

**Written Testimony before the U.S. Senate Committee on Health, Education, Labor and
Pensions hearing on “What is Fueling the Diabetes Epidemic?”**

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December 14, 2023

Introduction

Chairman Sanders, Ranking Member Cassidy, and Distinguished Members of the committee: thank you for the opportunity to participate in today's hearing. To begin, I will briefly review my qualifications to speak as an expert at today's hearing. I received my PhD in clinical psychology at Yale University with a focus on addictive disorders, obesity, and disordered eating. I have spent 11 years on the faculty at the University of Michigan. I am currently a professor of psychology and the director of the Food and Addiction Science Treatment laboratory at that institution. I am also a licensed clinical psychologist who has provided treatment to individuals with substance use disorders, obesity, and compulsive overeating.

Through my clinical experiences, I have gained a firsthand understanding of how hard people are working to try and get control over their eating behavior. I saw that even when people were faced with life threatening health conditions, they often still failed to reduce their intake of highly palatable foods despite being motivated to change. My research has been built on the parallels between what I observed in the clinic and my scientific training on how certain substances can trigger addictive processes that keep people stuck in compulsive and destructive patterns of consumption. In my program of research, I use multi-method approaches to explore the neurobiological, psychological, and behavioral factors that contribute to compulsive overeating across the lifespan. I have published over 175 peer-reviewed articles, including in prestigious outlets like the *JAMA Psychiatry* and *British Medical Journal*.

Ultra-Processed Foods Dominate the American Diet

The modern American diet is now composed mostly of ultra-processed foods (1, 2), which are industrial formulations manufactured by deconstructing foods into their component

parts, modifying them and recombining them with a myriad of additives (3-5). Common examples of ultra-processed foods are industrially created candy, sugar-sweetened carbonated beverages, instant noodles, frozen pizza, and salty snacks (4). Ultra-processed foods are a distinct category from minimally processed foods (e.g., fruit, vegetables) that have been washed, chopped, frozen, dried or fermented and processed culinary ingredients used for home cooking (e.g., butter, flour).

Ultra-processed foods are a major source of added sugar and saturated fats in the American diet (6, 7). Most ultra-processed foods are considered hyper-palatable due to their unnaturally high level of palatability-inducing nutrients (fats, sugars, carbohydrates and/or sodium), which trigger reward signals and reduce sensitivity to satiety signals (1, 8). Ultra-processed foods also often contain flavor additives and texturizers that enhance taste and the feel of the product in the mouth (3-5). The preservatives in many ultra-processed foods allow them to stay shelf-stable and come in convenient ready-to-heat or ready-to-eat packages (3-5). Epidemiological research estimates that the average American adult now gets the majority of their calories (57%) from ultra-processed foods while intake of nutrient-rich minimally processed foods like fruits, vegetables, and legumes is decreasing (2). This estimate is even higher for youth. From 1999 to 2018, a global team of epidemiologists found that the percentage of energy consumed from ultra-processed foods increased from 61.4% to 67.0% in children 2 to 19 years old (9).

A converging body of research highlights the potential ramifications of diets composed of high levels of ultra-processed foods (10). High levels of ultra-processed food intake have been implicated in an increased prevalence of health conditions like depression, heart disease, and obesity (10). In a controlled randomized crossover trial, a team of researchers at the National

Institute of Health found that being given a diet high in ultra-processed foods relative to minimally processed foods over a two-week period was associated with an increased daily intake of 500 calories and a two-pound weight gain (11). This occurred despite the ultra-processed and minimally processed meals being matched on the overall calories available to participants (11). Furthermore, a meta-analysis of over 400,000 participants found that every 10% increase in ultra-processed food intake was associated with a 12% higher risk of Type 2 diabetes (12). Thus, the high levels of ultra-processed food in the American diet are a major cause for concern and may be contributing to the obesity and diabetes epidemics.

