Social, clinical, and policy implications of ultra-processed food addiction

Conceptualising ultra-processed foods high in carbohydrates and fats as addictive substances can contribute to efforts to improve health, argue **Ashley Gearhardt and colleagues**

The scientific understanding of addiction is evolving. Although addiction to certain foods is not included in diagnostic frameworks such as the Diagnostic and Statistical Manual of Mental Disorders (DSM-5), research on this topic has grown rapidly in the past 20 years. Much of this research uses the Yale Food Addiction Scale (YFAS), which was developed to measure food addiction by assessing DSM-5 criteria for substance use disorder in the context of food intake (box 1).[1 4]

A recent analysis of two systematic reviews including 281 studies from 36 different countries found the overall pooled prevalence of food addiction using YFAS was 14% in adults and 12% in children.[8 9] This reported prevalence is similar to the levels of addiction seen for other legal substances in adults (eg, 14% for alcohol and 18% for tobacco),[10 11] but the level of implied addiction in children is unprecedented. In populations with defined clinical diagnoses, YFAS identified prevalence of food addiction reaches 32% in people with obesity having bariatric surgery,[12] and over 50% in those with binge eating disorder.[8] Food addiction based on the YFAS is also associated with core mechanisms of addiction, such as reward related neural dysfunction, impulsivity, and emotion dysregulation, as well as poorer physical and mental health and lower quality of life.[1 13-15] Thus, there is converging and consistent support for the validity and clinical relevance of food addiction; what remains a more open question is the types of foods that are addictive. Despite the uncertainty, classifying foods as addictive could stimulate research and shift attitudes to regulation.

KEY MESSAGES

- Ultra-processed foods high in refined carbohydrates and added fats are highly rewarding, appealing, and consumed compulsively and may be addictive
- Behaviours around ultra-processed food may meet the criteria for diagnosis of substance use disorder in some people
- Ultra-processed food addiction is estimated to occur in 14% of adults and 12% of children and is associated with biopsychological mechanisms of addiction and clinically significant problems
- Understanding of these foods as addictive could lead to novel approaches in the realm of social justice, clinical care, and policy approaches

What types of foods can be addictive

Not all foods have addictive potential. The YFAS asks people to report on intake of foods with high levels of refined carbohydrates or added fats, such as sweets and salty snacks.[14] These types of foods are most strongly implicated in the behavioural indicators of addiction, such as excessive intake, loss of control over consumption, intense cravings, and continued use despite negative consequences.[16-19] Refined carbohydrates or fats evoke similar levels of extracellular dopamine in the brain striatum to those seen with addictive substances such as nicotine and alcohol.[20-25] Based on these behavioural and biological parallels, foods that deliver high levels of refined carbohydrates or added fats are a strong candidate for an addictive substance.[16 17]

Ultra-processed foods (UPFs)—industrially produced foods containing ingredients not available in home kitchens—are the main source of source of refined carbohydrate and added fats in the modern food supply.[26-28] While natural or minimally processed foods typically contain either carbohydrates or fat, they rarely contain both—for example, 100 g of apple has 55 kcal from carbohydrates and 1.5 kcal from fat (roughly 36:1) and 100 g of salmon has 0 kcal from carbohydrates and 73 kcal from fat (roughly 0:1). By contrast, many UPFs contain much higher levels of both carbohydrates and fats in more equal proportions. For example, 100 g of a chocolate bar contains 237 kcal from carbohydrates and 266 kcal from fat (1:1). The combination of refined carbohydrates and fats often found in UPFs seems to have a supra-additive effect on brain reward systems,[29] above either macronutrient alone, which may increase the addictive potential of these foods.

The speed at which UPFs deliver carbohydrates and fats to the gut may also be important to their addictive potential. Drugs and routes of administration that affect the brain more quickly have a higher addictive potential.[30 31] This is the rationale behind substitution therapies and why a cigarette, which rapidly delivers nicotine to the brain, is more addictive than a slow release nicotine transdermal patch. The food matrix is altered in UPFs, which makes them easier and faster to consume, have greater bioavailability, and potentially allows them to affect the brain more rapidly.[32] The intact food matrix of minimally processed foods slows down their rate of consumption and reduces bioavailability. For example,

Box 1: Yale Food Addiction Scale (YFAS)

- The Yale Food Addiction Scale assesses all 11 symptom criteria for substance use disorder in DSM-5, including diminished control over intake, cravings, withdrawal, and continued use despite negative consequences[1 2]
- A substance use disorder is defined as the presence of two or more symptoms in the past year and clinically significant impairment or distress[2 3]
- The YFAS has undergone rigorous psychometric testing and has strong internal consistency and test-rest reliability, as well as convergent, discriminant, and incremental validity[1 4]
- It has been translated into over 12 languages, such as Spanish, Persian, and Chinese, and these versions also show strong psychometric properties[5-7]

