842]

Engel SG, Boseck JJ, Crosby RD, Wonderlich SA, Mitchell JE, Smyth J, Miltenberger R, Steiger H. The relationship of momentary anger and impulsivity to bulimic behavior. Behav Res Ther2007;45(3):437–47. doi: 10.1016/j.brat.2006.03.014. [PubMed: 16697350]

Engel SG, Wonderlich SA, Crosby RD, Mitchell JE, Crow S, Peterson CB, Le Grange D, Simonich HK, Cao L, Lavender JM, Gordon KH. The role of affect in the maintenance of anorexia nervosa: evidence from a naturalistic assessment of momentary behaviors and emotion. J Abnorm Psychol2013;122(3):709–19. doi: 10.1037/a0034010. [PubMed: 24016011]

Engelmann JM, Versace F, Robinson JD, Minnix JA, Lam CY, Cui Y, Brown VL, Cinciripini PM. Neural substrates of smoking cue reactivity: a meta-analysis of fMRI studies. Neuroimage2012;60(1):252–62. doi: 10.1016/j.neuroimage.2011.12.024. [PubMed: 22206965]

Epstein DH, Kennedy AP, Furnari M, Heilig M, Shaham Y, Phillips KA, Preston KL. Effect of the CRF1-receptor antagonist pexacerfont on stress-induced eating and food craving. Psychopharmacology2016;233(23–24):3921–3932. doi: 10.1007/s00213-016-4424-5. [PubMed: 27595147]

Epstein DH, Preston KL, Stewart J, Shaham Y. Toward a model of drug relapse: an assessment of the validity of the reinstatement procedure. Psychopharmacology2006;189(1):1–16. doi: 10.1007/s00213-006-0529-6. [PubMed: 17019567]

Epstein LH, Carr KA, Cavanaugh MD, Paluch RA, Bouton ME. Long-term habituation to food in obese and nonobese women. Am J Clin Nutr2011;94(2):371–6. doi: 10.3945/ajcn.110.009035. [PubMed: 21593492]

Ettenberg A, Raven MA, Danluck DA, Necessary BD. Evidence for opponent-process actions of intravenous cocaine. Pharmacol Biochem Behav1999;64(3):507–12. doi: 10.1016/s0091-3057(99)00109-4. [PubMed: 10548263]

Ezard N, Dunlop A, Hall M, Ali R, McKetin R, Bruno R, Phung N, Carr A, White J, Clifford B, Liu Z, Shanahan M, Dolan K, Baker AL, Lintzeris N. LiMA: a study protocol for a randomised, double-blind, placebo controlled trial of lisdexamfetamine for the treatment of methamphetamine dependence. BMJ Open2018719;8(7):e020723. doi: 10.1136/bmjopen-2017-020723.

Fachin A, Silva RK, Noschang CG, Pettenuzzo L, Bertinetti L, Billodre MN, Peres W, Busnello F, Dalmaz C. Stress effects on rats chronically receiving a highly palatable diet are sex-specific. Appetite2008;51(3):592–8. doi: 10.1016/j.appet.2008.04.016. [PubMed: 18524415]

Farokhnia M, Faulkner ML, Piacentino D, Lee MR, Leggio L. Ghrelin: From a gut hormone to a potential therapeutic target for alcohol use disorder. Physiol Behav2019;204:49–57. doi: 10.1016/j.physbeh.2019.02.008. [PubMed: 30738971]

Farokhnia M, Grodin EN, Lee MR, Oot EN, Blackburn AN, Stangl BL, Schwandt ML, Farinelli LA, Momenan R, Ramchandani VA, Leggio L. Exogenous ghrelin administration increases alcohol self-administration and modulates brain functional activity in heavy-drinking alcohol-dependent individuals. Mol Psychiatry. 2018;23(10):2029–2038. doi: 10.1038/mp.2017.226. [PubMed: 29133954]

Fay SH, Finlayson G. Negative affect-induced food intake in non-dieting women is reward driven and associated with restrained-disinhibited eating subtype. Appetite2011;56(3):682–8. doi: 10.1016/j.appet.2011.02.004. [PubMed: 21316410]

Fischer S, Smith GT, Annus AM, Hendricks M. The relationship of neuroticism and urgency to negative consequences of alcohol use in women with bulimic symptoms. Person Indiv Diff2007;43:1199–1209.

Fischer S, Smith GT, Cyders MA. Another look at impulsivity: a meta-analytic review comparing specific dispositions to rash action in their relationship to bulimic symptoms. Clin Psychol Rev2008;28(8):1413–25. doi: 10.1016/j.cpr.2008.09.001. [PubMed: 18848741]

Fischer S, Wonderlich J, Breithaupt L, Byrne C, Engel S. Negative urgency and expectancies increase vulnerability to binge eating in bulimia nervosa. Eat Disord2018;26(1):39–51. doi: 10.1080/10640266.2018.1418253. [PubMed: 29384460]

Fittipaldi AS, Hernández J, Castrogiovanni D, Lufrano D, De Francesco PN, Garrido V, Vitaux P, Fasano MV, Fehrentz JA, Fernández A, Andreoli MF, Perello M. Plasma levels of ghrelin, des-acyl ghrelin and LEAP2 in children with obesity: correlation with age and insulin resistance. Eur J Endocrinol2020;182(2):165–175. [PubMed: 31770106]

Foley KA, Fudge MA, Kavaliers M, Ossenkopp KP. Quinpirole-induced behavioral sensitization is enhanced by prior scheduled exposure to sucrose: A multi-variable examination of locomotor activity. Behav Brain Res2006;167(1):49–56. doi: 10.1016/j.bbr.2005.08.015. [PubMed: 16198008]

Fordahl SC, Locke JL, Jones SR. High fat diet augments amphetamine sensitization in mice: Role of feeding pattern, obesity, and dopamine terminal changes. Neuropharmacology2016;109:170–182. doi: 10.1016/j.neuropharm.2016.06.006. [PubMed: 27267686]

Frihauf JB, Fekete ÉM, Nagy TR, Levin BE, Zorrilla EP. Maternal Western diet increases adiposity even in male offspring of obesity-resistant rat dams: early endocrine risk markers. Am J Physiol Regul Integr Comp Physiol2016;311(6):R1045–R1059. doi: 10.1152/ajpregu.00023.2016. [PubMed: 27654396]

Frühbeck G, Fernández-Quintana B, Paniagua M, Hernández-Pardos AW, Valentí V, Moncada R, Catalán V, Becerril S, Gómez-Ambrosi J, Portincasa P, Silva C, Salvador J, Rodríguez A. FNDC4, a novel adipokine that reduces lipogenesis and promotes fat browning in human visceral adipocytes. Metabolism20207;108:154261. doi: 10.1016/j.metabol.2020.154261. [PubMed: 32407726]

Fukunaka A, Fukada T, Bhin J, Suzuki L, Tsuzuki T, Takamine Y, Bin BH, Yoshihara T, Ichinoseki-Sekine N, Naito H, Miyatsuka T, Takamiya S, Sasaki T, Inagaki T, Kitamura T, Kajimura S, Watada H, Fujitani Y. Zinc transporter ZIP13 suppresses beige adipocyte biogenesis and energy expenditure by regulating C/EBP-β expression. PLoS Genet2017830;13(8):e1006950. doi: 10.1371/journal.pgen.1006950. [PubMed: 28854265]

Funk CK, Zorrilla EP, Lee MJ, Rice KC, Koob GF. Corticotropin-releasing factor 1 antagonists selectively reduce ethanol self-administration in ethanol-dependent rats. Biol Psychiatry2007;61(1):78–86. doi: 10.1016/j.biopsych.2006.03.063. [PubMed: 16876134]

Galaj E, Xi ZX. Potential of Cannabinoid Receptor Ligands as Treatment for Substance Use Disorders. CNS Drugs2019;33(10):1001–1030. doi: 10.1007/s40263-019-00664-w. [PubMed: 31549358]

Galic MA, Persinger MA. Voluminous sucrose consumption in female rats: increased “nippiness” during periods of sucrose removal and possible oestrus periodicity. Psychol Rep2002;90(1):58–60. doi: 10.2466/pr0.2002.90.1.58. [PubMed: 11899012]

Gannon BM, Sulima A, Rice KC, Collins GT. Inhibition of Cocaine and 3,4-Methylenedioxypyrovalerone (MDPV) Self-Administration by Lorcaserin Is Mediated by 5-HT2C Receptors in Rats. J Pharmacol Exp Ther2018;364(2):359–366. doi: 10.1124/jpet.117.246082. [PubMed: 29217539]

Garfield JBB, Cotton SM, Allen NB, Cheetham A, Kras M, Yücel M, Lubman DI. Evidence that anhedonia is a symptom of opioid dependence associated with recent use. Drug Alcohol Depend2017;177:29–38. doi: 10.1016/j.drugalcdep.2017.03.012. [PubMed: 28551591]

Gasior M, Hudson J, Quintero J, Ferreira-Cornwell MC, Radewonuk J, McElroy SL. A Phase 3, Multicenter, Open-Label, 12-Month Extension Safety and Tolerability Trial of Lisdexamfetamine Dimesylate in Adults With Binge Eating Disorder. J Clin Psychopharmacol2017;37(3):315–322. doi: 10.1097/JCP.0000000000000702. [PubMed: 28383364]

Ge X, Yang H, Bednarek MA, Galon-Tilleman H, Chen P, Chen M, Lichtman JS, Wang Y, Dalmas O, Yin Y, Tian H, Jermutus L, Grimsby J, Rondinone CM, Konkar A, Kaplan DD. LEAP2 Is an Endogenous Antagonist of the Ghrelin Receptor. Cell Metab2018;27(2):461–469.e6. doi: 10.1016/j.cmet.2017.10.016. [PubMed: 29233536]

Gearhardt AN, Corbin WR. Body mass index and alcohol consumption: family history of alcoholism as a moderator. Psychol Addict Behav2009;23(2):216–25. doi: 10.1037/a0015011. [PubMed: 19586138]

Gearhardt AN, Corbin WR, Brownell KD. Development of the Yale Food Addiction Scale Version 2.0. Psychol Addict Behav2016;30(1):113–21. doi: 10.1037/adb0000136. [PubMed: 26866783]

Gearhardt AN, Waller R, Jester JM, Hyde LW, Zucker RA. Body mass index across adolescence and substance use problems in early adulthood. Psychol Addict Behav2018;32(3):309–319. doi: 10.1037/adb0000365. [PubMed: 29771559]

Gearhardt AN, White MA, Masheb RM, Morgan PT, Crosby RD, Grilo CM. An examination of the food addiction construct in obese patients with binge eating disorder. Int J Eat Disord2012;45(5):657–63. doi: 10.1002/eat.20957. [PubMed: 22684991]

Gearhardt AN, Yokum S, Orr PT, Stice E, Corbin WR, Brownell KD. Neural correlates of food addiction. Arch Gen Psychiatry2011;68(8):808–16. doi: 10.1001/archgenpsychiatry.2011.32. [PubMed: 21464344]

Geer B, Gibson D, Grayeb D, Benabe J, Victory S, Mehler S, Mehler P. Metformin abuse: A novel and dangerous purging behavior in anorexia nervosa. Int J Eat Disord20193;52(3):319–321. doi: 10.1002/eat.23010. Epub2019 Jan 10. [PubMed: 30629296]

Gehlert DR, Cippitelli A, Thorsell A, Lê AD, Hipskind PA, Hamdouchi C, Lu J, Hembre EJ, Cramer J, Song M, McKinzie D, Morin M, Ciccocioppo R, Heilig M. 3-(4-Chloro-2-morpholin-4-yl-thiazol-5-yl)-8-(1-ethylpropyl)-2,6-dimethyl-imidazo[1,2-b]pyridazine: a novel brain-penetrant, orally available corticotropin-releasing factor receptor 1 antagonist with efficacy in animal models of alcoholism. J Neurosci2007;27(10):2718–26. doi: 10.1523/JNEUROSCI.4985-06.2007. [PubMed: 17344409]

Geiger BM, Behr GG, Frank LE, Caldera-Siu AD, Beinfeld MC, Kokkotou EG, Pothos EN. Evidence for defective mesolimbic dopamine exocytosis in obesity-prone rats. FASEB J2008;22(8):2740–6. doi: 10.1096/fj.08-110759. [PubMed: 18477764]

Geiger BM, Haburcak M, Avena NM, Moyer MC, Hoebel BG, Pothos EN. Deficits of mesolimbic dopamine neurotransmission in rat dietary obesity. Neuroscience2009;159(4):1193–9. doi: 10.1016/j.neuroscience.2009.02.007. [PubMed: 19409204]

Geiger BM, Haburcak M, Avena NM, Moyer MC, Hoebel BG, Pothos EN. Deficits of mesolimbic dopamine neurotransmission in rat dietary obesity. Neuroscience2009;159(4):1193–9. doi: 10.1016/j.neuroscience.2009.02.007. [PubMed: 19409204]

George M, Rajaram M, Shanmugam E. New and emerging drug molecules against obesity. J Cardiovasc Pharmacol Ther2014;19(1):65–76. doi: 10.1177/1074248413501017. [PubMed: 24064009]

George O, Ghozland S, Azar MR, Cottone P, Zorrilla EP, Parsons LH, O'Dell LE, Richardson HN, Koob GF. CRF-CRF1 system activation mediates withdrawal-induced increases in nicotine self-administration in nicotine-dependent rats. Proc Natl Acad Sci U S A2007;104(43):17198–203. doi: 10.1073/pnas.0707585104. [PubMed: 17921249]

Gerak LR, Collins GT, France CP. Effects of Lorcaserin on Cocaine and Methamphetamine Self-Administration and Reinstatement of Responding Previously Maintained by Cocaine in Rhesus Monkeys. J Pharmacol Exp Ther2016;359(3):383–391. doi: 10.1124/jpet.116.236307. [PubMed: 27650954]

Gerak LR, Collins GT, Maguire DR, France CP. Effects of lorcaserin on reinstatement of responding previously maintained by cocaine or remifentanil in rhesus monkeys. Exp Clin Psychopharmacol2019;27(1):78–86. doi: 10.1037/pha0000234. [PubMed: 30382731]

Gibson EL. Emotional influences on food choice: sensory, physiological and psychological pathways. Physiol Behav200630;89(1):53–61. doi: 10.1016/j.physbeh.2006.01.024. [PubMed: 16545403]

Gilpin NW, Richardson HN, Koob GF. Effects of CRF1-receptor and opioid-receptor antagonists on dependence-induced increases in alcohol drinking by alcohol-preferring (P) rats. Alcohol Clin Exp Res2008;32(9):1535–42. doi: 10.1111/j.1530-0277.2008.00745.x. [PubMed: 18631323]

Glatz AC, Ehrlich M, Bae RS, Clarke MJ, Quinlan PA, Brown EC, Rada P, Hoebel BG. Inhibition of cocaine self-administration by fluoxetine or D-fenfluramine combined with phentermine. Pharmacol Biochem Behav2002;71(1–2):197–204. doi: 10.1016/s0091-3057(01)00657-8. [PubMed: 11812523]

Glowa JR, Rice KC, Matecka D, Rothman RB. Phentermine/fenfluramine decreases cocaine self-administration in rhesus monkeys. Neuroreport1997;8(6):1347–51. doi: 10.1097/00001756-199704140-00006. [PubMed: 9172133]

Gold MS, Badgaiyan RD, Blum K. A Shared Molecular and Genetic Basis for Food and Drug Addiction: Overcoming Hypodopaminergic Trait/State by Incorporating Dopamine Agonistic Therapy in Psychiatry. Psychiatr Clin North Am2015;38(3):419–62. doi: 10.1016/j.psc.2015.05.011. [PubMed: 26300032]

Gold MS, Blum K, Febo M, Baron D, Modestino EJ, Elman I, Badgaiyan RD. Molecular role of dopamine in anhedonia linked to reward deficiency syndrome (RDS) and anti-reward systems. Front Biosci2018;10:309–325. doi: 10.2741/s518.

Goldschmidt AB, Wall M, Choo TH, Becker C, Neumark-Sztainer D. Shared risk factors for mood-, eating-, and weight-related health outcomes. Health Psychol2016;35(3):245–52. doi: 10.1037/hea0000283. [PubMed: 26690639]

Goldstone AP, Prechtl de Hernandez CG, Beaver JD, Muhammed K, Croese C, Bell G, Durighel G, Hughes E, Waldman AD, Frost G, Bell JD. Fasting biases brain reward systems towards high-calorie foods. Eur J Neurosci2009;30(8):1625–35. doi: 10.1111/j.1460-9568.2009.06949.x. [PubMed: 19811532]

Gosnell BA. Sucrose intake enhances behavioral sensitization produced by cocaine. Brain Res2005;1031(2):194–201. doi: 10.1016/j.brainres.2004.10.037. [PubMed: 15649444]

Goudriaan AE, de Ruiter MB, van den Brink W, Oosterlaan J, Veltman DJ. Brain activation patterns associated with cue reactivity and craving in abstinent problem gamblers, heavy smokers and healthy controls: an fMRI study. Addict Biol2010;15(4):491–503. doi: 10.1111/j.1369-1600.2010.00242.x. [PubMed: 20840335]

Granero R, Hilker I, Agüera Z, Jiménez-Murcia S, Sauchelli S, Islam MA, Fagundo AB, Sánchez I, Riesco N, Dieguez C, Soriano J, Salcedo-Sánchez C, Casanueva FF, De la Torre R, Menchón JM, Gearhardt AN, Fernández-Aranda F. Food addiction in a Spanish sample of eating disorders: DSM-5 diagnostic subtype differentiation and validation data. Eur Eat Disord Rev2014;22(6):389–96. doi: 10.1002/erv.2311. [PubMed: 25139680]

Greenwell TN, Funk CK, Cottone P, Richardson HN, Chen SA, Rice KC, Zorrilla EP, Koob GF. Corticotropin-releasing factor-1 receptor antagonists decrease heroin self-administration in long-but not short-access rats. Addict Biol2009;14(2):130–43. doi: 10.1111/j.1369-1600.2008.00142.x. [PubMed: 19291009]

Grigson PS. The state of the reward comparison hypothesis: theoretical comment on Huang and Hsiao (2008). Behav Neurosci2008;122(6):1383–90. doi: 10.1037/a0013968. [PubMed: 19045958]

Grilo CM, White MA, Masheb RM. DSM-IV psychiatric disorder comorbidity and its correlates in binge eating disorder. Int J Eat Disord2009;42(3):228–234. doi:10.1002/eat.20599. [PubMed: 18951458]

Grimm JW. Incubation of food craving in rats: A review. J Exp Anal Behav2020;113(1):37–47. doi: 10.1002/jeab.561. [PubMed: 31709556]

Grönbladh A, Nylander E, Hallberg M. The neurobiology and addiction potential of anabolic androgenic steroids and the effects of growth hormone. Brain Res Bull2016;126(Pt 1):127–137. doi: 10.1016/j.brainresbull.2016.05.003. [PubMed: 27156843]

Grucza RA, Krueger RF, Racette SB, Norberg KE, Hipp PR, Bierut LJ. The emerging link between alcoholism risk and obesity in the United States. Arch Gen Psychiatry201012;67(12):1301–8. doi: 10.1001/archgenpsychiatry.2010.155.PMID: 21135330; PMCID: PMC3110764. [PubMed: 21135330]

Guerdjikova AI, Mori N, Casuto LS, McElroy SL. Novel pharmacologic treatment in acute binge eating disorder - role of lisdexamfetamine. Neuropsychiatr Dis Treat2016;12:833–41. doi: 10.2147/NDT.S80881. [PubMed: 27143885]

Guerdjikova AI, Walsh B, Shan K, Halseth AE, Dunayevich E, McElroy SL. Concurrent Improvement in Both Binge Eating and Depressive Symptoms with Naltrexone/Bupropion Therapy in Overweight or Obese Subjects with Major Depressive Disorder in an Open-Label, Uncontrolled Study. Adv Ther2017;34(10):2307–2315. doi: 10.1007/s12325-017-0613-9. [PubMed: 28918581]

Haedt-Matt AA, Keel PK. Revisiting the affect regulation model of binge eating: a meta-analysis of studies using ecological momentary assessment. Psychol Bull2011;137(4):660–681. doi: 10.1037/a0023660. [PubMed: 21574678]

Hagan MM, Wauford PK, Chandler PC, Jarrett LA, Rybak RJ, Blackburn K. A new animal model of binge eating: key synergistic role of past caloric restriction and stress. Physiol Behav2002;77(1):45–54. doi: 10.1016/s0031-9384(02)00809-0. [PubMed: 12213501]

Halladay AK, Wagner GC, Sekowski A, Rothman RB, Baumann MH, Fisher H. Alterations in alcohol consumption, withdrawal seizures, and monoamine transmission in rats treated with phentermine and 5-hydroxy-L-tryptophan. Synapse2006;59(5):277–89. doi: 10.1002/syn.20239. [PubMed: 16416445]

Halseth A, Shan K, Gilder K, Malone M, Acevedo L, Fujioka K. Quality of life, binge eating and sexual function in participants treated for obesity with sustained release naltrexone/bupropion. Obes Sci Pract2018;4(2):141–152. doi: 10.1002/osp4.156. [PubMed: 29670752]

Haltia LT, Rinne JO, Merisaari H, Maguire RP, Savontaus E, Helin S, Någren K, Kaasinen V. Effects of intravenous glucose on dopaminergic function in the human brain in vivo. Synapse2007;61(9):748–56. doi: 10.1002/syn.20418. [PubMed: 17568412]

Hansen HH, Jensen MM, Overgaard A, Weikop P, Mikkelsen JD. Tesofensine induces appetite suppression and weight loss with reversal of low forebrain dopamine levels in the diet-induced obese rat. Pharmacol Biochem Behav2013;110:265–71. doi: 10.1016/j.pbb.2013.07.018. [PubMed: 23932919]

Harvey-Lewis C, Li Z, Higgins GA, Fletcher PJ. The 5-HT(2C) receptor agonist lorcaserin reduces cocaine self-administration, reinstatement of cocaine-seeking and cocaine induced locomotor activity. Neuropharmacology2016;101:237–45. doi: 10.1016/j.neuropharm.2015.09.028. [PubMed: 26427596]

Hatzigiakoumis DS, Martinotti G, Giannantonio MD, Janiri L. Anhedonia and substance dependence: clinical correlates and treatment options. Front Psychiatry2011;2:10. doi: 10.3389/fpsyt.2011.00010. [PubMed: 21556280]

Hauck C, Weiß A, Schulte EM, Meule A, Ellrott T. Prevalence of 'Food Addiction' as Measured with the Yale Food Addiction Scale 2.0 in a Representative German Sample and Its Association with Sex, Age and Weight Categories. Obes Facts2017;10(1):12–24. doi: 10.1159/000456013. [PubMed: 28190017]

Havlickova T, Charalambous C, Lapka M, Puskina N, Jerabek P, Sustkova-Fiserova M. Ghrelin Receptor Antagonism of Methamphetamine-Induced Conditioned Place Preference and Intravenous Self-Administration in Rats. Int J Mol Sci2018; 19(10):2925. doi: 10.3390/ijms19102925.