There are Strong Parallels between Addictive Substances and Ultra-Processed Foods

Most addictive substances are created by processing natural substances (e.g., fruit, leaves) into a new product that delivers a heightened dose of a reinforcing ingredient (e.g., ethanol, nicotine) into the body (13). Speed of absorption is also important and the more rapidly the reinforcing ingredient is absorbed the more likely the substance is to be addictive (14, 15). All addictive substances activate the mesolimbic dopamine system, which is key to the reward and motivational mechanisms that go awry in addiction (16, 17). For example, cigarettes are created by processing naturally occurring tobacco leaves through drying and curing into products that can be smoked to rapidly deliver high doses of nicotine into the body. The nicotine in cigarettes is further amplified by flavor enhancers, such as sugar, cocoa, and menthol, which create brand-specific taste and flavor profiles (18, 19). These tastes and flavors become repeatedly paired with the delivery of nicotine and become salient drivers of smoking behavior in their own right (18, 19). The cigarettes that result from this processing are highly addictive and can lead people to continue smoking even when facing life-threatening health conditions, like heart disease and lung cancer (20).

Similarly, many ultra-processed foods are created by processing naturally occurring substances (e.g., fruits, grains, vegetables) into products that deliver unnaturally high doses of rapidly absorbed carbohydrates and/or fats. Refined carbohydrates, like sugar, and fat are highly reinforcing ingredients and they are effective at activating reward mechanisms in the brain (13, 21-23). While many minimally processed foods contain either carbohydrate (e.g., fruit) or fat (e.g., nuts, meat), the combination of both is rare in nature (21). In contrast, ultra-processed foods often deliver high levels of both refined carbohydrates and fats. This combination has a supra-additive effect in activating neural reward systems (22). Evidence exists that sugar, fat, and ultra-processed foods can activate mesolimbic dopamine in the brain at similar magnitudes as nicotine and ethanol (24-29). Additives further amplify ultra-processed foods by coupling industry created flavors and textures with the delivery of refined carbohydrates and added fats (4, 5). Thus, these ultra-processed foods with high levels of refined carbohydrates and fats are highly rewarding processed substances that share many commonalities with addictive substances like cigarettes (13).

Ultra-Processed Food Addiction

A common set of diagnostic criteria are used to identify individuals who are experiencing clinically significant problems with addictive substances (see Table 1), including a loss of control over intake, intense cravings, and continue consumption despite physical or emotional problems (30). In 2008, my colleagues and I developed the Yale Food Addiction Scale, which applies these same criteria to the intake of ultra-processed foods (e.g., chocolate, soda, French fries, pizza) (31). The Yale Food Addiction Scale has been extensively validated and is a widely used measure in the field with over 1000 citations and translations available in over a dozen languages (32). When we first began this research, the concept of ultra-processed foods was just emerging and

investigations into what types of foods were consumed addictively was limited. Given the dearth of research at that time, we used the term “food addiction” to reflect meeting the diagnostic criteria for a substance use disorder in the realm of food intake. Since that time, it has become clear that not all foods are consumed addictively. Multiple studies have identified that people report consuming ultra-processed foods high in refined carbohydrates and/or fats in an addictive manner, but not minimally processed foods like fruits, vegetables, and legumes (33-35). Dietary intake studies confirm that individuals who meet “food addiction” consume higher levels of ultra-processed foods, but lower levels of minimally processed foods (36, 37). Thus, I will refer to the construct measured by the Yale Food Addiction Scale as ultra-processed food addiction in the remainder of my testimony.

Although ultra-processed food addiction is not currently an officially recognized diagnosis by the American Psychiatric Association, the science on this topic has grown quickly. Systematic reviews of over 280 studies from 36 different countries estimate the prevalence of ultra-processed food addiction to be 14% in adults (38), which is similar to the prevalence of alcohol and tobacco use disorder (e.g., 14% for alcohol and 18% for tobacco) (39, 40). The estimated prevalence of ultra-processed food addiction is twice as high (28%) in adults with obesity (38). Particularly relevant to the current hearing, ultra-processed food addiction has been associated with a more than five times greater likelihood of Type 2 diabetes even when adjusting for sex and age (41).