Box 2: Future directions in the science of ultra-processed food addiction

- Evaluate how complex features of ultra-processed foods (eg, combinations of rewarding ingredients, flavour additives, altered food matrixes) combine to increase addictive potential
- Clarify the boundaries at which foods can be considered addictive and based on what attributes
- Identify the level of UPF intake at which risk for addiction may increase
- Investigate how levels of UPF addiction may differ by country based on the availability of ultra-processed foods in their food supply
- Assess the disproportionate impact of UPF addiction on disadvantaged communities
- Test the value of industry focused public health messaging to reduce UPF addiction
- Develop empirically supported clinical guidelines for the treatment, management, and prevention of UPF addiction
- Consider whether the scientific literature supports the recognition of an official diagnosis reflecting UPF addiction
- Further probe the overlap between UPF addiction, obesity, and eating disorders
- Evaluate the ability of multipronged litigation, regulatory, and policy efforts to reduce addictive patterns of UPF intake

nuts have a relatively high amount of fat compared with other minimally processed food (100 g of almonds provides 86 kcal from carbohydrates and 449 kcal from fat (roughly 1:5) but a lower addictive potential than UPFs). This is likely to be because nuts have a high ratio of fat to carbohydrate than most UPFs and the fats remain encapsulated in cell walls after chewing, making them unavailable, especially at the early stages of digestion.[33] This is especially important as signalling from the upper intestine (duodenum) but not the lower portion of the digestive track evokes dopamine in the striatum.[34 35] Thus, the ability of UPFs to rapidly deliver bioavailable rewarding substances may contribute to their increased addictive potential.

Additives may also be contributing to the addictiveness of UPFs. Many UPFs have flavour additives that increase sweet and savoury tastes, as well as texturisers that improve the mouthfeel.[28 36-39] Additives that aim to improve flavour and mouthfeel are also common in cigarettes, including sugar, cocoa, menthol, and alkaline salt.[40] These additives and flavour profiles are important for establishing brand loyalty and become potent secondary reinforcers, so much so that people prefer to smoke denicotinised cigarettes than receive an intravenous injection of nicotine.[41 42] Similarly, while food additives are not likely addictive on their own, they could become powerful reinforcers of the effects of calories in the gut.

Other additives can enhance the effects of a drug; menthol, for example, increases nicotine evoked dopamine in the striatum.[43] Artificial sweeteners in UPFs bind to receptors in the gut, increasing glucose transporter isoform 1 (SGLT1) and glucose transporter 2 (GLUT2) expression, increasing the capacity to absorb glucose.[44 45] In the United States there is a proposal to remove menthol flavoured cigarettes and flavoured cigars from the market because of their role in increasing addictive liability. Such a ban is expected to lead to hundreds of thousands of people to quit smoking.[46] A similar level of rigour in research and policy needs to be applied to UPFs to determine the role of additives in potentiating and maintaining UPF intake.

It is clear not all foods trigger addictive behaviours, just as not all drugs are addictive. Currently, of the foods available for consumption, UPFs seem to be the best candidate for an addictive substance. While further careful research is needed to determine the exact mechanism by which these foods trigger addictive responses, UPFs high in refined carbohydrates and fats are clearly consumed in addictive patterns[16 17] and are leading to deleterious health outcomes.[28] Therefore, we will use the term UPF addiction here to reflect those substances most strongly implicated in addictive eating.

Critiques of UPF addiction

While there are notable parallels between addictive substances and UPFs, there are also unanswered questions. Critics of the UPF addiction perspective have noted that specific addictive chemicals, such as nicotine for tobacco addiction, have not been identified for foods. Addictive chemicals potently activate endogenous reward systems, triggering addiction in some people. Although refined carbohydrates and fats do not act on reward systems directly, they seem to activate neural reward systems to a similar magnitude as nicotine and ethanol.[20-25] However, the presence of an addictive chemical is not sufficient to render a substance addictive—for example, aubergines contain nicotine. Dose and route of administration matter.

Even with well studied addictive substances such as nicotine, the exact dose and intake level at which addiction occurs is unknown. Similarly, the additive potential of UPFs is unlikely to be determined by the presence of a single chemical such as sucrose. Research has generally focused on single ingredients in UPFs, and further study is needed to investigate how UPF ingredients interact to increase addictive potential. It will also be important to explore at what dose and at what level of intake rewarding chemicals in UPFs are most addictive (box 2).