Heal DJ, Goddard S, Brammer RJ, Hutson PH, Vickers SP. Lisdexamfetamine reduces the compulsive and perseverative behaviour of binge-eating rats in a novel food reward/punished responding conflict model. J Psychopharmacol2016;30(7):662–75. doi: 10.1177/0269881116647506. [PubMed: 27170676]

Heinrichs SC, Menzaghi F, Schulteis G, Koob GF, Stinus L. Suppression of corticotropin-releasing factor in the amygdala attenuates aversive consequences of morphine withdrawal. Behav Pharmacol1995;6(1):74–80. [PubMed: 11224314]

Heinz A, Beck A, Grüsser SM, Grace AA, Wrase J. Identifying the neural circuitry of alcohol craving and relapse vulnerability. Addict Biol2009;14(1):108–18. doi: 10.1111/j.1369-1600.2008.00136.x. [PubMed: 18855799]

Heppner KM, Kirigiti M, Secher A, Paulsen SJ, Buckingham R, Pyke C, Knudsen LB, Vrang N, Grove KL. Expression and distribution of glucagon-like peptide-1 receptor mRNA, protein and binding in the male nonhuman primate (Macaca mulatta) brain. Endocrinology20151;156(1):255–67. doi: 10.1210/en.2014-1675. [PubMed: 25380238]

Hermanussen M, Tresguerres JA. A new anti-obesity drug treatment: first clinical evidence that, antagonising glutamate-gated Ca2+ ion channels with memantine normalises binge-eating disorders. Econ Hum Biol2005;3(2):329–37. doi: 10.1016/j.ehb.2005.04.001. [PubMed: 15886075]

Hernandez L, Hoebel BG. Food reward and cocaine increase extracellular dopamine in the nucleus accumbens as measured by microdialysis. Life Sci1988;42(18):1705–12. doi: 10.1016/0024-3205(88)90036-7. [PubMed: 3362036]

Hernandez NS, Ige KY, Mietlicki-Baase EG, Molina-Castro GC, Turner CA, Hayes MR, Schmidt HD. Glucagon-like peptide-1 receptor activation in the ventral tegmental area attenuates cocaine seeking in rats. Neuropsychopharmacology20189;43(10):2000–2008. doi: 10.1038/s41386-018-0010-3. Epub2018 Feb 14. [PubMed: 29497166]

Hernandez NS, O'Donovan B, Ortinski PI, Schmidt HD. Activation of glucagon-like peptide-1 receptors in the nucleus accumbens attenuates cocaine seeking in rats. Addict Biol20193;24(2):170–181. doi: 10.1111/adb.12583. Epub2017 Dec 11. [PubMed: 29226617]

Herzog DB, Keller MB, Sacks NR, Yeh CJ, Lavori PW. Psychiatric comorbidity in treatment-seeking anorexics and bulimics. J Am Acad Child Adolesc Psychiatry1992;31(5):810–8. doi: 10.1097/00004583-199209000-00006. [PubMed: 1400111]

Higgins GA, Fletcher PJ, Shanahan WR. Lorcaserin: A review of its preclinical and clinical pharmacology and therapeutic potential. Pharmacol Ther2020;205:107417. doi: 10.1016/j.pharmthera.2019.107417. [PubMed: 31629010]

Higo T, Mars RB, Boorman ED, Buch ER, Rushworth MF. Distributed and causal influence of frontal operculum in task control. Proc Natl Acad Sci U S A2011;108(10):4230–5. doi: 10.1073/pnas.1013361108. [PubMed: 21368109]

Higuchi S; Japanese Acamprosate Study Group. Efficacy of acamprosate for the treatment of alcohol dependence long after recovery from withdrawal syndrome: a randomized, double-blind, placebo-controlled study conducted in Japan (Sunrise Study). J Clin Psychiatry2015;76(2):181–8. doi: 10.4088/JCP.13m08940. [PubMed: 25742205]

Hinchliff GLM, Kelly AB, Chan GCK, Patton GC, Williams J. Risky dieting amongst adolescent girls: Associations with family relationship problems and depressed mood. Eat Behav2016;22:222–224. doi: 10.1016/j.eatbeh.2016.06.001. [PubMed: 27322520]

Hoebel BG, Avena NM, Rada P. Accumbens dopamine-acetylcholine balance in approach and avoidance. Curr Opin Pharmacol2007;7(6):617–27. doi: 10.1016/j.coph.2007.10.014. [PubMed: 18023617]

Hoertel HA, Will MJ, Leidy HJ. A randomized crossover, pilot study examining the effects of a normal protein vs. high protein breakfast on food cravings and reward signals in overweight/obese "breakfast skipping", late-adolescent girls. Nutr J2014;13:80. doi: 10.1186/1475-2891-13-80. [PubMed: 25098557]

Hopkins SC, Sunkaraneni S, Skende E, Hing J, Passarell JA, Loebel A, Koblan KS. Pharmacokinetics and Exposure-Response Relationships of Dasotraline in the Treatment of Attention-Deficit/Hyperactivity Disorder in Adults. Clin Drug Investig2016;36(2):137–46. doi: 10.1007/s40261-015-0358-7.

Howell LL, Cunningham KA. Serotonin 5-HT2 receptor interactions with dopamine function: implications for therapeutics in cocaine use disorder. Pharmacol Rev2015;67(1):176–97. doi: 10.1124/pr.114.009514. [PubMed: 25505168]

Hu L, Matthews A, Shmueli-Blumberg D, Killeen TK, Tai B, VanVeldhuisen P. Prevalence of obesity for opioid- and stimulant-dependent participants in substance use treatment clinical trials. Drug Alcohol Depend2018;190:255–262. doi:10.1016/j.drugalcdep.2018.06.014. [PubMed: 30077926]

Hudson JI, Hiripi E, Pope HG Jr, Kessler RC. The prevalence and correlates of eating disorders in the National Comorbidity Survey Replication. Biol Psychiatry2007;61(3):348–58. doi: 10.1016/j.biopsych.2006.03.040. [PubMed: 16815322]

Hudson JI, McElroy SL, Ferreira-Cornwell MC, Radewonuk J, Gasior M. Efficacy of Lisdexamfetamine in Adults With Moderate to Severe Binge-Eating Disorder: A Randomized Clinical Trial. JAMA Psychiatry2017;74(9):903–910. doi: 10.1001/jamapsychiatry.2017.1889. [PubMed: 28700805]

Hughes EK, Goldschmidt AB, Labuschagne Z, Loeb KL, Sawyer SM, Le Grange D. Eating disorders with and without comorbid depression and anxiety: similarities and differences in a clinical sample of children and adolescents. Eur Eat Disord Rev2013;21(5):386–94. doi: 10.1002/erv.2234. [PubMed: 23681932]

Íbias J, O'Dell LE, Nazarian A. Insulin dependent and independent normalization of blood glucose levels reduces the enhanced rewarding effects of nicotine in a rodent model of diabetes. Behav Brain Res2018;351:75–82. doi: 10.1016/j.bbr.2018.05.018. [PubMed: 29803655]

Iemolo A, Blasio A, St Cyr SA, Jiang F, Rice KC, Sabino V, Cottone P. CRF-CRF1 receptor system in the central and basolateral nuclei of the amygdala differentially mediates excessive eating of palatable food. Neuropsychopharmacology2013;38(12):2456–66. doi: 10.1038/npp.2013.147. [PubMed: 23748225]

Iemolo A, Valenza M, Tozier L, Knapp CM, Kornetsky C, Steardo L, Sabino V, Cottone P. Withdrawal from chronic, intermittent access to a highly palatable food induces depressive-like behavior in compulsive eating rats. Behav Pharmacol2012;23(5–6):593–602. doi: 10.1097/FBP.0b013e328357697f. [PubMed: 22854309]

Ifland JR, Preuss HG, Marcus MT, Rourke KM, Taylor WC, Burau K, Jacobs WS, Kadish W, Manso G. Refined food addiction: a classic substance use disorder. Med Hypotheses2009;72(5):518–26. doi: 10.1016/j.mehy.2008.11.035. [PubMed: 19223127]

Imaizumi T, Ando M, Nakatochi M, Yasuda Y, Honda H, Kuwatsuka Y, Kato S, Kondo T, Iwata M, Nakashima T, Yasui H, Takamatsu H, Okajima H, Yoshida Y, Maruyama S. Effect of dietary energy and polymorphisms in BRAP and GHRL on obesity and metabolic traits. Obes Res Clin Pract20181-Feb;12(Suppl 2):39–48. doi: 10.1016/j.orcp.2016.05.004 [PubMed: 27245511]

Iordanova MD, Deroche ML, Esber GR, Schoenbaum G. Neural correlates of two different types of extinction learning in the amygdala central nucleus. Nat Commun2016;7:12330. doi: 10.1038/ncomms12330. [PubMed: 27531638]

Ivezaj V, Saules KK, Schuh LM. New-onset substance use disorder after gastric bypass surgery: rates and associated characteristics. Obes Surg201411;24(11):1975–80. doi: 10.1007/s11695-014-1317-8.PMID: 24908245. [PubMed: 24908245]

Ivezaj V, Wiedemann AA, Grilo CM. Food addiction and bariatric surgery: a systematic review of the literature. Obes Rev2017;18(12):1386–1397. doi:10.1111/obr.12600. [PubMed: 28948684]

Jacka FN, Cherbuin N, Anstey KJ, Butterworth P. Dietary patterns and depressive symptoms over time: examining the relationships with socioeconomic position, health behaviours and cardiovascular risk. PLoS One2014;9(1):e87657. doi: 10.1371/journal.pone.0087657. [PubMed: 24489946]

Jacka FN, Kremer PJ, Berk M, de Silva-Sanigorski AM, Moodie M, Leslie ER, Pasco JA, Swinburn BA. A prospective study of diet quality and mental health in adolescents. PLoS One2011;6(9):e24805. doi: 10.1371/journal.pone.0024805. [PubMed: 21957462]

Jacka FN, Kremer PJ, Leslie ER, Berk M, Patton GC, Toumbourou JW, Williams JW. Associations between diet quality and depressed mood in adolescents: results from the Australian Healthy Neighbourhoods Study. Aust N Z J Psychiatry2010a;44(5):435–42. doi: 10.3109/00048670903571598. [PubMed: 20397785]

Jacka FN, O'Neil A, Opie R, Itsiopoulos C, Cotton S, Mohebbi M, Castle D, Dash S, Mihalopoulos C, Chatterton ML, Brazionis L, Dean OM, Hodge AM, Berk M. A randomised controlled trial of dietary improvement for adults with major depression (the 'SMILES' trial). BMC Med2017;15(1):23. doi: 10.1186/s12916-017-0791-y.Erratum in: BMC Med. 2018;16(1):236. [PubMed: 28137247]

Jacka FN, Pasco JA, Mykletun A, Williams LJ, Hodge AM, O'Reilly SL, Nicholson GC, Kotowicz MA, Berk M. Association of Western and traditional diets with depression and anxiety in women. Am J Psychiatry2010b;167(3):305–11. doi: 10.1176/appi.ajp.2009.09060881. [PubMed: 20048020]

Jacob A, Moullec G, Lavoie KL, Laurin C, Cowan T, Tisshaw C, Kazazian C, Raddatz C, Bacon SL. Impact of cognitive-behavioral interventions on weight loss and psychological outcomes: A meta-analysis. Health Psychol2018;37(5):417–432. doi: 10.1037/hea0000576. [PubMed: 29698017]

Jasinska AJ, Stein EA, Kaiser J, Naumer MJ, Yalachkov Y. Factors modulating neural reactivity to drug cues in addiction: a survey of human neuroimaging studies. Neurosci Biobehav Rev2014;38:1–16. doi: 10.1016/j.neubiorev.2013.10.013. [PubMed: 24211373]

Jasinski DR, Krishnan S. Abuse liability and safety of oral lisdexamfetamine dimesylate in individuals with a history of stimulant abuse. J Psychopharmacol2009;23(4):419–27. doi: 10.1177/0269881109103113. [PubMed: 19329547]

Jenkinson CP, Hanson R, Cray K, Wiedrich C, Knowler WC, Bogardus C, Baier L. Association of dopamine D2 receptor polymorphisms Ser311Cys and TaqIA with obesity or type 2 diabetes mellitus in Pima Indians. Int J Obes Relat Metab Disord2000;24(10):1233–8. doi: 10.1038/sj.ijo.0801381. [PubMed: 11093282]

Jerabek P, Havlickova T, Puskina N, Charalambous C, Lapka M, Kacer P, Sustkova-Fiserova M. Ghrelin receptor antagonism of morphine-induced conditioned place preference and behavioral and accumbens dopaminergic sensitization in rats. Neurochem Int2017; 110:101–113. doi: 10.1016/j.neuint.2017.09.013. [PubMed: 28958601]

Jerlhag EAlcohol-mediated behaviours and the gut-brain axis; with focus on glucagon-like peptide-1. Brain Res2020;1727:146562. doi: 10.1016/j.brainres.2019.146562. [PubMed: 31759971]

Jhou TC, Good CH, Rowley CS, Xu SP, Wang H, Burnham NW, Hoffman AF, Lupica CR, Ikemoto S. Cocaine drives aversive conditioning via delayed activation of dopamine-responsive habenular and midbrain pathways. J Neurosci2013;33(17):7501–12. doi: 10.1523/JNEUROSCI.3634-12.2013. [PubMed: 23616555]

Ji F, Liu Y, Hao JG, Wang LP, Dai MJ, Shen GF, Yan XB. KLB gene polymorphism is associated with obesity and non-alcoholic fatty liver disease in the Han Chinese. Aging2019;11(18):7847–7858. doi: 10.18632/aging.102293. [PubMed: 31548436]

Johnson BA, Ait-Daoud N, Wang XQ, Penberthy JK, Javors MA, Seneviratne C, Liu L. Topiramate for the treatment of cocaine addiction: a randomized clinical trial. JAMA Psychiatry2013;70(12):1338–46. doi: 10.1001/jamapsychiatry.2013.2295. [PubMed: 24132249]

Johnson PM, Kenny PJ. Dopamine D2 receptors in addiction-like reward dysfunction and compulsive eating in obese rats. Nat Neurosci2010;13(5):635–41. doi: 10.1038/nn.2519.Erratum in: Nat Neurosci 2010;13(8):1033. [PubMed: 20348917]

Kaland ME, Klein-Schwartz W. Comparison of lisdexamfetamine and dextroamphetamine exposures reported to U.S. poison centers. Clin Toxicol2015;53(5):477–85. doi: 10.3109/15563650.2015.1027903.

Kampman KM, Pettinati HM, Lynch KG, Spratt K, Wierzbicki MR, O'Brien CP. A double-blind, placebo-controlled trial of topiramate for the treatment of comorbid cocaine and alcohol dependence. Drug Alcohol Depend2013;133(1):94–9. doi: 10.1016/j.drugalcdep.2013.05.026. [PubMed: 23810644]

Kanji S, Wong E, Akioyamen L, Melamed O, Taylor VH. Exploring pre-surgery and post-surgery substance use disorder and alcohol use disorder in bariatric surgery: a qualitative scoping review [published correction appears in Int J Obes (Lond). 2019 Nov;43(11):2348]. Int J Obes (Lond)2019;43(9):1659–1674. doi:10.1038/s41366-019-0397-x. [PubMed: 31213657]

Karatayev O, Baylan J, Leibowitz SF. Increased intake of ethanol and dietary fat in galanin overexpressing mice. Alcohol2009;43(8):571–80. doi: 10.1016/j.alcohol.2009.09.025. [PubMed: 20004335]

Katterman SN, Kleinman BM, Hood MM, Nackers LM, Corsica JA. Mindfulness meditation as an intervention for binge eating, emotional eating, and weight loss: a systematic review. Eat Behav2014;15(2):197–204. doi: 10.1016/j.eatbeh.2014.01.005. [PubMed: 24854804]

Kawasaki K, Annicchiarico I, Glueck AC, Morón I, Papini MR. Reward loss and the basolateral amygdala: A function in reward comparisons. Behav Brain Res2017;331:205–213. doi: 10.1016/j.bbr.2017.05.036. [PubMed: 28511980]

Kawasaki K, Glueck AC, Annicchiarico I, Papini MR. Function of the centromedial amygdala in reward devaluation and open-field activity. Neuroscience2015;303:73–81. doi: 10.1016/j.neuroscience.2015.06.053. [PubMed: 26141844]

Kebir O, Gorsane MA, Blecha L, Krebs MO, Reynaud M, Benyamina A. Association of inflammation genes with alcohol dependence/abuse: a systematic review and a meta-analysis. Eur Addict Res2011;17(3):146–53. doi: 10.1159/000324849. [PubMed: 21447951]

Keele GR, Prokop JW, He H, Holl K, Littrell J, Deal A, Francic S, Cui L, Gatti DM, Broman KW, Tschannen M, Tsaih SW, Zagloul M, Kim Y, Baur B, Fox J, Robinson M, Levy S, Flister MJ, Mott R, Valdar W, Solberg Woods LC. Genetic Fine-Mapping and Identification of Candidate Genes and Variants for Adiposity Traits in Outbred Rats. Obesity (Silver Spring)20181;26(1):213–222. doi: 10.1002/oby.22075. [PubMed: 29193816]

Kelley AE, Will MJ, Steininger TL, Zhang M, Haber SN. Restricted daily consumption of a highly palatable food (chocolate Ensure(R)) alters striatal enkephalin gene expression. Eur J Neurosci2003;18(9):2592–8. doi: 10.1046/j.1460-9568.2003.02991.x. [PubMed: 14622160]

Kelly Y, Patalay P, Montgomery S, Sacker A. BMI Development and Early Adolescent Psychosocial Well-Being: UK Millennium Cohort Study. Pediatrics2016;138(6):e20160967. doi: 10.1542/peds.2016-0967. [PubMed: 27940679]

Keshen A, Helson T. Preliminary Evidence for the Off-Label Treatment of Bulimia Nervosa With Psychostimulants: Six Case Reports. J Clin Pharmacol2017;57(7):818–822. doi: 10.1002/jcph.868. [PubMed: 28111772]

Kessler RC, Berglund PA, Chiu WT, Deitz AC, Hudson JI, Shahly V, Aguilar-Gaxiola S, Alonso J, Angermeyer MC, Benjet C, Bruffaerts R, de Girolamo G, de Graaf R, Maria Haro J, Kovess-Masfety V, O'Neill S, Posada-Villa J, Sasu C, Scott K, Viana MC, Xavier M. The prevalence and correlates of binge eating disorder in the World Health Organization World Mental Health Surveys. Biol Psychiatry2013;73(9):904–14. doi: 10.1016/j.biopsych.2012.11.020. [PubMed: 23290497]

Khan A, Ahmed R, Burton NW. Prevalence and correlates of depressive symptoms in secondary school children in Dhaka city, Bangladesh. Ethn Health2020;25(1):34–46. doi: 10.1080/13557858.2017.1398313. [PubMed: 29096523]

Kim KB, Shin YA. Males with Obesity and Overweight. J Obes Metab Syndr2020;29(1):18–25. doi:10.7570/jomes20008. [PubMed: 32146733]

Kim YJ, Go MJ, Hu C, Hong CB, Kim YK, Lee JY, Hwang JY, Oh JH, Kim DJ, Kim NH, Kim S, Hong EJ, Kim JH, Min H, Kim Y, Zhang R, Jia W, Okada Y, Takahashi A, Kubo M, Tanaka T, Kamatani N, Matsuda K; MAGIC consortium, Park T, Oh B, Kimm K, Kang D, Shin C, Cho NH, Kim HL, Han BG, Lee JY, Cho YS. Large-scale genome-wide association studies in East Asians identify new genetic loci influencing metabolic traits. Nat Genet2011911;43(10):990–5. doi: 10.1038/ng.939. [PubMed: 21909109]

Kinzig KP, Hargrave SL, Honors MA. Binge-type eating attenuates corticosterone and hypophagic responses to restraint stress. Physiol Behav2008;95(1–2):108–13. doi: 10.1016/j.physbeh.2008.04.026. [PubMed: 18602652]

Knackstedt LA, Samimi MM, Ettenberg A. Evidence for opponent-process actions of intravenous cocaine and cocaethylene. Pharmacol Biochem Behav2002;72(4):931–6. doi: 10.1016/s0091-3057(02)00764-5. [PubMed: 12062583]