Below is a quote from a participant who was interviewed for a research study in my lab about their experience with ultra-processed food addiction.

“I can't even be in the same vicinity as [donut store] or any type of donuts, 'cause I will finish a dozen all by myself and I'm type 2 diabetic. So, that could kill me, and I know

that and I know that I shouldn't be eating all those. I shouldn't be eating one, let alone a whole dozen. But for some reason I just can't stop eating them.”

In children, the estimated prevalence for ultra-processed food addiction based on a systematic review of the literature is 12%, which surpasses the prevalence of other substance addictions at this stage of development (42). Children are typically protected against exposure to addictive substances through policy initiatives (e.g., marketing restrictions, age limits on purchases), but exposure to ultra-processed foods for children in America is a daily occurrence (9). There is also evidence that ultra-processed food addiction is important for older Americans. In collaboration with Michigan Medicine, my lab recently conducted a study on ultra-processed food addiction in the National Poll of Healthy Aging. This is a nationally representative poll of over 2000 older adults between the ages of 50 and 80. In this poll, 13% of participants met the criteria for a clinically significant ultra-processed food addiction, which was associated with a greater likelihood of reporting being overweight and in poorer physical and mental health (43). Finally, individuals with food insecurity that lack adequate access to nutritious food are more than three times more likely to meet the criteria for ultra-processed food addiction with chips, soda, chocolate, pizza, and ice cream being identified as the most addictive foods (35).

Taken together, this scientific body of evidence suggests that addictive processes play an important role in contributing to patterns of ultra-processed food intake implicated in poor health, obesity, and diabetes (21, 44). If addictive mechanisms are being triggered by ultra-processed foods, this may be an overlooked reason why it can be challenging to reduce intake of ultra-processed foods even in the face of health conditions like diabetes.

Connections between the Tobacco and Processed Food/Beverage Industries

The industries that profit from tobacco and ultra-processed foods are inter-connected. In the 1970s and 1980s, the tobacco companies RJ Reynolds and Philip Morris bought processed food and beverage companies, including Kraft and General Foods (45, 46). When Philip Morris merged Kraft and General Foods in 1987, it became the largest processed food corporation in the world (45, 46). Although the tobacco industry sold off many of their holdings in this arena by the late 2000s (45, 46), they had already impacted the nature of the American food supply. Internal tobacco industry documents demonstrate they took strategies designed to develop and sell cigarettes and applied them to their processed food and beverage products (45, 46). This includes putting flavor additives developed to enhance the palatability of cigarettes in their leading children's sugar-sweetened drinks and increasing marketing strategies that targeted children and racial/ethnic minorities (45, 46). A recent study published in the journal *Addiction* found that between 1988 to 2001 products from tobacco-owned food companies were significantly more likely to have foods with hyper-palatable combinations of carbohydrates, fat, and salt compared to foods from non-tobacco owned companies (47). However, by 2018, non-tobacco owned food companies had increased their level of hyper-palatable foods to levels that compared with tobacco-owned companies (47). This contributed to a modern food supply composed largely of ultra-processed, hyper-palatable foods (1). During this same time period, the amount of diabetes doubled (48) and the presence of moderate-to-high risk obesity tripled in America (49).

What Can Be Done to Address this Problem?

Tobacco also provides a point of reference on how we might reduce the costs associated with excessive intake of ultra-processed foods. Even when the health consequences of smoking became more evident, it took decades for their addictive nature to be acknowledged. Tobacco can

look different than other addictive substances, as it does not induce a clear intoxication syndrome and is legal and accessible. In part, because of these differences, the addictive nature of tobacco products was hotly debated for decades despite thousands of tobacco-related deaths occurring each year (20, 50). Eventually, consensus was reached that tobacco products were addictive based in large part on scientific evidence on their highly reinforcing nature and their ability to trigger compulsive patterns of use (20). A similar debate now exists about the addictive nature of ultra-processed foods (13).