A crucial point of debate is the criteria by which to categorise addictive foods. We have focused on UPFs, as this is the major source of refined carbohydrates and added fats.[26-28] One tool for classifying foods, NOVA, defines a category for UPFs as NOVA 4, focusing mainly on industrially created foods.[26-28] The UPF category in NOVA is broad and captures foods that may be unlikely to have strong addictive potential, such as meat alternatives.[47] Homemade foods made from processed ingredients such as sugar and butter may also be addictive (eg, homemade cookies)[48] but would not be considered a UPF based on the NOVA classification. UPFs with high levels of refined carbohydrates and fats are more accessible, convenient, and heavily marketed than homemade versions and are therefore likely to be a more potent driver of addictive food intake. Similarly, processed tobacco leaves have been available for hundreds of years for people to make their own addictive tobacco products. However, the invention of the cigarette roller in the 1880s[49] made mass produced cigarettes more accessible, convenient, and heavily advertised[50] and contributed to an over 1000% increase in cigarette smoking.[51] As with industrial cigarettes, higher consumption of highly rewarding UPFs is likely to make them a more effective target for intervention.

Social justice implications of UPF addiction

Unique social justice issues need to be considered with UPF addiction. Addictive drugs are not necessary for survival; eating is. In some countries UPFs are an important source of calories for many people.[52] It will

Box 3: Policy approaches to tackle ultra-processed food addiction

Ultra-processed food (UPF)and beverage taxes

103 countries around the globe passed sugar sweetened beverage (SSB) taxes,[83] with several more also taxing UPFs. A meta-analysis estimates that such taxes are associated with an average decline of 15% in SSB sales (P<0.001) and 18% in SSB intake (P=0.07), though most intake studies are limited by small samples.[84] Preliminary evidence has also linked such taxes with reductions in body mass index among adolescent girls in Mexico[85] and declines in dental caries among people with low incomes in a large US city.[86] Further, the revenue generated by these taxes is being invested in other health promoting initiatives.

Mandatory or voluntary front-of-pack or shelf labelling systems

Nutrition labels on the front of UPFs have been implemented in over 20 countries. Meta-analyses of short-term experimental studies on nutrition warning labels estimate that they significantly reduce purchases of labelled products, including SSB's, snack foods, and alcohol.[87-89] One quasi-experiment in a hospital cafeteria found that pictorial warnings (but not text-only warnings) reduced purchases of SSB's compared with calorie labels.[90]

Mandatory or voluntary reformulation of the food supply

Evaluations of the UK's salt reduction programme estimate that it was associated with 15% reduction in sodium intake and 42% and 40% reduction in stroke and ischaemic heart disease mortality, respectively.[91] Similarly, New York City's trans-fat ban was associated with 4.5% reduction in cardiovascular disease mortality.[92] Reductions in heart disease were also linked with Denmark's trans-fat ban.[93] In addition, the implementation of healthier nutrition standards in US schools was associated with reductions in body mass index among youth.[94]

Suite of policies targeting UPFs are needed

No one food policy will transform unhealthy food environments. Countries such as Chile and Mexico have implemented a bundle of healthy food polices, including taxes, nutrition labels, and marketing regulations on UPFs. An evaluation of Chile's law found that it was associated with average reductions of 7.4 kcal/person/day (−7.5%) from beverage purchases[95] and 16.4 kcal/person/day (−3.5%) from food purchases. The policies were also associated with declines of 10.2%, 3.9%, and 4.7% in sugar, saturated fat, and sodium purchased, respectively.[96]

be essential to understand the levels of UPF addiction with changes in UPF marketing and consumption globally, particularly in low and middle income countries. Even within countries, the food environment is not equitable, and food outlets in disadvantaged neighbourhoods are often dominated by UPFs, with limited access to minimally processed foods.[53-55] People facing food insecurity are more reliant on UPFs to meet their daily energy needs[56] and are more likely to exhibit higher levels of UPF addiction.[57]

It will take courageous action to change these and other economic and structural factors that drive people towards UPFs. Increasing the accessibility, affordability, and convenience of minimally processed foods is necessary but not sufficient. Stress amplifies the appeal of addictive substances,[58] and food insecurity is a stressful experience.[59] UPFs already have heightened appeal, and combined with their low cost, convenience, and marketing, it is hard for minimally processed foods to compete, particularly for those facing the stress of structural disadvantages. Policy approaches that combine increased access to convenient, affordable, and tasty minimally processed meals, while also limiting industry practices that inequitably promote UPFs to disadvantaged communities could help reduce UPF addiction.