Knapp DJ, Overstreet DH, Moy SS, Breese GR. SB242084, flumazenil, and CRA1000 block ethanol withdrawal-induced anxiety in rats. Alcohol2004;32(2):101–11. doi: 10.1016/j.alcohol.2003.08.007. [PubMed: 15163561]

Koball AM, Clark MM, Collazo-Clavell M, Kellogg T, Ames G, Ebbert J, Grothe KB. The relationship among food addiction, negative mood, and eating-disordered behaviors in patients seeking to have bariatric surgery. Surg Obes Relat Dis2016;12(1):165–70. doi: 10.1016/j.soard.2015.04.009. [PubMed: 26183302]

Koblan KS, Hopkins SC, Sarma K, Jin F, Goldman R, Kollins SH, Loebel A. Dasotraline for the Treatment of Attention-Deficit/Hyperactivity Disorder: A Randomized, Double-Blind, Placebo-Controlled, Proof-of-Concept Trial in Adults. Neuropsychopharmacology2015;40(12):2745–52. doi: 10.1038/npp.2015.124. [PubMed: 25948101]

Koob GF. The dark side of emotion: the addiction perspective. Eur J Pharmacol2015;753:73–87. doi: 10.1016/j.ejphar.2014.11.044. [PubMed: 25583178]

Koob GF, Le Moal M. Plasticity of reward neurocircuitry and the ‘dark side’ of drug addiction. Nat Neurosci2005;8(11):1442–4. doi: 10.1038/nn1105-1442. [PubMed: 16251985]

Koob GF, Le Moal M. Neurobiological mechanisms for opponent motivational processes in addiction. Philos Trans R Soc Lond B Biol Sci2008;363(1507):3113–23. doi: 10.1098/rstb.2008.0094. [PubMed: 18653439]

Koopmann A, von der Goltz C, Grosshans M, Dinter C, Vitale M, Wiedemann K, Kiefer F. The association of the appetitive peptide acetylated ghrelin with alcohol craving in early abstinent alcohol dependent individuals. Psychoneuroendocrinology. 2012;37(7):980–6. doi: 10.1016/j.psyneuen.2011.11.005. [PubMed: 22172639]

Kraja AT, Chasman DI, North KE, Reiner AP, Yanek LR, Kilpeläinen TO, Smith JA, Dehghan A, Dupuis J, Johnson AD, Feitosa MF, Tekola-Ayele F, Chu AY, Nolte IM, Dastani Z, Morris A, Pendergrass SA, Sun YV, Ritchie MD, Vaez A, Lin H, Ligthart S, Marullo L, Rohde R, Shao Y, Ziegler MA, Im HK; Cross Consortia Pleiotropy Group; Cohorts for Heart and; Aging Research in Genetic Epidemiology; Genetic Investigation of Anthropometric Traits Consortium; Global Lipids Genetics Consortium; Meta-Analyses of Glucose; Insulin-related traits Consortium; Global BPgen Consortium; ADIPOGen Consortium; Women’s Genome Health Study; Howard University Family Study, Schnabel RB, Jørgensen T, Jørgensen ME, Hansen T, Pedersen O, Stolk RP, Snieder H, Hofman A, Uitterlinden AG, Franco OH, Ikram MA, Richards JB, Rotimi C, Wilson JG, Lange L, Ganesh SK, Nalls M, Rasmussen-Torvik LJ, Pankow JS, Coresh J, Tang W, Linda Kao WH, Boerwinkle E, Morrison AC, Ridker PM, Becker DM, Rotter JI, Kardia SL, Loos RJ, Larson MG, Hsu YH, Province MA, Tracy R, Voight BF, Vaidya D, O’Donnell CJ, Benjamin EJ, Alizadeh BZ, Prokopenko I, Meigs JB, Borecki IB. Pleiotropic genes for metabolic syndrome and inflammation. Mol Genet Metab2014;112(4):317–38. doi: 10.1016/j.ymgme.2014.04.007. [PubMed: 24981077]

Kranzler HR, Covault J, Feinn R, Armeli S, Tennen H, Arias AJ, Gelernter J, Pond T, Oncken C, Kampman KM. Topiramate treatment for heavy drinkers: moderation by a GRIK1 polymorphism. Am J Psychiatry2014;171(4):445–52. doi: 10.1176/appi.ajp.2013.13081014.Erratum in: Am J Psychiatry 2014;171(5):585. [PubMed: 24525690]

Kranzler HR, Zhou H, Kember RL, Vickers Smith R, Justice AC, Damrauer S, Tsao PS, Klarin D, Baras A, Reid J, Overton J, Rader DJ, Cheng Z, Tate JP, Becker WC, Concato J, Xu K, Polimanti R, Zhao H, Gelernter J. Genome-wide association study of alcohol consumption and use disorder in 274,424 individuals from multiple populations. Nat Commun2019a;10(1):1499. doi: 10.1038/s41467-019-09480-8.Erratum in: Nat Commun 2019;10(1):2275. Erratum in: Nat Commun 2019;10(1):4050. [PubMed: 30940813]

Kranzler HR, Zhou H, Kember RL, Smith RV, Justice AC, Damrauer S, Tsao PS, Klarin D, Baras A, Reid J, Overton J, Rader DJ, Cheng Z, Tate JP, Becker WC, Concato J, Xu K, Polimanti R, Zhao H, Gelernter J. Author Correction: Genome-wide association study of alcohol consumption and use disorder in 274,424 individuals from multiple populations.

Nat Commun2019b;10(1):2275. doi: 10.1038/s41467-019-10254-5.Erratum for: Nat Commun 2019;10(1):1499. [PubMed: 31101824]

Kranzler HR, Zhou H, Kember RL, Smith RV, Justice AC, Damrauer S, Tsao PS, Klarin D, Baras A, Reid J, Overton J, Rader DJ, Cheng Z, Tate JP, Becker WC, Concato J, Xu K, Polimanti R, Zhao H, Gelernter J. Author Correction: Genome-wide association study of alcohol consumption and use disorder in 274,424 individuals from multiple populations. Nat Commun2019c;10(1):2275. doi: 10.1038/s41467-019-10254-5.Erratum for: Nat Commun 2019;10(1):1499. [PubMed: 31101824]

Kreisler AD, Garcia MG, Spierling SR, Hui BE, Zorrilla EP. Extended vs. brief intermittent access to palatable food differently promote binge-like intake, rejection of less preferred food, and weight cycling in female rats. Physiol Behav2017;177:305–316. doi: 10.1016/j.physbeh.2017.03.039. [PubMed: 28366814]

Kreisler AD, Mattock M, Zorrilla EP. The duration of intermittent access to preferred sucrose-rich food affects binge-like intake, fat accumulation, and fasting glucose in male rats. Appetite2018;130:59–69. doi: 10.1016/j.appet.2018.07.025. [PubMed: 30063959]

Krolow R, Noschang CG, Arcego D, Andreazza AC, Peres W, Gonçalves CA, Dalmaz C. Consumption of a palatable diet by chronically stressed rats prevents effects on anxiety-like behavior but increases oxidative stress in a sex-specific manner. Appetite2010;55(1):108–16. doi: 10.1016/j.appet.2010.03.013. [PubMed: 20347900]

Kuhar MJ, Pilotte NS. Neurochemical changes in cocaine withdrawal. Trends Pharmacol Sci1996; Jul;17(7):260–4. doi: 10.1016/0165-6147(96)10024-9. [PubMed: 8756185]

Kuppens RJ, Diène G, Bakker NE, Molinas C, Faye S, Nicolino M, Bernoux D, Delhanty PJ, van der Lely AJ, Allas S, Julien M, Delale T, Tauber M, Hokken-Koelega AC. Elevated ratio of acylated to unacylated ghrelin in children and young adults with Prader-Willi syndrome. Endocrine2015; 50(3):633–42. [PubMed: 25989955]

Kvaløy K, Holmen J, Hveem K, Holmen TL. Genetic Effects on Longitudinal Changes from Healthy to Adverse Weight and Metabolic Status – The HUNT Study. PLoS One2015;10(10):e0139632. doi: 10.1371/journal.pone.0139632. [PubMed: 26445370]

Kwak Y, Kim Y. Association between mental health and meal patterns among elderly Koreans. Geriatr Gerontol Int Jan;18(1):161–168. doi: 10.1111/ggi.13106.

Labarthe A, Fiquet O, Hassouna R, Zizzari P, Lanfumey L, Ramoz N, Grouselle D, Epelbaum J, Tolle V. Ghrelin-Derived Peptides: A Link between Appetite/Reward, GH Axis, and Psychiatric Disorders?Front Endocrinol2014;5:163. doi: 10.3389/fendo.2014.00163.

Lai JS, Oldmeadow C, Hure AJ, McEvoy M, Byles J, Attia J. Longitudinal diet quality is not associated with depressive symptoms in a cohort of middle-aged Australian women. Br J Nutr2016;115(5):842–50. doi: 10.1017/S000711451500519X. [PubMed: 26787123]

Lamiquiz-Moneo I, Mateo-Gallego R, Bea AM, Dehesa-Garcia B, Perez-Calahorra S, Marco-Benedi V, Baila-Rueda L, Laclaustra M, Civeira, Cenarro A. Genetic predictors of weight loss in overweight and obese subjects. Sci Rep2019;9(1):10770. doi: 10.1038/s41598-019-47283-5. [PubMed: 31341224]

Lancaster TM, Ihssen I, Brindley LM, Linden DE. Preliminary evidence for genetic overlap between body mass index and striatal reward response. Transl Psychiatry2018;8(1):19. doi: 10.1038/s41398-017-0068-4. [PubMed: 29317597]

Lanza HI, Grella CE, Chung PJ. Adolescent obesity and future substance use: Incorporating the psychosocial context. J Adolesc201512;45:20–30. doi: 10.1016/j.adolescence.2015.08.014. Epub2015 Sep 5. [PubMed: 26349450]

Laraia BA, Adler NE, Coleman-Phox K, Vieten C, Mellin L, Kristeller JL, Thomas M, Stotland NE, Lustig RH, Dallman MF, Hecht FM, Bush NR, de Groat CL, Epel E. Novel Interventions to Reduce Stress and Overeating in Overweight Pregnant Women: A Feasibility Study. Matern Child Health J2018;22(5):670–678. doi: 10.1007/s10995-018-2435-z. [PubMed: 29455384]

Lee G, Han K, Kim H. Risk of mental health problems in adolescents skipping meals: The Korean National Health and Nutrition Examination Survey 2010 to 2012. Nurs Outlook2017a;65(4):411–419. doi: 10.1016/j.outlook.2017.01.007. [PubMed: 28196640]

Lee KT, Byun MJ, Kang KS, Park EW, Lee SH, Cho S, Kim H, Kim KW, Lee T, Park JE, Park W, Shin D, Park HS, Jeon JT, Choi BH, Jang GW, Choi SH, Kim DW, Lim D, Park HS, Park MR, Ott J, Schook LB, Kim TH, Kim H. Neuronal genes for subcutaneous fat thickness in human and pig are identified by local genomic sequencing and combined SNP association study. PLoS One2011;6(2):e16356. doi: 10.1371/journal.pone.0016356. [PubMed: 21311593]

Lee MR, Tapocik JD, Ghareeb M, Schwandt ML, Dias AA, Le AN, Cobbina E, Farinelli LA, Bouhlal S, Farokhnia M, Heilig M, Akhlaghi F, Leggio L. The novel ghrelin receptor inverse agonist PF-5190457 administered with alcohol: preclinical safety experiments and a phase 1b human laboratory study. Mol Psychiatry2020;25(2):461–475. doi: 10.1038/s41380-018-0064-y. [PubMed: 29728704]

Lee SA, Park EC, Ju YJ, Lee TH, Han E, Kim TH. Breakfast consumption and depressive mood: A focus on socioeconomic status. Appetite2017b;114:313–319. doi: 10.1016/j.appet.2017.04.007. [PubMed: 28400301]

Leeman RF, O’Malley SS, White MA, McKee SA. Nicotine and food deprivation decrease the ability to resist smoking. Psychopharmacology2010;212(1):25–32. doi: 10.1007/s00213-010-1902-z. [PubMed: 20585761]

Leidy HJ, Ortinau LC, Douglas SM, Hoertel HA. Beneficial effects of a higher-protein breakfast on the appetitive, hormonal, and neural signals controlling energy intake regulation in overweight/obese, “breakfast-skipping,” late-adolescent girls. Am J Clin Nutr2013;97(4):677–88. doi: 10.3945/ajcn.112.053116. [PubMed: 23446906]

Lemeshow AR, Rimm EB, Hasin DS, Gearhardt AN, Flint AJ, Field AE, Genkinger JM. Food and beverage consumption and food addiction among women in the Nurses’ Health Studies. Appetite2018;121:186–197. doi: 10.1016/j.appet.2017.10.038. [PubMed: 29102534]

Lemieux AM, al’Absi M. Changes in circulating peptide YY and ghrelin are associated with early smoking relapse. Biol Psychol2018;131:43–48. doi: 10.1016/j.biopsycho.2017.03.007. [PubMed: 28300626]

Leon GR, Fulkerson JA, Perry CL, Keel PK, Klump KL. Three to four year prospective evaluation of personality and behavioral risk factors for later disordered eating in adolescent girls and boys. J Youth Adolesc1999;28:181.

Leventhal AM, Brightman M, Ameringer KJ, Greenberg J, Mickens L, Ray LA, Sun P, Sussman S. Anhedonia associated with stimulant use and dependence in a population-based sample of American adults. Exp Clin Psychopharmacol2010;18(6):562–9. doi: 10.1037/a0021964. [PubMed: 21186931]

Leventhal AM, Cho J, Stone MD, Barrington-Trimis JL, Chou CP, Sussman SY, Riggs NR, Unger JB, Audrain-McGovern J, Strong DR. Associations between anhedonia and marijuana use escalation across mid-adolescence. Addiction2017;112(12):2182–2190. doi: 10.1111/add.13912. [PubMed: 28623880]

Levy FMethamphetamine addiction: potential substitute treatment. Ther Adv Psychopharmacol201612;6(6):382–383. doi: 10.1177/2045125316672137. Epub2016 Sep 30. [PubMed: 28008351]

Li X, Tamashiro KL, Liu Z, Bello NT, Wang X, Aja S, Bi S, Ladenheim EE, Ross CA, Moran TH, Smith WW. A novel obesity model: synphilin-1-induced hyperphagia and obesity in mice. Int J Obes (Lond)20129;36(9):1215–21. doi: 10.1038/ijo.2011.235 [PubMed: 22158267]

Li X, Treesukosol Y, Moghadam A, Smith M, Ofeldt E, Yang D, Li T, Tamashiro K, Choi P, Moran TH, Smith WW. Behavioral characterization of the hyperphagia synphilin-1 overexpressing mice. PLoS One2014514;9(5):e91449. doi: 10.1371/journal.pone.0091449. [PubMed: 24829096]

Lien LIs breakfast consumption related to mental distress and academic performance in adolescents? Public Health Nutr2007;10(4):422–8. doi: 10.1017/S1368980007258550. [PubMed: 17362539]

Lindgren E, Gray K, Miller G, Tyler R, Wiers CE, Volkow ND, Wang GJ. Food addiction: A common neurobiological mechanism with drug abuse. Front Biosci2018;23:811–836. doi: 10.2741/4618.

Lips MA, Wijngaarden MA, van der Grond J, van Buchem MA, de Groot GH, Rombouts SA, Pijl H, Veer IM. Resting-state functional connectivity of brain regions involved in cognitive control, motivation, and reward is enhanced in obese females. Am J Clin Nutr2014;100(2):524–31. doi: 10.3945/ajcn.113.080671. [PubMed: 24965310]

Liu J, Li T, Yang D, Ma R, Moran TH, Smith WW. Synphilin-1 alters metabolic homeostasis in a novel Drosophila obesity model. Int J Obes (Lond)201212;36(12):1529–36. doi: 10.1038/ijo.2012.111 [PubMed: 22828940]

Howes Seth, Hartmann-Boyce Jamie, Livingstone-Banks Jonathan, Hong Bosun, Lindson Nicola. Antidepressants for smoking cessation. Cochrane Database Syst Rev2020422;4(4):CD000031. doi: 10.1002/14651858.CD000031.pub5. [PubMed: 32319681]

Loid P, Mustila T, Mäkitie RE, Viljakainen H, Kämpe A, Tossavainen P, Lipsanen-Nyman M, Pekkinen M, Mäkitie O. Rare Variants in Genes Linked to Appetite Control and Hypothalamic Development in Early-Onset Severe Obesity. Front Endocrinol2020;11:81. doi: 10.3389/fendo.2020.00081.

Lu B, Diz-Chaves Y, Markovic D, Contarino A, Penicaud L, Fanelli F, Clark S, Lehnert H, Cota D, Grammatopoulos DK, Tabarin A. The corticotrophin-releasing factor/urocortin system regulates white fat browning in mice through paracrine mechanisms. Int J Obes2015;39(3):408–17. doi: 10.1038/ijo.2014.164.

Lu Y, Day FR, Gustafsson S, Buchkovich ML, Na J, Bataille V, Cousminer DL, Dastani Z, Drong AW, Esko T, Evans DM, Falchi M, Feitosa MF, Ferreira T, Hedman ÅK, Haring R, Hysi PG, Iles MM, Justice AE, Kanoni S, Lagou V, Li R, Li X, Locke A, Lu C, Mägi R, Perry JR, Pers TH, Qi Q, Sanna M, Schmidt EM, Scott WR, Shungin D, Teumer A, Vinkhuyzen AA, Walker RW, Westra HJ, Zhang M, Zhang W, Zhao JH, Zhu Z, Afzal U, Ahluwalia TS, Bakker SJ, Bellis C, Bonnefond A, Borodulin K, Buchman AS, Cederholm T, Choh AC, Choi HJ, Curran JE, de Groot LC, De Jager PL, Dhonukshe-Rutten RA, Enneman AW, Eury E, Evans DS, Forsen T, Friedrich N, Fumeron F, Garcia ME, Gärtner S, Han BG, Havulinna AS, Hayward C, Hernandez D, Hillege H, Ittermann T, Kent JW, Kolcic I, Laatikainen T, Lahti J, Mateo Leach I, Lee CG, Lee JY, Liu T, Liu Y, Lobbens S, Loh M, Lyytikäinen LP, Medina-Gomez C, Michaëlsson K, Nalls MA, Nielson CM, Oozageer L, Pascoe L, Paternoster L, Polašek O, Ripatti S, Sarzynski MA, Shin CS, Narančić NS, Spira D, Srikanth P, Steinhagen-Thiessen E, Sung YJ, Swart KM, Taittonen L, Tanaka T, Tikkanen E, van der Velde N, van Schoor NM, Verweij N, Wright AF, Yu L, Zmuda JM, Eklund N, Forrester T, Grarup N, Jackson AU, Kristiansson K, Kuulasmaa T, Kuusisto J, Lichtner P, Luan J, Mahajan A, Männistö S, Palmer CD, Ried JS, Scott RA, Stancáková A, Wagner PJ, Demirkan A, Döring A, Gudnason V, Kiel DP, Kühnel B, Mangino M, Mcknight B, Menni C, O'Connell JR, Oostra BA, Shuldiner AR, Song K, Vandenput L, van Duijn CM, Vollenweider P, White CC, Boehnke M, Boettcher Y, Cooper RS, Forouhi NG, Gieger C, Grallert H, Hingorani A, Jørgensen T, Jousilahti P, Kivimaki M, Kumari M, Laakso M, Langenberg C, Linneberg A, Luke A, Mckenzie CA, Palotie A, Pedersen O, Peters A, Strauch K, Tayo BO, Wareham NJ, Bennett DA, Bertram L, Blangero J, Blüher M, Bouchard C, Campbell H, Cho NH, Cummings SR, Czerwinski SA, Demuth I, Eckardt R, Eriksson JG, Ferrucci L, Franco OH, Froguel P, Gansevoort RT, Hansen T, Harris TB, Hastie N, Heliövaara M, Hofman A, Jordan JM, Jula A, Kähönen M, Kajantie E, Knekt PB, Koskinen S, Kovacs P, Lehtimäki T, Lind L, Liu Y, Orwoll ES, Osmond C, Perola M, Pérusse L, Raitakari OT, Rankinen T, Rao DC, Rice TK, Rivadeneira F, Rudan I, Salomaa V, Sørensen TI, Stumvoll M, Tönjes A, Towne B, Tranah GJ, Tremblay A, Uitterlinden AG, van der Harst P, Vartiainen E, Viikari JS, Vitart V, Vohl MC, Völzke H, Walker M, Wallaschofski H, Wild S, Wilson JF, Yengo L, Bishop DT, Borecki IB, Chambers JC, Cupples LA, Dehghan A, Deloukas P, Fatemifar G, Fox C, Furey TS, Franke L, Han J, Hunter DJ, Karjalainen J, Karpe F, Kaplan RC, Kooner JS, McCarthy MI, Murabito JM, Morris AP, Bishop JA, North KE, Ohlsson C, Ong KK, Prokopenko I, Richards JB, Schadt EE, Spector TD, Widén E, Willer CJ, Yang J, Ingelsson E, Mohlke KL, Hirschhorn JN, Pospisilik JA, Zillikens MC, Lindgren C, Kilpeläinen TO, Loos RJ. New loci for body fat percentage reveal link between adiposity and cardiometabolic disease risk. Nat Commun2016;7:10495. doi: 10.1038/ncomms10495. [PubMed: 26833246]

Luppino FS, de Wit LM, Bouvy PF, Stijnen T, Cuijpers P, Penninx BW, Zitman FG. Overweight, obesity, and depression: a systematic review and meta-analysis of longitudinal studies. Arch Gen Psychiatry20103;67(3):220–9. doi: 10.1001/archgenpsychiatry.2010.2. [PubMed: 20194822]

Lutz B, Marsicano G, Maldonado R, Hillard CJ. The endocannabinoid system in guarding against fear, anxiety and stress. Nat Rev Neurosci2015;16(12):705–18. doi: 10.1038/nrn4036. [PubMed: 26585799]

Maclaren VV, Fugelsang JA, Harrigan KA, Dixon MJ. The personality of pathological gamblers: a meta-analysis. Clin Psychol Rev2011;31(6):1057–67. doi: 10.1016/j.cpr.2011.02.002. [PubMed: 21802620]

Mainz V, Drüke B, Boecker M, Kessel R, Gauggel S, Forkmann T. Influence of cue exposure on inhibitory control and brain activation in patients with alcohol dependence. Front Hum Neurosci2012;6:92. doi: 10.3389/fnhum.2012.00092. [PubMed: 22557953]

Maj M, Turchan J, Smiałowska M, Przewłocka B. Morphine and cocaine influence on CRF biosynthesis in the rat central nucleus of amygdala. Neuropeptides2003;37(2):105–10. doi: 10.1016/s0143-4179(03)00021-0. [PubMed: 12747942]

Mangubat M, Lutfy K, Lee ML, Pulido L, Stout D, Davis R, Shin CS, Shahbazian M, Seasholtz S, Sinha-Hikim A, Sinha-Hikim I, O'Dell LE, Lyzlov A, Liu Y, Friedman TC. Effect of nicotine on body composition in mice. J Endocrinol2012;212(3):317–26. doi: 10.1530/JOE-11-0350. [PubMed: 22138237]

Maniam J, Antoniadis CP, Le V, Morris MJ. A diet high in fat and sugar reverses anxiety-like behaviour induced by limited nesting in male rats: Impacts on hippocampal markers. Psychoneuroendocrinology2016;68:202–9. doi: 10.1016/j.psyneuen.2016.03.007. [PubMed: 26999723]

Maniam J, Morris MJ. Long-term postpartum anxiety and depression-like behavior in mother rats subjected to maternal separation are ameliorated by palatable high fat diet. Behav Brain Res2010a;208(1):72–9. doi: 10.1016/j.bbr.2009.11.005. [PubMed: 19896506]

Maniam J, Morris MJ. Palatable cafeteria diet ameliorates anxiety and depression-like symptoms following an adverse early environment. Psychoneuroendocrinology2010b;35(5):717–28. doi: 10.1016/j.psyneuen.2009.10.013. [PubMed: 19939573]

Maniam J, Morris MJ. Voluntary exercise and palatable high-fat diet both improve behavioural profile and stress responses in male rats exposed to early life stress: role of hippocampus. Psychoneuroendocrinology2010c;35(10):1553–64. doi: 10.1016/j.psyneuen.2010.05.012. [PubMed: 20594764]

Marcinkiewcz CA, Prado MM, Isaac SK, Marshall A, Rylkova D, Bruijnzeel AW. Corticotropin-releasing factor within the central nucleus of the amygdala and the nucleus accumbens shell mediates the negative affective state of nicotine withdrawal in rats. Neuropsychopharmacology2009;34(7):1743–52. doi: 10.1038/npp.2008.231. [PubMed: 19145226]

Marcus MD, Wildes JE. Obesity in DSM-5. Psychiatr Ann2012;42(11):431–435.