Cigarettes are complex substances with up to 4000 different chemicals and even now the exact dose at which nicotine can trigger addiction is unknown (13). However, research has investigated how different aspects of cigarettes interact to increase their addictiveness. In addition to the dose of nicotine, additives and delivery mechanisms that speed up the absorption of nicotine appear to increase the addictiveness of cigarettes (18, 19, 51). Processes that enhance the taste and flavor of tobacco products (e.g., sugar, menthol, cocoa) have also been identified as important contributors to their addictive nature (18, 19). Investing in similar research to unpack how different aspects of ultra-processed foods interact to activate mechanisms of addiction and contribute to excessive patterns of intake will be important. This science could provide guidance to inform consumers about the risks associated with different types of ultra-processed foods and could guide targets for different policy approaches.

A wide range of potential approaches are available for consideration to reduce excessive intake of ultra-processed foods to improve the health of Americans. The history of addressing addiction epidemics also suggest that no singular approach will be sufficient to address complex public health like the obesity and diabetes epidemic. However, multi-pronged strategies have been effective in reducing the costs associated with addictive substances. In the context of

tobacco, combining approaches like educational programs, labeling, economic incentives, age restrictions and marketing limitations helped drastically lower smoking rates in America (52-54). Countries, such as Chile and the United Kingdom, are instituting similar approaches to address the epidemic of diet-related disease, such as limiting marketing for less healthy foods to children. It is also not just people who experience clinically impairing levels of ultra-processed food addiction who would likely benefit. When addictive substances are inexpensive, easily accessible, and heavily marketed, many people without a clinical level of addiction are still prone to consume these substances excessively and experience problems in their mental or physical health. Thus, widespread use of addictive substances that stay below the clinical threshold for diagnosis can still pose a significant public health burden (55). On average, Americans experience between one to two symptoms of addiction in their intake of ultra-processed food, including intense cravings and an inability to cut down on intake despite a desire to do so (43, 56). Thus, many Americans would likely benefit from approaches to reduce the dominance of ultra-processed foods in the American food supply. Finally, another key point learned from the tobacco addiction epidemic is that prevention efforts can be far more cost effective than relying solely on treatment (57). Targeting prevention efforts on youth, especially, can be particularly helpful to shape lifelong health promoting behaviors (57).

Eating is necessary for survival. We each make numerous food-related decisions every day all while surrounded by grocery stores, restaurants, gas stations, convenience stores and marketing that promote ultra-processed foods. It is essential that we address the factors that contribute to obesity and diabetes and encourage an American food supply that promotes health, particularly for our children.

Table 1. Diagnostic Criteria for Substance Use Disorders

DSM-5 Diagnostic Criteria for Substance Use Disorders(30)
Consumption of larger amounts and/or over longer time than intended
Persistent, unsuccessful attempts to cut down
Significant time spent obtaining, using, or recovering from effects
Cravings (i.e., intense almost irresistible urges for the substance)
Interference with role obligations at work, school, or home
Use despite social or interpersonal problems
Important activities given up or reduced
Use in physically hazardous situations
Continued use despite physical and/or psychological consequences
Tolerance (i.e., needing more and more of the substance to get the desired effect)
Withdrawal (i.e., experiencing psychological and/or physiological symptoms when reducing intake)

Note. Individuals meet the diagnostic threshold for a substance use disorder in the Substance-Related and Addictive Disorders section of the Diagnostic and Statistical Manual of Mental Disorders-Fifth Edition (DSM 5) by endorsing at least 2 of the symptoms above plus clinically significant functional impairment or distress(30). Severity of substance use disorders determined by the number of symptoms endorsed (mild 2-3 symptoms; moderate 4-5 symptoms; severe 6-11 symptoms).

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