A potential concern with conceptualising UPFs as addictive is that it may increase stigma, particularly within already stigmatised communities. However, experimental studies find that the addiction model of excessive food intake seems to reduce stigma towards people with obesity,[60] while a framework that focuses on deficits in personal responsibility is reported as increasing stigma.[60] This aligns with evidence that public messaging campaigns highlighting practices of the tobacco industry such as predatory marketing and engineering addictive products were effective in driving public attitudes against tobacco.[61] The effect of similar industry focused public health messaging in the context of UPFs needs to be tested.

Clinical implications of UPF addiction

The presence of UPF addiction in people with obesity or eating disorders is associated with more severe clinical presentations, including higher levels of diet related disease, higher general psychopathology, lower cognitive functioning, and worse treatment outcomes.[62-66] Despite the potential relevance of UPF addiction for clinical care,[67] the scientific literature on the treatment, management, or prevention of UPF addiction is sparse. Most research has focused on evaluating the validity of UPF addictionas a concept, with work on development of clinical guidelines for UPF addiction just beginning.[67]

UPF addiction is not currently an official diagnosis,[68] but such recognition would be likely to promote research into its clinical management. Although it has been suggested that existing eating disorder diagnoses obviate the need for making UPF addiction a diagnosis,[69] there are substantial differences in estimated prevalence (14% for UPF addiction and around 1% for binge-type eating disorders[8 70]). This discrepancy suggests that a substantial proportion of people with problematic eating are being missed in current diagnostic frameworks.[71] This is concerning given that many individuals with UPF addiction report clinically significant problems and demonstrate neurobiological differences from those without food addiction, even when they do not meet criteria for an eating disorder.[72-74] The inclusion of a UPF addiction diagnosis in clinical care would be likely to improve access to support and enable the development of treatments to reduce compulsive patterns of UPF intake.[68]

Several promising treatment directions for UPF addiction need further evaluation. Preliminary evidence suggests that drugs used to treat substance use disorders, such as naltrexone and bupropion, may reduce symptoms of UPF addiction.[75] New glucagon-like peptide (GLP)-1 agonists seem to reduce food craving and may reduce desire for addictive drugs,[76 77] suggesting a potential treatment for UPF addiction. Twelve step addiction treatment models (eg, Overeaters Anonymous) have been available since the 1960s but have

rarely been studied. Given that abstinence from UPFs is unfeasible or unnecessary for many, it will be important to investigate the utility of harm reduction treatments for UPF addiction. Further research will be needed to identify the optimal timing and clinical threshold for different approaches to tackle UPF addiction.

Policy implications of UPF addiction

The misclassification of addictive substances as non-addictive can delay necessary policy action. Tobacco companies minimised the addictive nature of their products by focusing on users' personal responsibility.[50] However, people find it challenging to reduce intake of addictive substances even when highly motivated, which challenges the personal responsibility narrative used by industry.[78 79] Appropriately classifying cigarettes as addictive increased the focus on industry culpability[78 80] and supported litigation, regulatory, and policy efforts that have been effective in reducing tobacco use globally.[81 82]

If the science supports reclassifying UPFs as addictive substances, it may support the use of similar approaches to address UPF addiction (box 3). This would particularly highlight the need for regulatory safeguards to curtail industry practices such as the creation of UPFs that maximise "craveability" by hitting consumers' "bliss point," and the aggressive marketing of such products to children.[97 98] As past addiction epidemics have shown, multipronged action will be needed to address the factors that allow the spread of potentially addictive UPFs to occur unchecked.

Contributors and sources: AG is an expert on food addiction and creator of the Yale Food Addiction Scale; NB is an expert on nutrition physiology; AdiF is an expert on gut-brain reward signalling; CR is an expert on food policy; SJ-M is an expert on behavioural addictions; and FFA is an expert on eating disorders. All authors contributing to the writing of this manuscript and have reviewed and approved the final version. AG is the guarantor.

Competing interests: We have read and understood *BMJ* policy on declaration of interests and declare that CAR receives funding from Bloomberg Philanthropies to support her research on soda taxes.

Provenance and peer review: Commissioned; externally peer reviewed.

This article is part of a collection proposed by Swiss Re, which also provided funding for the collection, including open access fees. *The BMJ* commissioned, peer reviewed, edited, and made the decision to publish. Nita Forouhi, Dariush Mozaffarian, and David Ludwig provided advice and guided the selection of topics. The lead editors for the collection were Navjoyt Ladher, Rachael Hinton, and Emma Veitch.

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Cite this as: *BMJ* 2023;383:e075354
http://dx.doi.org/10.1136/bmj-2023-075354