Markus CR, Panhuysen G, Tuiten A, Koppeschaar H, Fekkes D, Peters ML. Does carbohydrate-rich, protein-poor food prevent a deterioration of mood and cognitive performance of stress-prone subjects when subjected to a stressful task?Appetite1998;31(1):49–65. doi: 10.1006/appe.1997.0155. [PubMed: 9716435]

Martin WR, Jasinski DR, Mansky PA. Naltrexone, an antagonist for the treatment of heroin dependence. Effects in man. Arch Gen Psychiatry1973;28(6):784–91. doi: 10.1001/archpsyc.1973.01750360022003. [PubMed: 4707988]

Martinotti G, Di Nicola M, Reina D, Andreoli S, Focà F, Cunniff A, Tonioni F, Bria P, Janiri L. Alcohol protracted withdrawal syndrome: the role of anhedonia. Subst Use Misuse2008;43(3–4):271–84. doi: 10.1080/10826080701202429. [PubMed: 18365930]

Martins de Carvalho L, Lauar Gonçalves J, Sondertoft Braga Pedersen A, Damasceno S, Elias Moreira Júnior R, Uceli Maioli T, Faria AMC, Brunialti Godard AL. High-fat diet withdrawal modifies alcohol preference and transcription of dopaminergic and GABAergic receptors. J Neurogenet2019;33(1):10–20. doi: 10.1080/01677063.2018.1526934. [PubMed: 30516420]

Masheb RM, Ruser CB, Min KM, Bullock AJ, Dorflinger LM. Does food addiction contribute to excess weight among clinic patients seeking weight reduction?Examination of the Modified Yale Food Addiction Survey. Compr Psychiatry2018;84:1–6. doi: 10.1016/j.comppsych.2018.03.006. [PubMed: 29654930]

Masheb RM, Ruser CB, Min KM, Bullock AJ, Dorflinger LM. Does food addiction contribute to excess weight among clinic patients seeking weight reduction?Examination of the Modified Yale Food Addiction Survey. Compr Psychiatry2018;84:1–6. doi: 10.1016/j.comppsych.2018.03.006. [PubMed: 29654930]

Masih T, Dimmock JA, Epel ES, Guelfi KJ. Stress-induced eating and the relaxation response as a potential antidote: A review and hypothesis. Appetite2017;118:136–143. doi: 10.1016/j.appet.2017.08.005. [PubMed: 28789869]

Mason AE, Lustig RH, Brown RR, Acree M, Bacchetti P, Moran PJ, Dallman M, Laraia B, Adler N, Hecht FM, Daubenmier J, Epel ES. Acute responses to opioidergic blockade as a biomarker of hedonic eating among obese women enrolled in a mindfulness-based weight loss intervention trial. Appetite2015;91:311–320. doi: 10.1016/j.appet.2015.04.062. [PubMed: 25931433]

Mason BJ, Heyser CJ. Acamprosate: a prototypic neuromodulator in the treatment of alcohol dependence. CNS Neurol Disord Drug Targets2010;9(1):23–32. doi: 10.2174/187152710790966641. [PubMed: 20201812]

Mason BJ, Lehert P. Acamprosate for alcohol dependence: a sex-specific meta-analysis based on individual patient data. Alcohol Clin Exp Res2012;36(3):497–508. doi: 10.1111/j.1530-0277.2011.01616.x. [PubMed: 21895717]

Mather AA, Cox BJ, Enns MW, Sareen J. Associations of obesity with psychiatric disorders and suicidal behaviors in a nationally representative sample. J Psychosom Res2009;66(4):277–285. doi:10.1016/j.jpsychores.2008.09.008. [PubMed: 19302884]

Mayorov AV, Amara N, Chang JY, Moss JA, Hixon MS, Ruiz DI, Meijler MM, Zorrilla EP, Janda KD. Catalytic antibody degradation of ghrelin increases whole-body metabolic rate and reduces refeeding in fasting mice. Proc Natl Acad Sci U S A2008;105(45):17487–92. [PubMed: 18981425]

McCue DL, Kasper JM, A, Hommel JD. Incubation of feeding behavior is regulated by neuromedin U receptor 2 in the paraventricular nucleus of the hypothalamus. Behav Brain Res2019;359:763–770. doi: 10.1016/j.bbr.2018.08.015. [PubMed: 30227148]

McElroy SL, Guerdjikova AI, Winstanley EL, O'Melia AM, Mori N, McCoy J, Keck PE Jr, Hudson JI. Acamprosate in the treatment of binge eating disorder: a placebo-controlled trial. Int J Eat Disord2011;44(1):81–90. doi: 10.1002/eat.20876. [PubMed: 21080416]

McElroy SL, Hudson J, Ferreira-Cornwell MC, Radewonuk J, Whitaker T, Gasior M. Lisdexamfetamine Dimesylate for Adults with Moderate to Severe Binge Eating Disorder: Results of Two Pivotal Phase 3 Randomized Controlled Trials. Neuropsychopharmacology2016a;41(5):1251–60. doi: 10.1038/npp.2015.275. [PubMed: 26346638]

McElroy SL, Hudson JI, Gasior M, Herman BK, Radewonuk J, Wilfley D, Busner J. Time course of the effects of lisdexamfetamine dimesylate in two phase 3, randomized, double-blind, placebo-controlled trials in adults with binge-eating disorder. Int J Eat Disord2017;50(8):884–892. doi: 10.1002/eat.22722. [PubMed: 28481434]

McElroy SL, Hudson JI, Mitchell JE, Wilfley D, Ferreira-Cornwell MC, Gao J, Wang J, Whitaker T, Jonas J, Gasior M. Efficacy and safety of lisdexamfetamine for treatment of adults with moderate to severe binge-eating disorder: a randomized clinical trial. JAMA Psychiatry2015;72(3):235–46. doi: 10.1001/jamapsychiatry.2014.2162. [PubMed: 25587645]

McElroy SL, Mitchell JE, Wilfley D, Gasior M, Ferreira-Cornwell MC, McKay M, Wang J, Whitaker T, Hudson JI. Lisdexamfetamine Dimesylate Effects on Binge Eating Behaviour and Obsessive-Compulsive and Impulsive Features in Adults with Binge Eating Disorder. Eur Eat Disord Rev2016b;24(3):223–31. doi: 10.1002/erv.2418. [PubMed: 26621156]

McGuire BA, Baladi MG, France CP. Eating high-fat chow enhances sensitization to the effects of methamphetamine on locomotion in rats. Eur J Pharmacol2011;658(2–3):156–9. doi: 10.1016/j.ejphar.2011.02.027. [PubMed: 21371470]

McLellan AT, Childress AR, Ehrman R, O'Brien CP, Pashko S. Extinguishing conditioned responses during opiate dependence treatment turning laboratory findings into clinical procedures. J Subst Abuse Treat1986;3(1):33–40. doi: 10.1016/0740-5472(86)90006-1. [PubMed: 2874232]

McNally GP, Akil H. Role of corticotropin-releasing hormone in the amygdala and bed nucleus of the stria terminalis in the behavioral, pain modulatory, and endocrine consequences of opiate withdrawal. Neuroscience2002;112(3):605–17. doi: 10.1016/s0306-4522(02)00105-7.

Meng Q, Han Y, Ji G, Li G, Hu Y, Liu L, Jin Q, von Deneen KM, Zhao J, Cui G, Wang H, Tomasi D, Volkow ND, Liu J, Nie Y, Zhang Y, Wang GJ. Disrupted topological organization of the frontal-mesolimbic network in obese patients. Brain Imaging Behav2018;12(6):1544–1555. doi: 10.1007/s11682-017-9802-z. [PubMed: 29318488]

Merchenthaler I, Lane M, Shughrue P. Distribution of pre-pro-glucagon and glucagon-like peptide-1 receptor messenger RNAs in the rat central nervous system. J Comp Neurol1999111;403(2):261–80. doi: 10.1002/(sici)1096-9861(19990111)403:2<261::aid-cne8>3.0.co;2-5. [PubMed: 9886047]

Merikangas KR, McClair VL. Epidemiology of substance use disorders. Hum Genet2012;131(6):779–789. doi:10.1007/s00439-012-1168-0. [PubMed: 22543841]

Meule A, Gearhardt AN. Food addiction in the light of DSM-5. Nutrients2014;6(9):3653–71. doi: 10.3390/nu6093653. [PubMed: 25230209]

Meule A, Heckel D, Jurowich CF, Vögele C, Kübler A. Correlates of food addiction in obese individuals seeking bariatric surgery. Clin Obes2014;4(4):228–36. doi: 10.1111/cob.12065. [PubMed: 25826794]

Meule A, Hermann T, Kübler A. Food addiction in overweight and obese adolescents seeking weight-loss treatment. Eur Eat Disord Rev2015;23(3):193–8. doi: 10.1002/erv.2355. [PubMed: 25778000]

Meule A, Kübler A. Food cravings in food addiction: the distinct role of positive reinforcement. Eat Behav2012;13(3):252–5. doi: 10.1016/j.eatbeh.2012.02.001. [PubMed: 22664405]

Meule A, Müller A, Gearhardt AN, Blechert J. German version of the Yale Food Addiction Scale 2.0: Prevalence and correlates of ‘food addiction’ in students and obese individuals. Appetite2017;115:54–61. doi: 10.1016/j.appet.2016.10.003. [PubMed: 27717658]

Michaelides M, Thanos PK, Volkow ND, Wang GJ. Dopamine-related frontostriatal abnormalities in obesity and binge-eating disorder: emerging evidence for developmental psychopathology. Int Rev Psychiatry2012;24(3):211–8. doi: 10.3109/09540261.2012.679918. [PubMed: 22724642]

Micioni Di Bonaventura MV, Ciccocioppo R, Romano A, Bossert JM, Rice KC, Ubaldi M, St Laurent R, Gaetani S, Massi M, Shaham Y, Cifani C. Role of bed nucleus of the stria terminalis corticotrophin-releasing factor receptors in frustration stress-induced binge-like palatable food consumption in female rats with a history of food restriction. J Neurosci2014;34(34):11316–24. doi: 10.1523/JNEUROSCI.1854-14.2014. [PubMed: 25143612]

Micioni Di Bonaventura MV, Lutz TA, Romano A, Pucci M, Geary N, Asarian L, Cifani C. Estrogenic suppression of binge-like eating elicited by cyclic food restriction and frustrative-nonreward stress in female rats. Int J Eat Disord2017a;50(6):624–635. doi: 10.1002/eat.22687. [PubMed: 28230907]

Micioni Di Bonaventura MV, Ubaldi M, Giusepponi ME, Rice KC, Massi M, Ciccocioppo R, Cifani C. Hypothalamic CRF1 receptor mechanisms are not sufficient to account for binge-like palatable food consumption in female rats. Int J Eat Disord2017b;50(10):1194–1204. doi: 10.1002/eat.22767. [PubMed: 28833350]

Micioni Di Bonaventura MV, Vitale G, Massi M, Cifani C. Effect of Hypericum perforatum Extract in an Experimental Model of Binge Eating in Female Rats. J Obes2012;2012:956137. doi: 10.1155/2012/956137. [PubMed: 22997570]

Mies GW, Treur JL, Larsen JK, Halberstadt J, Pasman JA, Vink JM. The prevalence of food addiction in a large sample of adolescents and its association with addictive substances. Appetite2017;118:97–105. doi: 10.1016/j.appet.2017.08.002. [PubMed: 28826746]

Minozzi S, Amato L, Pani PP, Solimini R, Vecchi S, De Crescenzo F, Zuccaro P, Davoli M. Dopamine agonists for the treatment of cocaine dependence. Cochrane Database Syst Rev2015527;2015(5):CD003352. doi: 10.1002/14651858.CD003352.pub4.

Miranda-Lora AL, Cruz M, Aguirre-Hernández J, Molina-Díaz M, Gutiérrez J, Flores-Huerta S, Klünder-Klünder M. Exploring single nucleotide polymorphisms previously related to obesity and metabolic traits in pediatric-onset type 2 diabetes. Acta Diabetol20177;54(7):653–662. doi: 10.1007/s00592-017-0987-9 [PubMed: 28401323]

Mitchell JE, Mussell MP. Comorbidity and binge eating disorder. Addict Behav1995;20(6):725–32. doi: 10.1016/0306-4603(95)00095-x. [PubMed: 8820525]

Moore CF, Sabino V, Koob GF, Cottone P. Pathological Overeating: Emerging Evidence for a Compulsivity Construct. Neuropsychopharmacology2017;42(7):1375–1389. doi: 10.1038/npp.2016.269. [PubMed: 27922596]

Moore CF, Leonard MZ, Micovic NM, Miczek KA, Sabino V, Cottone P. Reward sensitivity deficits in a rat model of compulsive eating behavior. Neuropsychopharmacology. 20203;45(4):589–596. doi: 10.1038/s41386-019-0550-1. [PubMed: 31622973]

Morris J, Bailey MES, Baldassarre D, Cullen B, de Faire U, Ferguson A, Gigante B, Giral P, Goel A, Graham N, Hamsten A, Humphries SE, Johnston KJA, Lyall DM, Lyall LM, Sennblad B, Silveira A, Smit AJ, Tremoli E, Veglia F, Ward J, Watkins H, Smith DJ, Strawbridge RJ. Genetic variation in CADM2 as a link between psychological traits and obesity. Sci Rep2019;9(1):7339. doi: 10.1038/s41598-019-43861-9. [PubMed: 31089183]

Mühlig Y, Antel J, Föcker M, Hebebrand J. Are bidirectional associations of obesity and depression already apparent in childhood and adolescence as based on high-quality studies? A systematic review. Obes Rev2016;17(3):235–249. doi:10.1111/obr.12357. [PubMed: 26681065]

Müller A, Leukefeld C, Hase C, Gruner-Labitzke K, Mall JW, Köhler H, de Zwaan M. Food addiction and other addictive behaviours in bariatric surgery candidates. Eur Eat Disord Rev201811;26(6):585–596. doi: 10.1002/erv.2629. Epub2018 Aug 9. [PubMed: 30094889]

Muniyappa R, Sable S, Ouwerkerk R, Mari A, Gharib AM, Walter M, Courville A, Hall G, Chen KY, Volkow ND, Kunos G, Huestis MA, Skarulis MC. Metabolic effects of chronic cannabis smoking. Diabetes Care2013;36(8):2415–22. doi: 10.2337/dc12-2303. [PubMed: 23530011]

Munro JF, MacCuish AC, Wilson EM, Duncan LJ. Comparison of continuous and intermittent anorectic therapy in obesity. Br Med J1968;1(5588):352–4. doi: 10.1136/bmj.1.5588.352. [PubMed: 15508204]

Murphy CM, Stojek MK, MacKillop J. Interrelationships among impulsive personality traits, food addiction, and Body Mass Index. Appetite2014;73:45–50. doi: 10.1016/j.appet.2013.10.008. [PubMed: 24511618]

Murray JE, Belin-Rauscent A, Simon M, Giuliano C, Benoit-Marand M, Everitt BJ, Belin D. Basolateral and central amygdala differentially recruit and maintain dorsolateral striatum-dependent cocaine-seeking habits. Nat Commun2015;6:10088. doi: 10.1038/ncomms10088. [PubMed: 26657320]

Nanni G, Scheggi S, Leggio B, Grappi S, Masi F, Rauggi R, De Montis MG. Acquisition of an appetitive behavior prevents development of stress-induced neurochemical modifications in rat nucleus accumbens. J Neurosci Res2003;73(4):573–80. doi: 10.1002/jnr.10685. [PubMed: 12898542]

Neelakantan H, Holliday ED, Fox RG, Stutz SJ, Comer SD, Haney M, Anastasio NC, Moeller FG, Cunningham KA. Lorcaserin Suppresses Oxycodone Self-Administration and Relapse Vulnerability in Rats. ACS Chem Neurosci2017;8(5):1065–1073. doi: 10.1021/acschemneuro.6b00413. [PubMed: 28107783]

Neufeld-Cohen A, Tsoory MM, Evans AK, Getselter D, Gil S, Lowry CA, Vale WW, Chen A. A triple urocortin knockout mouse model reveals an essential role for urocortins in stress recovery. Proc Natl Acad Sci U S A2010;107(44):19020–5. doi: 10.1073/pnas.1013761107. [PubMed: 20937857]

Ng J, Stice E, Yokum S, Bohon C. An fMRI study of obesity, food reward, and perceived caloric density. Does a low-fat label make food less appealing?Appetite2011;57(1):65–72. doi: 10.1016/j.appet.2011.03.017. [PubMed: 21497628]

Ng M, Fleming T, Robinson M, Thomson B, Graetz N, Margono C, Mullany EC, Biryukov S, Abbafati C, Abera SF, Abraham JP, Abu-Rmeileh NM, Achoki T, AlBuhairan FS, Alemu ZA, Alfonso R, Ali MK, Ali R, Guzman NA, Ammar W, Anwari P, Banerjee A, Barquera S, Basu S, Bennett DA, Bhutta Z, Blore J, Cabral N, Nonato IC, Chang JC, Chowdhury R, Courville KJ, Criqui MH, Cundiff DK, Dabhadkar KC, Dandona L, Davis A, Dayama A, Dharmaratne SD, Ding EL, Durrani AM, Esteghamati A, Farzadfar F, Fay DF, Feigin VL, Flaxman A, Forouzanfar MH, Goto A, Green MA, Gupta R, Hafezi-Nejad N, Hankey GJ, Harewood HC, Havmoeller R, Hay S, Hernandez L, Husseini A, Idrisov BT, Ikeda N, Islami F, Jahangir E, Jassal SK, Jee SH, Jeffreys M, Jonas JB, Kabagambe EK, Khalifa SE, Kengne AP, Khader YS, Khang YH, Kim D, Kimokoti RW, Kinge JM, Kokubo Y, Kosen S, Kwan G, Lai T, Leinsalu M, Li Y, Liang X, Liu S, Logroscino G, Lotufo PA, Lu Y, Ma J, Mainoo NK, Mensah GA, Merriman TR, Mokdad AH, Moschandreas J, Naghavi M, Naheed A, Nand D, Narayan KM, Nelson EL, Neuhouser ML, Nisar MI, Ohkubo T, Oti SO, Pedroza A, Prabhakaran D, Roy N, Sampson U, Seo H, Sepanlou SG, Shibuya K, Shiri R, Shiue I, Singh GM, Singh JA, Skirbekk V, Stapelberg NJ, Sturua L, Sykes BL, Tobias M, Tran BX, Trasande L, Toyoshima H, van de Vijver S, Vasankari TJ, Veerman JL, Velasquez-Melendez G, Vlassov VV, Vollset SE, Vos T, Wang C, Wang X, Weiderpass E, Werdecker A, Wright JL, Yang YC, Yatsuya H, Yoon J, Yoon SJ, Zhao Y, Zhou M, Zhu S, Lopez AD, Murray CJ, Gakidou E. Global, regional, and national prevalence of overweight and obesity in children and adults during 1980–2013: a systematic analysis for the Global Burden of Disease Study 2013. Lancet2014;384(9945):766–81. doi: 10.1016/S0140-6736(14)60460-8. [PubMed: 24880830]

Nguyen B, Clements J. Obesity management among patients with type 2 diabetes and prediabetes: a focus on lifestyle modifications and evidence of antiobesity medications. Expert Rev Endocrinol Metab2017;12(5):303–313. doi: 10.1080/17446651.2017.1367285. [PubMed: 30058889]

Nguyen T, Thomas BF, Zhang Y. Overcoming the Psychiatric Side Effects of the Cannabinoid CB1 Receptor Antagonists: Current Approaches for Therapeutics Development. Curr Top Med Chem2019;19(16):1418–1435. doi: 10.2174/1568026619666190708164841. [PubMed: 31284863]

Nielsen AL, Larsen TM, Madsbad S, Breum L, Jensen TJ, Kroustrup JP, Astrup A. Effekt af tesofensine på kropsvaegt og kropssammensaetning hos svaert overvaegtige--sekundaerpublikation [The effect of tesofensine on body weight and body composition in obese subjects--secondary publication]. Ugeskr Laeger2009;171(41):2974–7. [PubMed: 19824222]

Nissenbaum JW, Sclafani A. Sham-feeding response of rats to Polycose and sucrose. Neurosci Biobehav Rev1987;11(2):215–22. doi: 10.1016/s0149-7634(87)80029-5. [PubMed: 3614789]

Nolan LJ, Geliebter A. Validation of the Night Eating Diagnostic Questionnaire (NEDQ) and its relationship with depression, sleep quality, “food addiction”, and body mass index. Appetite2017;111:86–95. doi: 10.1016/j.appet.2016.12.027. [PubMed: 28017909]

Nowinski J, Baker S, Carroll K. Twelve Step Facilitation Therapy Manual: A Clinical Research Guide for Therapists Treating Individuals With Alcohol Abuse and DependenceRockville: National Institute on Alcohol Abuse and Alcoholism. 1999.

Nutt DJ, Lingford-Hughes A, Erritzoe D, Stokes PR. The dopamine theory of addiction: 40 years of highs and lows. Nat Rev Neurosci2015;16(5):305–12. doi: 10.1038/nrn3939. [PubMed: 25873042]

Nyland JE, Grigson PS. A drug-paired taste cue elicits withdrawal and predicts cocaine self-administration. Behav Brain Res2013;240:87–90. doi: 10.1016/j.bbr.2012.10.057. [PubMed: 23174208]

O’Dell LE, Chen SA, Smith RT, Specio SE, Balster RL, Paterson NE, Markou A, Zorrilla EP, Koob GF. Extended access to nicotine self-administration leads to dependence: Circadian measures, withdrawal measures, and extinction behavior in rats. J Pharmacol Exp Ther2007;320(1):180–93. doi: 10.1124/jpet.106.105270. [PubMed: 17050784]

O’Dell LE, Natividad LA, Pipkin JA, Roman F, Torres I, Jurado J, Torres OV, Friedman TC, Tenayuca JM, Nazarian A. Enhanced nicotine self-administration and suppressed dopaminergic systems in a rat model of diabetes. Addict Biol2014;19(6):1006–19. doi: 10.1111/adb.12074. [PubMed: 23834715]

O’Dell LE, Nazarian A. Enhanced vulnerability to tobacco use in persons with diabetes: A behavioral and neurobiological framework. Prog Neuropsychopharmacol Biol Psychiatry2016;65:288–96. doi: 10.1016/j.pnpbp.2015.06.005. [PubMed: 26092247]

Oddy WH, Robinson M, Ambrosini GL, O’Sullivan TA, de Klerk NH, Beilin LJ, Silburn SR, Zubrick SR, Stanley FJ. The association between dietary patterns and mental health in early adolescence. Prev Med2009;49(1):39–44. doi: 10.1016/j.ypmed.2009.05.009. [PubMed: 19467256]

Oginsky MF, Ferrario CR. Eating “junk food” has opposite effects on intrinsic excitability of nucleus accumbens core neurons in obesity-susceptible versus -resistant rats. J Neurophysiol201991;122(3):1264–1273. doi: 10.1152/jn.00361.2019. Epub2019 Jul 31. [PubMed: 31365322]

Oginsky MF, Maust JD, Corthell JT, Ferrario CR. Enhanced cocaine-induced locomotor sensitization and intrinsic excitability of NAc medium spiny neurons in adult but not in adolescent rats susceptible to diet-induced obesity. Psychopharmacology (Berl)20163;233(5):773–84. doi: 10.1007/s00213-015-4157-x. Epub2015 Nov 27. [PubMed: 26612617]

Oswald KD, Murdaugh DL, King VL, Boggiano MM. Motivation for palatable food despite consequences in an animal model of binge eating. Int J Eat Disord2011;44(3):203–11. doi: 10.1002/eat.20808. [PubMed: 20186718]

Overstreet DH, Knapp DJ, Breese GR. Modulation of multiple ethanol withdrawal-induced anxiety-like behavior by CRF and CRF1 receptors. Pharmacol Biochem Behav2004;77(2):405–13. doi: 10.1016/j.pbb.2003.11.010. [PubMed: 14751471]

Papini MR, Dudley T. Consequences of surprising reward omissions. Review of General Psychology1997; 1(2):175–197. doi: 10.1037/1089-2680.1.2.175.

Parsons LH, Hurd YL. Endocannabinoid signalling in reward and addiction. Nat Rev Neurosci2015;16(10):579–94. doi: 10.1038/nrn4004. [PubMed: 26373473]

Parylak SL, Cottone P, Sabino V, Rice KC, Zorrilla EP. Effects of CB1 and CRF1 receptor antagonists on binge-like eating in rats with limited access to a sweet fat diet: lack of withdrawal-like responses. Physiol Behav2012;107(2):231–42. doi: 10.1016/j.physbeh.2012.06.017. [PubMed: 22776620]

Parylak SL, Koob GF, Zorrilla EP. The dark side of food addiction. Physiol Behav2011;104(1):149–56. doi: 10.1016/j.physbeh.2011.04.063. [PubMed: 21557958]

Pasch KE, Velazquez CE, Cance JD, Moe SG, Lytle LA. Youth substance use and body composition: does risk in one area predict risk in the other?. J Youth Adolesc2012;41(1):14–26. doi:10.1007/s10964-011-9706-y. [PubMed: 21853355]

Pastor A, Conn J, Teng J, O'Brien CL, Loh M, Collins L, MacIsaac R, Bonomo Y. Alcohol and recreational drug use in young adults with type 1 diabetes. Diabetes Res Clin Pract2017;130:186–195. doi: 10.1016/j.diabres.2017.05.026. [PubMed: 28646702]

Pearce JM, Hall G. A model for Pavlovian learning: variations in the effectiveness of conditioned but not of unconditioned stimuli. Psychol Rev1980; 11;87(6):532–52. [PubMed: 7443916]

Pearson CM, Riley EN, Davis HA, Smith GT. Two pathways toward impulsive action: an integrative risk model for bulimic behavior in youth. J Child Psychol Psychiatry2014;55(8):852–64. doi: 10.1111/jcpp.12214. [PubMed: 24673546]

Pearson CM, Zapolski TC, Smith GT. A longitudinal test of impulsivity and depression pathways to early binge eating onset. Int J Eat Disord2015;48(2):230–7. doi: 10.1002/eat.22277. [PubMed: 24659534]

Pearson CM, Zapolski TC, Smith GT. A longitudinal test of impulsivity and depression pathways to early binge eating onset. Int J Eat Disord2015b;48(2):230–7. doi: 10.1002/eat.22277. [PubMed: 24659534]

Peckmezian T, Hay P. A systematic review and narrative synthesis of interventions for uncomplicated obesity: weight loss, well-being and impact on eating disorders. J Eat Disord2017;5:15. doi: 10.1186/s40337-017-0143-5. [PubMed: 28469914]

Pecoraro N, Reyes F, Gomez F, Bhargava A, Dallman MF. Chronic stress promotes palatable feeding, which reduces signs of stress: feedforward and feedback effects of chronic stress. Endocrinology2004;145(8):3754–62. doi: 10.1210/en.2004-0305. [PubMed: 15142987]

Pereira-Lancha LO, Coelho DF, de Campos-Ferraz PL, Lancha AH Jr. Body fat regulation: is it a result of a simple energy balance or a high fat intake?J Am Coll Nutr2010;29(4):343–51. doi: 10.1080/07315724.2010.10719850. [PubMed: 21041808]

Perez Diaz M, Wilson ME, Howell LL. Effects of long-term high-fat food or methamphetamine intake and serotonin 2C receptors on reversal learning in female rhesus macaques. Neuropsychopharmacology2019;44(3):478–486. doi: 10.1038/s41386-018-0200-z. [PubMed: 30188516]

Perney P, Lehert P, Mason BJ. Sleep disturbance in alcoholism: proposal of a simple measurement, and results from a 24-week randomized controlled study of alcohol-dependent patients assessing acamprosate efficacy. Alcohol Alcohol2012;47(2):133–9. doi: 10.1093/alcalc/agr160. [PubMed: 22218671]

Piccoli L, Micioni Di Bonaventura MV, Cifani C, Costantini VJ, Massagrande M, Montanari D, Martinelli P, Antolini M, Ciccocioppo R, Massi M, Merlo-Pich E, Di Fabio R, Corsi M. Role of orexin-1 receptor mechanisms on compulsive food consumption in a model of binge eating in female rats. Neuropsychopharmacology2012;37(9):1999–2011. doi: 10.1038/npp.2012.48. [PubMed: 22569505]

Pickering C, Alsiö J, Hulting AL, Schiöth HB. Withdrawal from free-choice high-fat high-sugar diet induces craving only in obesity-prone animals. Psychopharmacology2009;204(3):431–43. doi: 10.1007/s00213-009-1474-y. [PubMed: 19205668]

Pickering RP, Goldstein RB, Hasin DS, et al.Temporal relationships between overweight and obesity and DSM-IV substance use, mood, and anxiety disorders: results from a prospective study, the National Epidemiologic Survey on Alcohol and Related Conditions. J Clin Psychiatry2011;72(11):1494–1502. doi:10.4088/JCP.10m06077gry. [PubMed: 21457678]

Pipkin JA, Cruz B, Flores RJ, Hinojosa CA, Carcoba LM, Ibarra M, Francis W, Nazarian A, O'Dell LE. Both nicotine reward and withdrawal are enhanced in a rodent model of diabetes. Psychopharmacology2017;234(9–10):1615–1622. doi: 10.1007/s00213-017-4592-y. [PubMed: 28342091]

Pirtle JL, Hickman MD, Boinpelly VC, Surineni K, Thakur HK, Grasing KW. The serotonin-2C agonist Lorcaserin delays intravenous choice and modifies the subjective and cardiovascular effects of cocaine: A randomized, controlled human laboratory study. Pharmacol Biochem Behav2019;180:52–59. doi: 10.1016/j.pbb.2019.02.010. [PubMed: 30811963]

Pisetsky EM, Thornton LM, Lichtenstein P, Pedersen NL, Bulik CM. Suicide attempts in women with eating disorders. J Abnorm Psychol2013;122(4):1042–56. doi: 10.1037/a0034902. [PubMed: 24364606]

Pivarunas B, Conner BT. Impulsivity and emotion dysregulation as predictors of food addiction. Eat Behav2015;19:9–14. doi: 10.1016/j.eatbeh.2015.06.007. [PubMed: 26164390]

Popik P, Kos T, Zhang Y, Bisaga A. Memantine reduces consumption of highly palatable food in a rat model of binge eating. Amino Acids2011;40(2):477–85. doi: 10.1007/s00726-010-0659-3. [PubMed: 20571841]

Pothos E, Rada P, Mark GP, Hoebel BG. Dopamine microdialysis in the nucleus accumbens during acute and chronic morphine, naloxone-precipitated withdrawal and clonidine treatment. Brain Res1991;566(1–2):348–50. doi: 10.1016/0006-8993(91)91724-f. [PubMed: 1814554]

Puhl MD, Cason AM, Wojnicki FH, Corwin RL, Grigson PS. A history of bingeing on fat enhances cocaine seeking and taking. Behav Neurosci2011;125(6):930–42. doi: 10.1037/a0025759. [PubMed: 21988520]

Rada P, Avena NM, Hoebel BG. Daily bingeing on sugar repeatedly releases dopamine in the accumbens shell. Neuroscience2005;134(3):737–44. doi: 10.1016/j.neuroscience.2005.04.043. [PubMed: 15987666]

Rada P, Bocarsly ME, Barson JR, Hoebel BG, Leibowitz SF. Reduced accumbens dopamine in Sprague-Dawley rats prone to overeating a fat-rich diet. Physiol Behav2010;101(3):394–400. doi: 10.1016/j.physbeh.2010.07.005. [PubMed: 20643155]

Rada P, Pothos E, Mark GP, Hoebel BG. Microdialysis evidence that acetylcholine in the nucleus accumbens is involved in morphine withdrawal and its treatment with clonidine. Brain Res1991;561(2):354–6. doi: 10.1016/0006-8993(91)91616-9. [PubMed: 1802350]

Radke AK, Rothwell PE, Gewirtz JC. An anatomical basis for opponent process mechanisms of opiate withdrawal. J Neurosci2011;31(20):7533–9. doi: 10.1523/JNEUROSCI.0172-11.2011. [PubMed: 21593338]

Ramos J, Hardin EJ, Grant AH, Flores-Robles G, Gonzalez AT, Cruz B, Martinez AK, Beltran NM, Serafine KM. The Effects of Eating a High Fat Diet on Sensitivity of Male and Female Rats to Methamphetamine and Dopamine D1 Receptor Agonist SKF 82958. J Pharmacol Exp Ther2020;374(1):6–15. doi: 10.1124/jpet.119.263293. [PubMed: 32265322]

Ramos J, Hernandez-Casner C, Cruz B, Serafine KM. Sex differences in high fat diet-induced impairments to striatal Akt signaling and enhanced sensitivity to the behavioral effects of dopamine D2/D3receptor agonist quinpirole. Physiol Behav2019;203:25–32. doi: 10.1016/j.physbeh.2017.11.014. [PubMed: 29154786]

Razzoli M, Pearson C, Crow S, Bartolomucci A. Stress, overeating, and obesity: Insights from human studies and preclinical models. Neurosci Biobehav Rev2017;76(Pt A):154–162. doi: 10.1016/j.neubiorev.2017.01.026. [PubMed: 28292531]

Reid M, Hammersley R. The effects of sucrose and maize oil on subsequent food intake and mood. Br J Nutr1999;82(6):447–55. [PubMed: 10690160]

Ricca V, Castellini G, Mannucci E, Monami M, Ravaldi C, Gorini Amedei S, Lo Sauro C, Rotella CM, Faravelli C. Amphetamine derivatives and obesity. Appetite20094;52(2):405–9. doi: 10.1016/j.appet.2008.11.013. Epub2008 Dec 3. [PubMed: 19103239]

Richardson HN, Zhao Y, Fekete EM, Funk CK, Wirsching P, Janda KD, Zorrilla EP, Koob GF. MPZP: a novel small molecule corticotropin-releasing factor type 1 receptor (CRF1) antagonist. Pharmacol Biochem Behav2008;88(4):497–510. doi: 10.1016/j.pbb.2007.10.008. [PubMed: 18031798]

Richardson JR, O'Dell LE, Nazarian A. Examination of nicotine and saccharin reward in the Goto-Kakizaki diabetic rat model. Neurosci Lett2020;721:134825. doi: 10.1016/j.neulet.2020.134825. [PubMed: 32036029]

Richardson JR, Pipkin JA, O'Dell LE, Nazarian A. Insulin resistant rats display enhanced rewarding effects of nicotine. Drug Alcohol Depend2014;140:205–7. doi: 10.1016/j.drugalcdep.2014.03.028. [PubMed: 24774962]

Richardson JR, Pipkin JA, O'Dell LE, Nazarian A. Insulin resistant rats display enhanced rewarding effects of nicotine. Drug Alcohol Depend2014;140:205–7. doi: 10.1016/j.drugalcdep.2014.03.028. [PubMed: 24774962]

Richmond RL, Roberto CA, Gearhardt AN. The association of addictive-like eating with food intake in children. Appetite2017;117:82–90. doi: 10.1016/j.appet.2017.06.002. [PubMed: 28587942]

Richter RM, Weiss F. In vivo CRF release in rat amygdala is increased during cocaine withdrawal in self-administering rats. Synapse1999;32(4):254–61. doi: 10.1002/(SICI)1098-2396(19990615)32:4<254::AID-SYN2>3.0.CO;2-H. [PubMed: 10332801]

Rios M, Fan G, Fekete C, Kelly J, Bates B, Kuehn R, Lechan RM, Jaenisch R. Conditional deletion of brain-derived neurotrophic factor in the postnatal brain leads to obesity and hyperactivity. Mol Endocrinol2001;15(10):1748–57. doi: 10.1210/mend.15.10.0706. [PubMed: 11579207]

Robbins TW, Gillan CM, Smith DG, de Wit S, Ersche KD. Neurocognitive endophenotypes of impulsivity and compulsivity: towards dimensional psychiatry. Trends Cogn Sci2012;16(1):81–91. doi: 10.1016/j.tics.2011.11.009. [PubMed: 22155014]

Roberto M, Cruz MT, Gilpin NW, Sabino V, Schweitzer P, Bajo M, Cottone P, Madamba SG, Stouffer DG, Zorrilla EP, Koob GF, Siggins GR, Parsons LH. Corticotropin releasing factor-induced amygdala gamma-aminobutyric Acid release plays a key role in alcohol dependence. Biol Psychiatry2010;67(9):831–9. doi: 10.1016/j.biopsych.2009.11.007. [PubMed: 20060104]

Roberto M, Spierling SR, Kirson D, Zorrilla EP. Corticotropin-Releasing Factor (CRF) and Addictive Behaviors. Int Rev Neurobiol2017;136:5–51. doi: 10.1016/bs.irn.2017.06.004. [PubMed: 29056155]

Robinson MJ, Burghardt PR, Patterson CM, Nobile CW, Akil H, Watson SJ, Berridge KC, Ferrario CR. Individual Differences in Cue-Induced Motivation and Striatal Systems in Rats Susceptible to Diet-Induced Obesity. Neuropsychopharmacology20158;40(9):2113–23. doi: 10.1038/npp.2015.71. Epub2015 Mar 12. [PubMed: 25761571]

Rodríguez de Fonseca F, Carrera MR, Navarro M, Koob GF, Weiss F. Activation of corticotropin-releasing factor in the limbic system during cannabinoid withdrawal. Science1997;276(5321):2050–4. doi: 10.1126/science.276.5321.2050. [PubMed: 9197270]

Rodriguez S, Eiriksdottir G, Gaunt TR, Harris TB, Launer LJ, Gudnason V, Day IN. IGF2BP1, IGF2BP2 and IGF2BP3 genotype, haplotype and genetic model studies in metabolic syndrome traits and diabetes. Growth Horm IGF Res2010;20(4):310–8. doi: 10.1016/j.ghir.2010.04.002. [PubMed: 20627640]

Rose MH, Nadler EP, Mackey ER. Impulse Control in Negative Mood States, Emotional Eating, and Food Addiction are Associated with Lower Quality of Life in Adolescents with Severe Obesity. J Pediatr Psychol2018;43(4):443–451. doi: 10.1093/jpepsy/jsx127. [PubMed: 29048569]

Rosen JC, Tacy B, Howell D. Life stress, psychological symptoms and weight reducing behavior in adolescent girls: A prospective analysis. Int J Eat Disord1990;9(1):17–26.

Rossetti C, Spena G, Halfon O, Boutrel B. Evidence for a compulsive-like behavior in rats exposed to alternate access to highly preferred palatable food. Addict Biol2014;19(6):975–85. doi: 10.1111/adb.12065. [PubMed: 23654201]

Rowley HL, Kulkarni R, Gosden J, Brammer R, Hackett D, Heal DJ. Lisdexamfetamine and immediate release d-amfetamine - differences in pharmacokinetic/pharmacodynamic relationships revealed by striatal microdialysis in freely-moving rats with simultaneous determination of plasma drug concentrations and locomotor activity. Neuropharmacology2012;63(6):1064–74. doi: 10.1016/j.neuropharm.2012.07.008. [PubMed: 22796358]

Runfola CD, Thornton LM, Pisetsky EM, Bulik CM, Birgegård A. Self-image and suicide in a Swedish national eating disorders clinical register. Compr Psychiatry2014;55(3):439–49. doi: 10.1016/j.comppsych.2013.11.007. [PubMed: 24332388]

Rupprecht LE, Kreisler AD, Spierling SR, de Guglielmo G, Kallupi M, George O, Donny EC, Zorrilla EP, Sved AF. Self-administered nicotine increases fat metabolism and suppresses weight gain in male rats. Psychopharmacology2018;235(4):1131–1140. doi: 10.1007/s00213-018-4830-y. [PubMed: 29354872]

Sabino V, Cottone P, Koob GF, Steardo L, Lee MJ, Rice KC, Zorrilla EP. Dissociation between opioid and CRF1 antagonist sensitive drinking in Sardinian alcohol-preferring rats. Psychopharmacology2006;189(2):175–86. doi: 10.1007/s00213-006-0546-5. [PubMed: 17047935]

Sam AH, Salem V, Ghatei MA. Rimonabant: From RIO to Ban. J Obes2011;2011:432607. doi: 10.1155/2011/432607. [PubMed: 21773005]

Sánchez-Villegas A, Delgado-Rodríguez M, Alonso A, Schlatter J, Lahortiga F, Serra Majem L, Martínez-González MA. Association of the Mediterranean dietary pattern with the incidence of depression: the Seguimiento Universidad de Navarra/University of Navarra follow-up (SUN) cohort. Arch Gen Psychiatry2009;66(10):1090–8. doi: 10.1001/archgenpsychiatry.2009.129. [PubMed: 19805699]

Sarnyai Z, Bíró E, Gardi J, Vecsernyés M, Julesz J, Telegdy G. Brain corticotropin-releasing factor mediates 'anxiety-like' behavior induced by cocaine withdrawal in rats. Brain Res1995;675(1–2):89–97. doi: 10.1016/0006-8993(95)00043-p. [PubMed: 7796157]

Sarris J, Logan AC, Akbaraly TN, Amminger GP, Balanzá-Martínez V, Freeman MP, Hibbeln J, Matsuoka Y, Mischoulon D, Mizoue T, Nanri A, Nishi D, Ramsey D, Rucklidge JJ, Sanchez-Villegas A, Scholey A, Su KP, Jacka FN; International Society for Nutritional Psychiatry Research. Nutritional medicine as mainstream in psychiatry. Lancet Psychiatry2015;2(3):271–4. doi: 10.1016/S2215-0366(14)00051-0. [PubMed: 26359904]

Sarwer DB, Allison KC, Wadden TA, Ashare R, Spitzer JC, McCuen-Wurst C, LaGrotte C, Williams NN, Edwards M, Tewksbury C, Wu J. Psychopathology, disordered eating, and impulsivity as predictors of outcomes of bariatric surgery. Surg Obes Relat Dis20194;15(4):650–655. doi: 10.1016/j.soard.2019.01.029. Epub2019 Feb 23. [PubMed: 30858009]

Sayon-Orea C, Martinez-Gonzalez MA, Bes-Rastrollo M. Alcohol consumption and body weight: a systematic review. Nutr Rev2011;69(8):419–431. doi:10.1111/j.1753-4887.2011.00403.x. [PubMed: 21790610]

Schmidt HD, Mietlicki-Baase EG, Ige KY, Maurer JJ, Reiner DJ, Zimmer DJ, Van Nest DS, Guercio LA, Wimmer ME, Olivos DR, De Jonghe BC, Hayes MR. Glucagon-Like Peptide-1 Receptor Activation in the Ventral Tegmental Area Decreases the Reinforcing Efficacy of Cocaine. Neuropsychopharmacology20166;41(7):1917–28. doi: 10.1038/npp.2015.362. Epub2015 Dec 17. [PubMed: 26675243]

Schreiber LR, Odlaug BL, Grant JE. The overlap between binge eating disorder and substance use disorders: Diagnosis and neurobiology. J Behav Addict2013;2(4):191–198. doi:10.1556/JBA.2.2013.015. [PubMed: 25215200]

Schulte EM, Grilo CM, Gearhardt AN. Shared and unique mechanisms underlying binge eating disorder and addictive disorders. Clin Psychol Rev2016;44:125–139. doi: 10.1016/j.cpr.2016.02.001. [PubMed: 26879210]

Schulte EM, Jacques-Tiura AJ, Gearhardt AN, Naar S. Food addiction prevalence and concurrent validity in African American adolescents with obesity. Psychol Addict Behav2018;32(2):187–196. doi: 10.1037/adb0000325. [PubMed: 29094956]

Schultz WDopamine reward prediction error coding. Dialogues Clin Neurosci2016; 3;18(1):23–32. doi: 10.31887/DCNS.2016.18.1/wschultz. [PubMed: 27069377]

Schumann G, Liu C, O'Reilly P, Gao H, Song P, Xu B, Ruggeri B, Amin N, Jia T, Preis S, Segura Lepe M, Akira S, Barbieri C, Baumeister S, Cauchi S, Clarke TK, Enroth S, Fischer K, Hällfors J, Harris SE, Hieber S, Hofer E, Hottenga JJ, Johansson Å, Joshi PK, Kaartinen N, Laitinen J, Lemaitre R, Loukola A, Luan J, Lyytikäinen LP, Mangino M, Manichaikul A, Mbarek H, Milaneschi Y, Moayyeri A, Mukamal K, Nelson C, Nettleton J, Partinen E, Rawal R, Robino A, Rose L, Sala C, Satoh T, Schmidt R, Schraut K, Scott R, Smith AV, Starr JM, Teumer A, Trompet S, Uitterlinden AG, Venturini C, Vergnaud AC, Verweij N, Vitart V, Vuckovic D, Wedenoja J, Yengo L, Yu B, Zhang W, Zhao JH, Boomsma DI, Chambers J, Chasman DI, Daniela T, de Geus E, Deary I, Eriksson JG, Esko T, Eulenburg V, Franco OH, Froguel P, Gieger C, Grabe HJ, Gudnason V, Gyllensten U, Harris TB, Hartikainen AL, Heath AC, Hocking L, Hofman A, Huth C, Jarvelin MR, Jukema JW, Kaprio J, Kooner JS, Kutalik Z, Lahti J, Langenberg C, Lehtimäki T, Liu Y, Madden PA, Martin N, Morrison A, Penninx B, Pirastu N, Psaty B, Raitakari O, Ridker P, Rose R, Rotter JI, Samani NJ, Schmidt H, Spector TD, Stott D, Strachan D, Tzoulaki I, van der Harst P, van Duijn CM, Marques-Vidal P, Vollenweider P, Wareham NJ, Whitfield JB, Wilson J, Wolffenbuttel B, Bakalkin G, Evangelou E, Liu Y, Rice KM, Desrivières S, Kliewer SA, Mangelsdorf DJ, Müller CP, Levy D, Elliott P. KLB is associated with alcohol drinking, and its gene product β-Klotho is necessary for FGF21 regulation of alcohol preference. Proc Natl Acad Sci U S A2016;113(50):14372–14377. doi: 10.1073/pnas.1611243113. [PubMed: 27911795]

Serafine KM, Bentley TA, Koek W, France CP. Eating high fat chow, but not drinking sucrose or saccharin, enhances the development of sensitization to the locomotor effects of cocaine in adolescent female rats. Behav Pharmacol2015a;26(3):321–5. doi: 10.1097/FBP.0000000000000114. [PubMed: 25485647]

Serafine KM, Bentley TA, Kilborn DJ, Koek W, France CP. Drinking sucrose or saccharin enhances sensitivity of rats to quinpirole-induced yawning. Eur J Pharmacol2015b;764:529–536. doi: 10.1016/j.ejphar.2015.07.036. [PubMed: 26189020]

Shalev U, Grimm JW, Shaham Y. Neurobiology of relapse to heroin and cocaine seeking: a review. Pharmacol Rev2002;54(1):1–42. doi: 10.1124/pr.54.1.1. [PubMed: 11870259]

Shalev U, Highfield D, Yap J, Shaham Y. Stress and relapse to drug seeking in rats: studies on the generality of the effect. Psychopharmacology2000;150(3):337–46. doi: 10.1007/s002130000441. [PubMed: 10923762]

Shalev U, Marinelli M, Baumann MH, Piazza PV, Shaham Y. The role of corticosterone in food deprivation-induced reinstatement of cocaine seeking in the rat. Psychopharmacology2003;168(1–2):170–176. doi: 10.1007/s00213-002-1200-5. [PubMed: 12845419]

Sharma S, Fernandes MF, Fulton S. Adaptations in brain reward circuitry underlie palatable food cravings and anxiety induced by high-fat diet withdrawal. Int J Obes2013;37(9):1183–91. doi: 10.1038/ijo.2012.197.

Sharpe AL, Coste SC, Burkhart-Kasch S, Li N, Stenzel-Poore MP, Phillips TJ. Mice deficient in corticotropin-releasing factor receptor type 2 exhibit normal ethanol-associated behaviors. Alcohol Clin Exp Res2005;29(9):1601–9. doi: 10.1097/01.alc.0000179371.46716.5e.Erratum in: Alcohol Clin Exp Res 2008;32(11):2028. [PubMed: 16205360]

Shearrer GE, Stice E, Burger KS. Adolescents at high risk of obesity show greater striatal response to increased sugar content in milkshakes. Am J Clin Nutr2018;107(6):859–866. doi: 10.1093/ajcn/nqy050. [PubMed: 29771283]

Sheehan DV, Herman BK. The Psychological and Medical Factors Associated With Untreated Binge Eating Disorder. Prim Care Companion CNS Disord2015;17(2):10.4088/PCC.14r01732. doi: 10.4088/PCC.14r01732.

Sherman MM, Ungureanu S, Rey JA. Naltrexone/Bupropion ER (Contrave): Newly Approved Treatment Option for Chronic Weight Management in Obese Adults. P T2016;41(3):164–72. [PubMed: 26957883]

Siegel S, Ramos BM. Applying laboratory research: drug anticipation and the treatment of drug addiction. Exp Clin Psychopharmacol2002;10(3):162–83. doi: 10.1037//1064-1297.10.3.162. [PubMed: 12233979]

Silbersweig D, Clarkin JF, Goldstein M, Kernberg OF, Tuescher O, Levy KN, Brendel G, Pan H, Beutel M, Pavony MT, Epstein J, Lenzenweger MF, Thomas KM, Posner MI, Stern E. Failure of frontolimbic inhibitory function in the context of negative emotion in borderline personality disorder. Am J Psychiatry2007;164(12):1832–41. doi: 10.1176/appi.ajp.2007.06010126. [PubMed: 18056238]

Simon GE, Von Korff M, Saunders K, et al.Association between obesity and psychiatric disorders in the US adult population. Arch Gen Psychiatry2006;63(7):824–830. doi:10.1001/archpsyc.63.7.824. [PubMed: 16818872]

Singh M. Mood, food, and obesity. Front Psychol2014;5:925. doi: 10.3389/fpsyg.2014.00925. [PubMed: 25225489]

Siniscalchi A, Bonci A, Biagio Mercuri N, Pirritano D, Squillace A, De Sarro G, Gallelli L. The Role of Topiramate in the Management of Cocaine Addiction: a Possible Therapeutic Option. Curr Neuropharmacol2015;13(6):815–8. doi: 10.2174/1570159x13666150729222643. [PubMed: 26630959]

Sinnayah P, Wallingford NM, Evans AE, Cowley MA. Bupropion and naltrexone interact synergistically to decrease food intake in mice. ScienceOpen, 2007. https://www.scienceopen.com/document?vid=675a2d4d-d825-45be-bf9c-716f23852839

Sirohi S, Schurdak JD, Seeley RJ, Benoit SC, Davis JF. Central & peripheral glucagon-like peptide-1 receptor signaling differentially regulate addictive behaviors. Physiol Behav201671;161:140–144. doi: 10.1016/j.physbeh.2016.04.013. Epub2016 Apr 9. [PubMed: 27072507]

Sjödin A, Gasteyger C, Nielsen AL, Raben A, Mikkelsen JD, Jensen JK, Meier D, Astrup A. The effect of the triple monoamine reuptake inhibitor tesofensine on energy metabolism and appetite in overweight and moderately obese men. Int J Obes2010;34(11):1634–43. doi: 10.1038/ijo.2010.87.

Skelton KH, Oren D, Gutman DA, Easterling K, Holtzman SG, Nemeroff CB, Owens MJ. The CRF1 receptor antagonist, R121919, attenuates the severity of precipitated morphine withdrawal. Eur J Pharmacol2007;571(1):17–24. doi: 10.1016/j.ejphar.2007.05.041. [PubMed: 17610870]

Smith GT, Cyders MA. Integrating affect and impulsivity: The role of positive and negative urgency in substance use risk. Drug Alcohol Depend2016;163Suppl 1(Suppl 1):S3–S12. doi: 10.1016/j.drugalcdep.2015.08.038. [PubMed: 27306729]

Smith KE, Engel SG, Steffen KJ, Garcia L, Grothe K, Koball A, Mitchell JE. Problematic Alcohol Use and Associated Characteristics Following Bariatric Surgery. Obes Surg20185;28(5):1248–1254. doi: 10.1007/s11695-017-3008-8. [PubMed: 29110243]

Smith KL, Rao RR, Velázquez-Sánchez C, Valenza M, Giuliano C, Everitt BJ, Sabino V, Cottone P. The uncompetitive N-methyl-D-aspartate antagonist memantine reduces binge-like eating, food-seeking behavior, and compulsive eating: role of the nucleus accumbens shell. Neuropsychopharmacology2015;40(5):1163–71. doi: 10.1038/npp.2014.299. [PubMed: 25381776]

Smith LC, George O. Advances in smoking cessation pharmacotherapy: Non-nicotinic approaches in animal models. Neuropharmacology2020111;178:108225. doi: 10.1016/j.neuropharm.2020.108225. Epub2020 Aug 3. [PubMed: 32758566]

Smith ME, Lee JS, Bonham A, Varban OA, Finks JF, Carlin AM, Ghaferi AA. Effect of new persistent opioid use on physiologic and psychologic outcomes following bariatric surgery. Surg Endosc20198;33(8):2649–2656. doi: 10.1007/s00464-018-6542-0. Epub2018 Oct 23. [PubMed: 30353238]

Smith ML, Li J, Ryabinin AE. Increased alcohol consumption in urocortin 3 knockout mice is unaffected by chronic inflammatory pain. Alcohol Alcohol2015;50(2):132–9. doi: 10.1093/alcalc/agu084. [PubMed: 25451237]

Smoller JW, Wadden TA, Stunkard AJ. Dieting and depression: a critical review. J Psychosom Res1987;31(4):429–40. doi: 10.1016/0022-3999(87)90001-8. [PubMed: 3312589]

Smyth JM, Wonderlich SA, Heron KE, Sliwinski MJ, Crosby RD, Mitchell JE, Engel SG. Daily and momentary mood and stress are associated with binge eating and vomiting in bulimia nervosa patients in the natural environment. J Consult Clin Psychol2007;75(4):629–38. doi: 10.1037/0022-006X.75.4.629. [PubMed: 17663616]

Søberg S, Andersen ES, Dalsgaard NB, Jarlhelt I, Hansen NL, Hoffmann N, Vilsbøll T, Chenchar A, Jensen M, Grevengoed TJ, Trammell SAJ, Knop FK, Gillum MP. FGF21, a liver hormone that inhibits alcohol intake in mice, increases in human circulation after acute alcohol ingestion and sustained binge drinking at Oktoberfest. Mol Metab2018;11:96–103. doi: 10.1016/j.molmet.2018.03.010. [PubMed: 29627377]

Søberg S, Sandholt CH, Jespersen NZ, Toft U, Madsen AL, von Holstein-Rathlou S, Grevengoed TJ, Christensen KB, Bredie WLP, Potthoff MJ, Solomon TPJ, Scheele C, Linneberg A, Jørgensen T, Pedersen O, Hansen T, Gillum MP, Grarup N. FGF21 Is a Sugar-Induced Hormone Associated with Sweet Intake and Preference in Humans. Cell Metab2017;25(5):1045–1053.e6. doi: 10.1016/j.cmet.2017.04.009. [PubMed: 28467924]

Sommer WH, Rimondini R, Hansson AC, Hipskind PA, Gehlert DR, Barr CS, Heilig MA. Upregulation of voluntary alcohol intake, behavioral sensitivity to stress, and amygdala crhr1 expression following a history of dependence. Biol Psychiatry2008;63(2):139–45. doi: 10.1016/j.biopsych.2007.01.010. [PubMed: 17585886]

Sørensen G, Caine SB, Thomsen M. Effects of the GLP-1 Agonist Exendin-4 on Intravenous Ethanol Self-Administration in Mice. Alcohol Clin Exp Res201610;40(10):2247–2252. doi: 10.1111/acer.13199. Epub2016 Aug 31. [PubMed: 27579999]

Sørensen G, Reddy IA, Weikop P, Graham DL, Stanwood GD, Wortwein G, Galli A, Fink-Jensen A. The glucagon-like peptide 1 (GLP-1) receptor agonist exendin-4 reduces cocaine self-administration in mice. Physiol Behav2015101;149:262–8. doi: 10.1016/j.physbeh.2015.06.013. Epub2015 Jun 11. [PubMed: 26072178]

South T, Huang XF. High-fat diet exposure increases dopamine D2 receptor and decreases dopamine transporter receptor binding density in the nucleus accumbens and caudate putamen of mice. Neurochem Res2008;33(3):598–605. doi: 10.1007/s11064-007-9483-x. [PubMed: 17940894]

Spangler R, Wittkowski KM, Goddard NL, Avena NM, Hoebel BG, Leibowitz SF. Opiate-like effects of sugar on gene expression in reward areas of the rat brain. Brain Res Mol Brain Res2004;124(2):134–42. doi: 10.1016/j.molbrainres.2004.02.013. [PubMed: 15135221]

Specio SE, Wee S, O'Dell LE, Boutrel B, Zorrilla EP, Koob GF. CRF(1) receptor antagonists attenuate escalated cocaine self-administration in rats. Psychopharmacology2008;196(3):473–82. doi: 10.1007/s00213-007-0983-9. [PubMed: 17965976]

Speed N, Saunders C, Davis AR, Owens WA, Matthies HJ, Saadat S, Kennedy JP, Vaughan RA, Neve RL, Lindsley CW, Russo SJ, Daws LC, Niswender KD, Galli A. Impaired striatal Akt signaling disrupts dopamine homeostasis and increases feeding. PLoS One2011;6(9):e25169. doi: 10.1371/journal.pone.0025169. [PubMed: 21969871]

Spierling S, de Guglielmo G, Kirson D, Kreisler A, Roberto M, George O, Zorrilla EP. Insula to ventral striatal projections mediate compulsive eating produced by intermittent access to palatable food. Neuropsychopharmacology2020;45(4):579–588. doi: 10.1038/s41386-019-0538-x. [PubMed: 31593982]

Spierling SR, Kreisler AD, Williams CA, Fang SY, Pucci SN, Kines KT, Zorrilla EP. Intermittent, extended access to preferred food leads to escalated food reinforcement and cyclic whole-body metabolism in rats: Sex differences and individual vulnerability. Physiol Behav2018;192:3–16. doi: 10.1016/j.physbeh.2018.04.001. [PubMed: 29654812]

Spierling SR, Mattock M, Zorrilla EP. Modeling hypohedonia following repeated social defeat: Individual vulnerability and dopaminergic involvement. Physiol Behav. 2017;177:99–106. doi: 10.1016/j.physbeh.2017.04.016. [PubMed: 28433467]

Spierling SR, Zorrilla EP. Don't stress about CRF: assessing the translational failures of CRF1antagonists. Psychopharmacology2017;234(9–10):1467–1481. doi: 10.1007/s00213-017-4556-2. [PubMed: 28265716]

Spoor ST, Stice E, Bekker MH, Van Strien T, Croon MA, Van Heck GL. Relations between dietary restraint, depressive symptoms, and binge eating: A longitudinal study. Int J Eat Disord2006;39(8):700–7. doi: 10.1002/eat.20283. [PubMed: 16941629]

Spring B, Schneider K, Smith M, Kendzor D, Appelhans B, Hedeker D, Pagoto S. Abuse potential of carbohydrates for overweight carbohydrate cravers. Psychopharmacology2008;197(4):637–47. doi: 10.1007/s00213-008-1085-z. [PubMed: 18273603]

Stafford D, LeSage MG, Rice KC, Glowa JR. A comparison of cocaine, GBR 12909, and phentermine self-administration by rhesus monkeys on a progressive-ratio schedule. Drug Alcohol Depend2001;62(1):41–7. doi: 10.1016/s0376-8716(00)00158-7. [PubMed: 11173166]

Staiger H, Keuper M, Berti L, Hrabe de Angelis M, Häring HU. Fibroblast Growth Factor 21-Metabolic Role in Mice and Men. Endocr Rev2017;38(5):468–488. doi: 10.1210/er.2017-00016. [PubMed: 28938407]

Stamp JA, Mashoodh R, van Kampen JM, Robertson HA. Food restriction enhances peak corticosterone levels, cocaine-induced locomotor activity, and DeltaFosB expression in the nucleus accumbens of the rat. Brain Res2008;1204:94–101. doi: 10.1016/j.brainres.2008.02.019. [PubMed: 18342839]

Stautz K, Cooper A. Impulsivity-related personality traits and adolescent alcohol use: a meta-analytic review. Clin Psychol Rev2013;33(4):574–92. doi: 10.1016/j.cpr.2013.03.003. [PubMed: 23563081]

Steffen KJ, Engel SG, Wonderlich JA, Pollert GA, Sondag C. Alcohol and Other Addictive Disorders Following Bariatric Surgery: Prevalence, Risk Factors and Possible Etiologies. Eur Eat Disord Rev2015;23(6):442–50. doi: 10.1002/erv.2399. [PubMed: 26449524]

Stice ERelations of restraint and negative affect to bulimic pathology: a longitudinal test of three competing models. Int J Eat Disord1998;23(3):243–60. doi: 10.1002/(sici)1098-108x(199804)23:3<243::aid-eat2>3.0.co;2-j. [PubMed: 9547659]

Stice EA prospective test of the dual-pathway model of bulimic pathology: mediating effects of dieting and negative affect. J Abnorm Psychol2001;110(1):124–35. doi: 10.1037//0021-843x.110.1.124. [PubMed: 11261386]

Stice E. Risk and maintenance factors for eating pathology: a meta-analytic review. Psychol Bull2002;128(5):825–48. doi: 10.1037/0033-2909.128.5.825. [PubMed: 12206196]

Stice E, Bearman SK. Body-image and eating disturbances prospectively predict increases in depressive symptoms in adolescent girls: a growth curve analysis. Dev Psychol2001;37(5):597–607. doi: 10.1037//0012-1649.37.5.597. [PubMed: 11552756]

Stice E, Burger KS, Yokum S. Reward Region Responsivity Predicts Future Weight Gain and Moderating Effects of the TaqIA Allele. J Neurosci2015;35(28):10316–24. doi: 10.1523/JNEUROSCI.3607-14.2015. [PubMed: 26180206]

Stice E, Spoor S, Bohon C, Small DM. Relation between obesity and blunted striatal response to food is moderated by TaqIA A1 allele. Science2008;322(5900):449–52. doi: 10.1126/science.1161550. [PubMed: 18927395]

Stice E, Yokum S, Blum K, Bohon C. Weight gain is associated with reduced striatal response to palatable food. J Neurosci2010;30(39):13105–9. doi: 10.1523/JNEUROSCI.2105-10.2010. [PubMed: 20881128]

Stice E, Yokum S. Gain in Body Fat Is Associated with Increased Striatal Response to Palatable Food Cues, whereas Body Fat Stability Is Associated with Decreased Striatal Response. J Neurosci2016a;36(26):6949–56. doi: 10.1523/JNEUROSCI.4365-15.2016. [PubMed: 27358453]

Stice E, Yokum S. Neural vulnerability factors that increase risk for future weight gain. Psychol Bull2016b;142(5):447–71. doi: 10.1037/bul0000044. [PubMed: 26854866]

Stice E, Yokum S, Zald D, Dagher A. Dopamine-based reward circuitry responsivity, genetics, and overeating. Curr Top Behav Neurosci2011;6:81–93. doi: 10.1007/7854_2010_89. [PubMed: 21243471]

Stinus L, Cador M, Zorrilla EP, Koob GF. Buprenorphine and a CRF1 antagonist block the acquisition of opiate withdrawal-induced conditioned place aversion in rats. Neuropsychopharmacology2005;30(1):90–8. doi: 10.1038/sj.npp.1300487. [PubMed: 15138444]

Stoeckel LE, Weller RE, Cook EW 3rd, Twieg DB, Knowlton RC, Cox JE. Widespread reward-system activation in obese women in response to pictures of high-calorie foods. Neuroimage2008;41(2):636–47. doi: 10.1016/j.neuroimage.2008.02.031. [PubMed: 18413289]

Stokes A, Berry KM, Collins JM, Hsiao CW, Waggoner JR, Johnston SS, Ammann EM, Scamuffa RF, Lee S, Lundberg DJ, Solomon DH, Felson DT, Neogi T, Manson JE. The contribution of obesity to prescription opioid use in the United States. Pain201910;160(10):2255–2262. doi: 10.1097/j.pain.0000000000001612. [PubMed: 31149978]

Strahler J, Nater UM. Differential effects of eating and drinking on wellbeing-An ecological ambulatory assessment study. Biol Psychol2018131:72–88. doi: 10.1016/j.biopsycho.2017.01.008. [PubMed: 28119068]

Sustkova-Fiserova M, Jerabek P, Havlickova T, Kacer P, Krsiak M. Ghrelin receptor antagonism of morphine-induced accumbens dopamine release and behavioral stimulation in rats. Psychopharmacology (Berl)2014;231(14):2899–908. doi: 10.1007/s00213-014-3466-9. [PubMed: 24531567]

Sustkova-Fiserova M, Puskina N, Havlickova T, Lapka M, Syslova K, Pohorala V, Charalambous C. Ghrelin receptor antagonism of fentanyl-induced conditioned place preference, intravenous self-administration, and dopamine release in the nucleus accumbens in rats. Addict Biol2020;25(6):e12845. doi: 10.1111/adb.12845. [PubMed: 31696597]

Sutton RS, Barto AG. Toward a modern theory of adaptive networks: expectation and prediction. Psychol Rev1981; 3;88(2):135–70. [PubMed: 7291377]

Swanson SA, Crow SJ, Le Grange D, Swendsen J, Merikangas KR. Prevalence and correlates of eating disorders in adolescents. Results from the national comorbidity survey replication adolescent supplement. Arch Gen Psychiatry2011;68(7):714–23. doi: 10.1001/archgenpsychiatry.2011.22. [PubMed: 21383252]

Taber KH, Black DN, Porrino LJ, Hurley RA. Neuroanatomy of dopamine: reward and addiction. J Neuropsychiatry Clin Neurosci2012;24(1):1–4. doi: 10.1176/appi.neuropsych.24.1.1. [PubMed: 22450608]

Takahashi RN, Singer G, Oei TP. Schedule induced self-injection of D-amphetamine by naive animals. Pharmacol Biochem Behav1978;9(6):857–61. doi: 10.1016/0091-3057(78)90369-6. [PubMed: 746058]

Talukdar S, Owen BM, Song P, Hernandez G, Zhang Y, Zhou Y, Scott WT, Paratala B, Turner T, Smith A, Bernardo B, Müller CP, Tang H, Mangelsdorf DJ, Goodwin B, Kliewer SA. FGF21 Regulates Sweet and Alcohol Preference. Cell Metab2016;23(2):344–9. doi: 10.1016/j.cmet.2015.12.008. [PubMed: 26724861]

Tanihata T, Kanda H, Osaki Y, Ohida T, Minowa M, Wada K, Suzuki K, Hayashi K. Unhealthy lifestyle, poor mental health, and its correlation among adolescents: a nationwide cross-sectional survey. Asia Pac J Public Health2015;27(2):NP1557–65. doi: 10.1177/1010539512452753.

Teegarden SL, Bale TL. Decreases in dietary preference produce increased emotionality and risk for dietary relapse. Biol Psychiatry2007;61(9):1021–9. doi: 10.1016/j.biopsych.2006.09.032. [PubMed: 17207778]

Teegarden SL, Bale TL. Effects of stress on dietary preference and intake are dependent on access and stress sensitivity. Physiol Behav2008;93(4–5):713–23. doi: 10.1016/j.physbeh.2007.11.030. [PubMed: 18155095]

Thompson A, Cook J, Choquet H, Jorgenson E, Yiin J, Kinnunen T, Barclay J, Morris AP, Pirmohamed. Functional validity, role, and implications of heavy alcohol consumption genetic loci. Sci Adv2020; 6 (3):eaay5034. Doi: 10.1126/sciadv.aay5034. [PubMed: 31998841]

Thomsen M, Dencker D, Wörtwein G, Weikop P, Egecioglu E, Jerlhag E, Fink-Jensen A, Molander A. The glucagon-like peptide 1 receptor agonist Exendin-4 decreases relapse-like drinking in socially housed mice. Pharmacol Biochem Behav20179;160:14–20. doi: 10.1016/j.pbb.2017.07.014. Epub2017 Aug 1. [PubMed: 28778739]

Thomsen WJ, Grottick AJ, Menzaghi F, Reyes-Saldana H, Espitia S, Yuskin D, Whelan K, Martin M, Morgan M, Chen W, Al-Shamma H, Smith B, Chalmers D, Behan D. Lorcaserin, a novel selective human 5-hydroxytryptamine2C agonist: in vitro and in vivo pharmacological characterization. J Pharmacol Exp Ther2008;325(2):577–87. doi: 10.1124/jpet.107.133348. [PubMed: 18252809]

Tomasi D, Volkow ND. Striatocortical pathway dysfunction in addiction and obesity: differences and similarities. Crit Rev Biochem Mol Biol2013;48(1):1–19. doi: 10.3109/10409238.2012.735642. [PubMed: 23173916]

Topp L, Lovibond PF, Mattick RP. Cue reactivity in dependent amphetamine users: can monistic conditioning theories advance our understanding of reactivity?Drug Alcohol Rev1998;17(3):277–88. doi: 10.1080/09595239800187111. [PubMed: 16203494]

Traversy G, Chaput JP. Alcohol Consumption and Obesity: An Update. Curr Obes Rep2015;4(1):122–130. doi:10.1007/s13679-014-0129-4. [PubMed: 25741455]

Treesukosol Y, Liang NC, Moran TH. Alterations in sucrose sham-feeding intake as a function of diet-exposure in rats maintained on calorically dense diets. Appetite2015;92:278–86. doi: 10.1016/j.appet.2015.05.014. [PubMed: 25987540]

Tronieri JS, Wurst CM, Pearl RL, Allison KC. Sex Differences in Obesity and Mental Health. Curr Psychiatry Rep2017;19(6):29. doi:10.1007/s11920-017-0784-8. [PubMed: 28439762]

Tuesta LM, Chen Z, Duncan A, Fowler CD, Ishikawa M, Lee BR, Liu XA, Lu Q, Cameron M, Hayes MR, Kamenecka TM, Pletcher M, Kenny PJ. GLP-1 acts on habenular avoidance circuits to control nicotine intake. Nat Neurosci20175;20(5):708–716. doi: 10.1038/nn.4540. Epub2017 Apr 3. [PubMed: 28368384]

Tye KM, Cone JJ, Schairer WW, Janak PH. Amygdala neural encoding of the absence of reward during extinction. J Neurosci2010;30(1):116–25. doi: 10.1523/JNEUROSCI.4240-09.2010. [PubMed: 20053894]

Ulrich-Lai YM, Christiansen AM, Ostrander MM, Jones AA, Jones KR, Choi DC, Krause EG, Evanson NK, Furay AR, Davis JF, Solomon MB, de Kloet AD, Tamashiro KL, Sakai RR, Seeley RJ, Woods SC, Herman JP. Pleasurable behaviors reduce stress via brain reward pathways. Proc Natl Acad Sci U S A2010;107(47):20529–34. doi: 10.1073/pnas.1007740107. [PubMed: 21059919]

Ulrich-Lai YM, Ostrander MM, Herman JP. HPA axis dampening by limited sucrose intake: reward frequency vs. caloric consumption. Physiol Behav2011;103(1):104–10. doi: 10.1016/j.physbeh.2010.12.011. [PubMed: 21168428]

Ulrich-Lai YM, Ostrander MM, Thomas IM, Packard BA, Furay AR, Dolgas CM, Van Hooren DC, Figueiredo HF, Mueller NK, Choi DC, Herman JP. Daily limited access to sweetened drink attenuates hypothalamic-pituitary-adrenocortical axis stress responses. Endocrinology2007;148(4):1823–34. doi: 10.1210/en.2006-1241. [PubMed: 17204558]

Valdez GR, Roberts AJ, Chan K, Davis H, Brennan M, Zorrilla EP, Koob GF. Increased ethanol self-administration and anxiety-like behavior during acute ethanol withdrawal and protracted abstinence: regulation by corticotropin-releasing factor. Alcohol Clin Exp Res2002;26(10):1494–501. doi: 10.1097/01.ALC.0000033120.51856.F0. [PubMed: 12394282]

Valenstein ES, Cox VC, Kakolewski JW. Polydipsia elicited by the synergistic action of a saccharin and glucose solution. Science. 1967;157(3788):552–4. [PubMed: 6028919]

van de Giessen E, Celik F, Schweitzer DH, van den Brink W, Booij J. Dopamine D2/3 receptor availability and amphetamine-induced dopamine release in obesity. J Psychopharmacol2014;28(9):866–73. doi: 10.1177/0269881114531664. [PubMed: 24785761]

van de Giessen E, de Bruin K, la Fleur SE, van den Brink W, Booij J. Triple monoamine inhibitor tesofensine decreases food intake, body weight, and striatal dopamine D2/D3 receptor availability in diet-induced obese rats. Eur Neuropsychopharmacol2012;22(4):290–9. doi: 10.1016/j.euroneuro.2011.07.015. [PubMed: 21889317]

VanderBroek-Stice L, Stojek MK, Beach SRH, vanDellen MR, MacKillop J. Multidimensional assessment of impulsivity in relation to obesity and food addiction. Appetite2017;112:59–68. doi: 10.1016/j.appet.2017.01.009. [PubMed: 28087369]

van Vliet-Ostaptchouk JV, den Hoed M, Luan J, Zhao JH, Ong KK, van der Most PJ, Wong A, Hardy R, Kuh D, van der Klauw MM, Bruinenberg M, Khaw KT, Wolffenbuttel BH, Wareham NJ, Snieder H, Loos RJ. Pleiotropic effects of obesity-susceptibility loci on metabolic traits: a meta-analysis of up to 37,874 individuals. Diabetologia201310;56(10):2134–46. doi: 10.1007/s00125-013-2985-y. [PubMed: 23827965]

Vargas-Perez H, Ting-A-Kee R, van der Kooy D. Different neural systems mediate morphine reward and its spontaneous withdrawal aversion. Eur J Neurosci2009;29(10):2029–34. doi: 10.1111/j.1460-9568.2009.06749.x. [PubMed: 19453632]

Vargas-Perez H, Ting-A-Kee RA, Heinmiller A, Sturgess JE, van der Kooy D. A test of the opponent-process theory of motivation using lesions that selectively block morphine reward. Eur J Neurosci2007;25(12):3713–8. doi: 10.1111/j.1460-9568.2007.05599.x. [PubMed: 17610590]

Veiga-da-Cunha M, Delplanque J, Gillain A, Bonthron DT, Boutin P, Van Schaftingen E, Froguel P. Mutations in the glucokinase regulatory protein gene in 2p23 in obese French caucasians. Diabetologia2003;46(5):704–11. doi: 10.1007/s00125-003-1083-y. [PubMed: 12739015]

Vendruscolo LF, Gueye AB, Darnaudéry M, Ahmed SH, Cador M. Sugar overconsumption during adolescence selectively alters motivation and reward function in adult rats. PLoS One2010;5(2):e9296. doi: 10.1371/journal.pone.0009296. [PubMed: 20174565]

Vickers SP, Goddard S, Brammer RJ, Hutson PH, Heal DJ. Investigation of impulsivity in binge-eating rats in a delay-discounting task and its prevention by the d-amphetamine prodrug, lisdexamfetamine. J Psychopharmacol2017;31(6):784–797. doi: 10.1177/0269881117691672. [PubMed: 28372478]

Volkow ND, Baler RD. NOW vs LATER brain circuits: implications for obesity and addiction. Trends Neurosci2015;38(6):345–52. doi: 10.1016/j.tins.2015.04.002. [PubMed: 25959611]

Volkow ND, Fowler JS, Wang GJ, Baler R, Telang F. Imaging dopamine's role in drug abuse and addiction. Neuropharmacology2009;56Suppl 1(Suppl 1):3–8. doi: 10.1016/j.neuropharm.2008.05.022. [PubMed: 18617195]

Volkow ND, Fowler JS, Wang GJ, Swanson JM, Telang F. Dopamine in drug abuse and addiction: results of imaging studies and treatment implications. Arch Neurol2007;64(11):1575–9. doi: 10.1001/archneur.64.11.1575. [PubMed: 17998440]

Volkow ND, Wang GJ, Fowler JS, Logan J, Jayne M, Franceschi D, Wong C, Gatley SJ, Gifford AN, Ding YS, Pappas N. "Nonhedonic" food motivation in humans involves dopamine in the dorsal striatum and methylphenidate amplifies this effect. Synapse2002;44(3):175–80. doi: 10.1002/syn.10075. [PubMed: 11954049]

Volkow ND, Wang GJ, Fowler JS, Telang F. Overlapping neuronal circuits in addiction and obesity: evidence of systems pathology. Philos Trans R Soc Lond B Biol Sci2008a;363(1507):3191–200. doi: 10.1098/rstb.2008.0107. [PubMed: 18640912]

Volkow ND, Wang GJ, Fowler JS, Tomasi D, Telang F. Addiction: beyond dopamine reward circuitry. Proc Natl Acad Sci U S A2011;108(37):15037–42. doi: 10.1073/pnas.1010654108. [PubMed: 21402948]

Volkow ND, Wang GJ, Telang F, Fowler JS, Thanos PK, Logan J, Alexoff D, Ding YS, Wong C, Ma Y, Pradhan K. Low dopamine striatal D2 receptors are associated with prefrontal metabolism in obese subjects: possible contributing factors. Neuroimage2008b;42(4):1537–43. doi: 10.1016/j.neuroimage.2008.06.002. [PubMed: 18598772]

Volkow ND, Wang GJ, Tomasi D, Baler RD. Obesity and addiction: neurobiological overlaps. Obes Rev2013;14(1):2–18. doi: 10.1111/j.1467-789X.2012.01031.x. [PubMed: 23016694]

Vollbrecht PJ, Mabrouk OS, Nelson AD, Kennedy RT, Ferrario CR. Pre-existing differences and diet-induced alterations in striatal dopamine systems of obesity-prone rats. Obesity (Silver Spring)20163;24(3):670–7. doi: 10.1002/oby.21411. Epub2016 Feb 5. [PubMed: 26847484]

Vollbrecht PJ, Nesbitt KM, Mabrouk OS, Chadderdon AM, Jutkiewicz EM, Kennedy RT, Ferrario CR. Cocaine and desipramine elicit distinct striatal noradrenergic and behavioral responses in selectively bred obesity-resistant and obesity-prone rats. Behav Brain Res201872;346:137–143. doi: 10.1016/j.bbr.2017.11.009. Epub2017 Nov 9. [PubMed: 29129597]

Vollbrecht PJ, Nobile CW, Chadderdon AM, Jutkiewicz EM, Ferrario CR. Pre-existing differences in motivation for food and sensitivity to cocaine-induced locomotion in obesity-prone rats. Physiol Behav2015121;152(Pt A):151–60. doi: 10.1016/j.physbeh.2015.09.022. Epub2015 Sep 28. [PubMed: 26423787]

Wallace LM, Masson PC, Safer DL, von Ranson KM. Change in emotion regulation during the course of treatment predicts binge abstinence in guided self-help dialectical behavior therapy for binge eating disorder. J Eat Disord2014;2(1):35. doi: 10.1186/s40337-014-0035-x. [PubMed: 25516798]

Wallis DJ, Hetherington MM. Emotions and eating. Self-reported and experimentally induced changes in food intake under stress. Appetite2009;52(2):355–62. doi: 10.1016/j.appet.2008.11.007. [PubMed: 19071171]

Walter KN, Wagner JA, Cengiz E, Tamborlane WV, Petry NM. Substance Use Disorders among Patients with Type 2 Diabetes: a Dangerous but Understudied Combination. Curr Diab Rep2017;17(1):2. doi: 10.1007/s11892-017-0832-0. [PubMed: 28101793]

Wang GJ, Geliebter A, Volkow ND, Telang FW, Logan J, Jayne MC, Galanti K, Selig PA, Han H, Zhu W, Wong CT, Fowler JS. Enhanced striatal dopamine release during food stimulation in binge eating disorder. Obesity2011;19(8):1601–8. doi: 10.1038/oby.2011.27. [PubMed: 21350434]

Wang GJ, Tomasi D, Volkow ND, Wang R, Telang F, Caparelli EC, Dunayevich E. Effect of combined naltrexone and bupropion therapy on the brain's reactivity to food cues. Int J Obes2014;38(5):682–8. doi: 10.1038/ijo.2013.145.

Wang GJ, Volkow ND, Logan J, Pappas NR, Wong CT, Zhu W, Netusil N, Fowler JS. Brain dopamine and obesity. Lancet2001;357(9253):354–7. doi: 10.1016/s0140-6736(00)03643-6. [PubMed: 11210998]

Wang GJ, Volkow ND, Thanos PK, Fowler JS. Imaging of brain dopamine pathways: implications for understanding obesity. J Addict Med2009;3(1):8–18. doi: 10.1097/ADM.0b013e31819a86f7. [PubMed: 21603099]

Warne JP. Shaping the stress response: interplay of palatable food choices, glucocorticoids, insulin and abdominal obesity. Mol Cell Endocrinol2009;300(1–2):137–46. doi: 10.1016/j.mce.2008.09.036. [PubMed: 18984030]

Warren MW, Gold MS. The relationship between obesity and drug use. Am J Psychiatry2007;164(8):1268; author reply 1268–9. doi: 10.1176/appi.ajp.2007.07030388. [PubMed: 17671293]

Wei ZX, Chen L, Zhang JJ, Cheng Y. Aberrations in peripheral inflammatory cytokine levels in substance use disorders: a meta-analysis of 74 studies. Addiction2020, in press. doi: 10.1111/add.15160.

Weingarten HP. Diet palatability modulates sham feeding in VMH-lesion and normal rats: implications for finickiness and evaluation of sham-feeding data. J Comp Physiol Psychol1982;96(2):223–33. doi: 10.1037/h0077878. [PubMed: 7068985]

Weiss F, Ciccocioppo R, Parsons LH, Katner S, Liu X, Zorrilla EP, Valdez GR, Ben-Shahar O, Angeletti S, Richter RR. Compulsive drug-seeking behavior and relapse. Neuroadaptation, stress, and conditioning factors. Ann N Y Acad Sci2001;937:1–26. doi: 10.1111/j.1749-6632.2001.tb03556.x. [PubMed: 11458532]

Wellman PJ, Nation JR, Davis KW. Impairment of acquisition of cocaine self-administration in rats maintained on a high-fat diet. Pharmacol Biochem Behav2007;88(1):89–93. doi: 10.1016/j.pbb.2007.07.008. [PubMed: 17764729]

Wells AS, Read NW, Laugharne JD, Ahluwalia NS. Alterations in mood after changing to a low-fat diet. Br J Nutr1998;79(1):23–30. doi: 10.1079/bjn19980005. [PubMed: 9505799]

Wendling A, Wudyka A. Narcotic addiction following gastric bypass surgery--a case study. Obes Surg2011;21(5):680–3. doi: 10.1007/s11695-010-0177-0. [PubMed: 20473721]

Wenzel JM, Waldroup SA, Haber ZM, Su ZI, Ben-Shahar O, Ettenberg A. Effects of lidocaine-induced inactivation of the bed nucleus of the stria terminalis, the central or the basolateral nucleus of the amygdala on the opponent-process actions of self-administered cocaine in rats. Psychopharmacology2011;217(2):221–30. doi: 10.1007/s00213-011-2267-7. [PubMed: 21487661]

Werrij MQ, Jansen A, Mulkens S, Elgersma HJ, Ament AJ, Hospers HJ. Adding cognitive therapy to dietetic treatment is associated with less relapse in obesity. J Psychosom Res2009;67(4):315–24. doi: 10.1016/j.jpsychores.2008.12.011. [PubMed: 19773024]

Wijngaarden MA, Veer IM, Rombouts SA, van Buchem MA, Willems van Dijk K, Pijl H, van der Grond J. Obesity is marked by distinct functional connectivity in brain networks involved in food reward and salience. Behav Brain Res2015;287:127–34. doi: 10.1016/j.bbr.2015.03.016. [PubMed: 25779924]

Williams MJ, Almén MS, Fredriksson R, Schiöth HB. What model organisms and interactomics can reveal about the genetics of human obesity. Cell Mol Life Sci201211;69(22):3819–34. doi: 10.1007/s00018-012-1022-5 [PubMed: 22618246]

Winnier DA, Fourcaudot M, Norton L, Abdul-Ghani MA, Hu SL, Farook VS, Coletta DK, Kumar S, Puppala S, Chittoor G, Dyer TD, Arya R, Carless M, Lehman DM, Curran JE, Cromack DT, Tripathy D, Blangero J, Duggirala R, Göring HH, DeFronzo RA, Jenkinson CP. Transcriptomic identification of ADH1B as a novel candidate gene for obesity and insulin resistance in human adipose tissue in Mexican Americans from the Veterans Administration Genetic Epidemiology Study (VAGES). PLoS One2015;10(4):e0119941. doi: 10.1371/journal.pone.0119941. [PubMed: 25830378]

Winpenny EM, van Harmelen AL, White M, van Sluijs EM, Goodyer IM. Diet quality and depressive symptoms in adolescence: no cross-sectional or prospective associations following adjustment for covariates. Public Health Nutr2018;21(13):2376–2384. doi: 10.1017/S1368980018001179. [PubMed: 29766837]

Winter SR, Yokum S, Stice E, Osipowicz K, Lowe MR. Elevated reward response to receipt of palatable food predicts future weight variability in healthy-weight adolescents. Am J Clin Nutr2017;105(4):781–789. doi: 10.3945/ajcn.116.141143. [PubMed: 28228422]

Wise RA, Bozarth MA. Brain mechanisms of drug reward and euphoria. Psychiatr Med1985;3(4):445–60. [PubMed: 2893431]

Wittekind DA, Kratzsch J, Mergl R, Enzenbach C, Witte V, Villringer A, Kluge M. Higher fasting ghrelin serum levels in active smokers than in former and never-smokers. World J Biol Psychiatry2019:1–9. doi: 10.1080/15622975.2019.1671610. [PubMed: 32064999]

Wojnicki FH, Rothman RB, Rice KC, Glowa JR. Effects of phentermine on responding maintained under multiple fixed-ratio schedules of food and cocaine presentation in the rhesus monkey. J Pharmacol Exp Ther1999;288(2):550–60. [PubMed: 9918558]

Womble LG, Williamson DA, Martin CK, Zucker NL, Thaw JM, Netemeyer R, Lovejoy JC, Greenway FL. Psychosocial variables associated with binge eating in obese males and females. Int J Eat Disord2001;30(2):217–21. doi: 10.1002/eat.1076. [PubMed: 11449457]

Wonderlich SA, Peterson CB, Crosby RD, Smith TL, Klein MH, Mitchell JE, Crow SJ. A randomized controlled comparison of integrative cognitive-affective therapy (ICAT) and enhanced cognitive-behavioral therapy (CBT-E) for bulimia nervosa. Psychol Med2014;44(3):543–53. doi: 10.1017/S0033291713001098.Erratum in: Psychol Med 2014;44(11):2462–3. [PubMed: 23701891]

Woods SC, D'Alessio DA, Tso P, Rushing PA, Clegg DJ, Benoit SC, Gotch K, Liu M, Seely RJ. Consumption of a high-fat diet alters the homeostatic regulation of energy balance. Physiol Behav2004;83(4):573–578. doi: 10.1016/jphysbeh.2004.07.026. [PubMed: 15621062]

Wu L, Xi B, Hou D, Zhao X, Liu J, Cheng H, Shen Y, Wang X, Mi J. The single nucleotide polymorphisms in BRAP decrease the risk of metabolic syndrome in a Chinese young adult population. Diab Vasc Dis Res20135;10(3):202–7. doi: 10.1177/1479164112455535. [PubMed: 22965072]

Xu K, Kranzler HR, Sherva R, Sartor CE, Almasy L, Koesterer R, Zhao H, Farrer LA, Gelernter J. Genomewide Association Study for Maximum Number of Alcoholic Drinks in European Americans and African Americans. Alcohol Clin Exp Res2015;39(7):1137–47. doi: 10.1111/acer.12751. [PubMed: 26036284]

Xu LLeptin action in the midbrain: From reward to stress. J Chem Neuroanat2014;61–62:256–65. doi: 10.1016/j.jchemneu.2014.06.007.

Yamada Y, Sakuma J, Takeuchi I, Yasukochi Y, Kato K, Oguri M, Fujimaki T, Horibe H, Muramatsu M, Sawabe M, Fujiwara Y, Taniguchi Y, Obuchi S, Kawai H, Shinkai S, Mori S, Arai T, Tanaka M. Identification of rs7350481 at chromosome 11q23.3 as a novel susceptibility locus for metabolic syndrome in Japanese individuals by an exome-wide association study. Oncotarget2017;8(24):39296–39308. doi: 10.18632/oncotarget.16945. [PubMed: 28445147]

Yan X, Wang Z, Schmidt V, Gauert A, Willnow TE, Heinig M, Poy MA. Cadm2 regulates body weight and energy homeostasis in mice2018; 8:180–188. doi: 10.1016/j.molmet.2017.11.010.

Yang Q, Xiao T, Guo J, Su Z. Complex Relationship between Obesity and the Fat Mass and Obesity Locus. Int J Biol Sci2017;13(5):615–629. doi: 10.7150/ijbs.17051. [PubMed: 28539834]

Yarnell S, Oscar-Berman M, Avena N, Blum K, Gold M. Pharmacotherapies for Overeating and Obesity. J Genet Syndr Gene Ther2013;4(3):131. doi: 10.4172/2157-7412.1000131. [PubMed: 23826512]

Yeh TL, Chen HH, Pai TP, Liu SJ, Wu SL, Sun FJ, Hwang LC. The Effect of Auricular Acupoint Stimulation in Overweight and Obese Adults: A Systematic Review and Meta-Analysis of Randomized Controlled Trials. Evid Based Complement Alternat Med2017;2017:3080547. doi: 10.1155/2017/3080547. [PubMed: 29358964]

Yeomans MR. Alcohol, appetite and energy balance: is alcohol intake a risk factor for obesity?. Physiol Behav2010;100(1):82–89. doi:10.1016/j.physbeh.2010.01.012. [PubMed: 20096714]

Yokoyama A, Taniki N, Nakamoto N, Tomita K, Hara S, Mizukami T, Maruyama K, Yokoyama T. Associations among liver disease, serum lipid profile, body mass index, ketonuria, meal skipping, and the alcohol dehydrogenase-1B and aldehyde dehydrogenase-2 genotypes in Japanese men with alcohol dependence. Hepatol Res2020;50(5):565–577. doi: 10.1111/hepr.13475. [PubMed: 31845443]

Yu YL, Fisher H, Sekowski A, Wagner GC. Amphetamine and fenfluramine suppress ethanol intake in ethanol-dependent rats. Alcohol1997;14(1):45–8. doi: 10.1016/s0741-8329(96)00110-3. [PubMed: 9014023]

Zakhari JS, Zorrilla EP, Zhou B, Mayorov AV, Janda KD. Oligoclonal antibody targeting ghrelin increases energy expenditure and reduces food intake in fasted mice. Mol Pharm2012; 9(2):281–9. doi: 10.1021/mp200376c. [PubMed: 22149064]

Zellner DA, Loaiza S, Gonzalez Z, Pita J, Morales J, Pecora D, Wolf A. Food selection changes under stress. Physiol Behav2006;87(4):789–93. doi: 10.1016/j.physbeh.2006.01.014. [PubMed: 16519909]

Zhang G, Wu X, Zhang YM, Liu H, Jiang Q, Pang G, Tao X, Dong L, Stackman RW Jr. Activation of serotonin 5-HT(2C) receptor suppresses behavioral sensitization and naloxone-precipitated withdrawal symptoms in morphine-dependent mice. Neuropharmacology2016a;101:246–54. doi: 10.1016/j.neuropharm.2015.09.031. [PubMed: 26432939]

Zhang R, Maratos-Flier E, Flier JS. Reduced adiposity and high-fat diet-induced adipose inflammation in mice deficient for phosphodiesterase 4B. Endocrinology2009;150(7):3076–82. doi: 10.1210/en.2009-0108. [PubMed: 19359377]

Zhang Y, Ji G, Xu M, Cai W, Zhu Q, Qian L, Zhang YE, Yuan K, Liu J, Li Q, Cui G, Wang H, Zhao Q, Wu K, Fan D, Gold MS, Tian J, Tomasi D, Liu Y, Nie Y, Wang GJ. Recovery of brain structural abnormalities in morbidly obese patients after bariatric surgery. Int J Obes2016b;40(10):1558–1565. doi: 10.1038/ijo.2016.98.

Zhang Y, von Deneen KM, Tian J, Gold MS, Liu Y. Food addiction and neuroimaging. Curr Pharm Des2011;17(12):1149–57. doi: 10.2174/138161211795656855. [PubMed: 21492080]

Zhou H, Sealock JM, Sanchez-Roige S, Clarke TK, Levey DF, Cheng Z, Li B, Polimanti R, Kember RL, Smith RV, Thygesen JH, Morgan MY, Atkinson SR, Thursz MR, Nyegaard M, Mattheisen M, Børglum AD, Johnson EC, Justice AC, Palmer AA, McQuillin A, Davis LK, Edenberg HJ, Agrawal A, Kranzler HR, Gelernter J. Genome-wide meta-analysis of problematic alcohol use in 435,563 individuals yields insights into biology and relationships with other traits. Nat Neurosci2020;23(7):809–818. doi: 10.1038/s41593-020-0643-5. [PubMed: 32451486]

Zhou H, Sealock JM, Sanchez-Roige S, Clarke TK, Levey DF, Cheng Z, Li B, Polimanti R, Kember RL, Smith RV, Thygesen JH, Morgan MY, Atkinson SR, Thursz MR, Nyegaard M, Mattheisen M, Børglum AD, Johnson EC, Justice AC, Palmer AA, McQuillin A, Davis LK, Edenberg HJ, Agrawal A, Kranzler HR, Gelernter J. Genome-wide meta-analysis of problematic alcohol use in 435,563 individuals yields insights into biology and relationships with other traits. Nat Neurosci2020;23(7):809–818. doi: 10.1038/s41593-020-0643-5. [PubMed: 32451486]

Zhuang QS, Zheng H, Gu XD, Shen L, Ji HF. Detecting the genetic link between Alzheimer’s disease and obesity using bioinformatics analysis of GWAS data. Oncotarget201778;8(34):55915–55919. doi: 10.18632/oncotarget.19115. [PubMed: 28915562]

Zorrilla EP, Conti B. Interleukin-18 null mutation increases weight and food intake and reduces energy expenditure and lipid substrate utilization in high-fat diet fed mice. Brain Behav Immun2014;37:45–53. doi: 10.1016/j.bbi.2013.12.001. [PubMed: 24316258]

Zorrilla EP, Iwasaki S, Moss JA, Chang J, Otsuji J, Inoue K, Meijler MM, Janda KD. Vaccination against weight gain. Proc Natl Acad Sci U S A2006;103(35):13226–31. doi: 10.1073/pnas.0605376103. [PubMed: 16891413]

Zorrilla EP, Koob GF. Impulsivity derived from the dark side: neurocircuits that contribute to negative urgency. Front Behav Neurosci2019;13:136. [PubMed: 31293401]

Zorrilla EP, Koob GF. The dark side of compulsive eating and food addiction: Affective dysregulation, negative reinforcement and negative urgency. In: Cottone P, Sabino V, Koob GF, Moore C (eds) Food addiction and compulsive eating behavior: Research perspectives New York: Elsevier, 2020, in press.

Zorrilla EP, Sanchez-Alavez M, Sugama S, Brennan M, Fernandez R, Bartfai T, Conti B. Interleukin-18 controls energy homeostasis by suppressing appetite and feed efficiency. Proc Natl Acad Sci U S A2007;104(26):11097–102. doi: 10.1073/pnas.0611523104. [PubMed: 17578927]

Zorrilla EP, Valdez GR, Weiss F. Changes in levels of regional CRF-like-immunoreactivity and plasma corticosterone during protracted drug withdrawal in dependent rats. Psychopharmacology2001;158(4):374–81. doi: 10.1007/s002130100773. [PubMed: 11797058]

Food, alcohol, and drug use each impact and are regulated by metabolic hormones.

Palatable food changes brain reward and withdrawal circuitry akin to abused drugs.

Negative reinforcement, affect, and urgency are key shared substrates of addiction.

Metabolic and motivational risk genes are shared by compulsive drug and food use.

Substance use disorders, eating disorders and obesity share effective treatments.

Table 1.

Selected hormones and neurotransmitter systems similarly impacted by chronic palatable food or substances of abuse

Neurotransmitter hormone	Impact of chronic highly palatable food		Impact of chronic substance use or in SUD patients	
Striatal Dopamine D2 receptors	↓	Dunn et al., 2012; Haltia et al., 2007; Johnson & Kenney et al., 2010; Lindgren et al., 2018; Stice et al., 2011; Tomasi & Volkow, 2013; Bello et al, 2002 (though see also South and Huang 2008)	↓	Koob and Le Moal 2005
Striatal Dopamine release	↓	Geiger et al., 2009; Rada et al., 2010	↓	Koob and Le Moal, 2005
Striatal DA transporters	↓	Speed et al., 2011; Cone et al., 2013	↓	Kuhar and Pilotte, 1996
Central amygdala CRF-CRF1 activity *effects are different depending on if examined during withdrawal or after chronic exposure. Arrows in this row refer to following withdrawal and not ongoing chronic exposure.	↑	Cottone et al., 2009a; Iemolo et al., 2012; Micioni Di Bonaventura et al., 2014; Micioni Di Bonaventura et al., 2017b	↑	Bruijnzeel et al., 2009; Bruijnzeel et al., 2010; Knapp et al., 2004; Overstreet et al., 2004; Sommer et al., 2008; Skelton et al., 2007; Stinus et al., 2005; Basso et al., 1999; Sarnyai et al., 1995; George et al., 2007; Chu et al., 2007; Funk et al., 2007; Gehlert et al., 2007; Gilpin et al., 2008; Richardson et al., 2008; Sabino et al., 2006; Valdez et al., 2002; Specio et al., 2008; Greenwell et al., 2009; Roberto et al., 2010; Zorrilla et al., 2001; Heinrichs et al., 1995; Maj et al., 2003; McNally and Akil, 2002; Weiss et al., 2001; Richter and Weiss, 1999; Rodriguez de Fonseca et al., 1997; Marcinkiewcz et al., 2009; Iemolo et al., 2013; Roberto et al., 2017
NAc preproenkephalin mRNA	↓	Spangler et al., 2004; Kelley et al., 2003	↓	Spangler et al., 2004
Naloxone/naltrexone withdrawal	↑	Colantuoni et al., 2002; Avena et al., 2008; Mason et al., 2015	↑	Pothos et al., 1991; Skelton et al., 2007; Zhang et al., 2016a
NAc Ach	↑	Colantuoni et al., 2002; Avena et al., 2008; Hoebel et al., 2007	↑	Pothos et al., 1991; Rada et al., 1991;
Metabolic Hormones, inflammatory cytokines and insulin status	**Impact of highly palatable food**		**Impact by Drugs or in models of SUD/AUD or in SUD/AUD patients**	
Ghrelin	↓	Spierling et al., 2020; Cottone et al., 2008	↓	Suskova-Fiserova et al., 2019 (though see also Wittekind et al., 2019; Farokhnia et al., 2019)
Interleukin-6	↑	Cottone et al., 2009b	↑	Wei et al., 2020
Insulin resistance	↑	Clawson et al., 2019; Woods et al., 2004	↑	Daws et al., 2011; see also Richardson et al., 2014; Ibias et al., 2018

Table 2

Selected genetic loci jointly associated with risk for obesity and substance- or alcohol use-related disorders

Hormones and Neurotransmitters	**Relation to obesity, feeding or metabolism**	**Relation to SUD/AUD**
Fibroblast growth factor 21 / *KLB* (β-klotho)	Ji et al., 2019	Staiger et al., 2017; Desai et al., 2017; Soberg et al., 2018; Zhou et al., 2020; Schumann et al., 2016, Søberg et al., 2017; Clarke et al., 2017; Thompson et al., 2020
GCKR	Kraja et al., 2014; Viega-da-Cunha et al., 2003	Zhou et al., 2020; Thompson et al., 2020
FTO	Chang et al., 2018; Yang et al., 2017	Zhou et al., 2020
ADH1B	Winner et al., 2015; Yokoyama et al., 2020	Zhou et al., 2020; Thompson et al., 2020
ISL1	Loid et al., 2020; Clément et al., 1999	Zhou et al., 2020
IGF2BP1	Rodrigues et al., 2010; Lu et al., 2016; Zhou et al., 2020	Zhou et al., 2020
DRD2	Lancaster et al., 2018; Jenkinson et al., 2000; Col Araz et al., 2012; Kvaløy et al, 2015; Aliasghari et al., 2020	Lancaster et al., 2018; Jenkinson et al., 2000; Col Araz et al., 2012; Kvaløy et al, 2015 Zhou et al., 2020; Thompson et al., 2020
ANKK1	Bauer 2014; Yamada et al., 2017; Aliasghari et al., 2020	Zhou et al., 2020
CRHR1	Curtis & UK10K Consortium 2015; Lu et al., 2015	Zhou et al., 2020
BDNF	Rios et al., 2001; Akbarian et al., 2018	Zhou et al., 2020
PDE4B	Zhang et al., 2009; Lee et al., 2011	Zhou et al., 2020
CADM2	Morris et al., 2019; Lamiquiz-Moneo et al., 2019; Yan et al., Mol Metab. 2018; Miranda-Lora et al., 2017; Dorajoo et al., 2012	Zhou et al., 2020
BRAP	Imaizumi et al., 2018; Wu et al., 2013	Zhou et al., 2020
PSMC3	Zhuang et al., 2017	Zhou et al., 2020

Hormones and Neurotransmitters	Relation to obesity, feeding or metabolism	Relation to SUD/AUD
SP1	Li et al., 2011; Liu et al., 2012; Li et al., 2014; Zhuang et al., 2017	Zhou et al., 2020
KRTCAP3	Keele et al., 2018	Zhou et al., 2020
SLC39A13/ZIP13	Fukunaka et al., 2017	Zhou et al., 2020
SLC39A8	Williams MJ et al., 2012; van Vliet-Ostaptchouk et al., 2013; Kraja et al., 2014	Zhou et al., 2020; Thompson et al., 2020.
FNDC4	Frühbeck G et al., 2020	Zhou et al., 2020
TBL2	Kim et al., 2011; Kraja et al., 2014	Zhou et al., 2020

Table 3

Selected FDA-approved treatments with therapeutic potential in both feeding- and substance/alcohol use-related disorders.

Treatment	Mechanism of action	Effect on feeding/ obesity		Effect on SUD/AUD or animal models of SUD/AUD		Clinical Trial
Lorcaserin	5-HT2C receptor agonist	↓	Thomsen et al., 2008; Perez Diaz et al., 2019	↓	Anastasio et al., 2020; Collins et al., 2016; Collins & France 2018; Gannon et al., 2018; Harey-Lewis et al., 2016; Neelakatan et al., 2018; Perez Diaz et al., 2019 though see also Banks & Negus 2017	NCT03007394 NCT02044874 NCT03637842 NCT03192995 NCT02906644 NCT03169816 NCT04396834 NCT04396847 NCT03253926 NCT03143543 NCT02537873 NCT03143855 NCT03266939
Rimonabant	CB1 receptor inverse agonist	↓	Nguyen et al., 2019	↓	Galaj & Xi 2019	NCT00464256 NCT00464165 NCT00358228 NCT00459173 NCT00458718 NCT00075205 NCT01041170 NCT00656487
Buproprion + naltrexone	Dual DAT/NET inhibition and noncompetitve nAchR antagonist + opioid receptor antagonist	↓	Sherman et al., 2016; Apovian 2016; Wang et al., 2014; Sinnayah et al., 2007; Guerdjiko va et al., 2017; Halseth et al., 2018	↓	*naltrexone alone (Martin et al., 1973; Anton 2008) *bupropion alone Howes et al., 2020	NCT04553263 NCT00129246
Lisdexamfetamine dimesylate	Prodrug of *d*-amphetamine, monoamine reverse transport	↓	Citrome 2015; Gasior et al., 2017; Hudson et al., 2017; McElroy et al., 2016 & 2017	↓	Nadine Exard et al., 2016	NCT00573534 NCT02034201 NCT01490216 NCT00958282 NCT01486810 NCT00736255 NCT02144415
Phentermine + Topiramate	Stimulant & TAAR1 receptor agonist + GABA facilitator/ glutamate inhibitor	↓	Munro et al., 1968	↓	Phentermine alone (Glowa et al., 1997; Glatz et al., 2002; Wojnicki et al., 1999; Yi et al., 1997), Topiramate alone (Kampman et al., 2013; Kranzler et al., 2014; Johnson et al., 2013; Siniscalchi et al., 2015)	NCT02239913