

betes. SPRINT will couple a somewhat more extensive cognitive assessment with brain magnetic resonance imaging, including assessments of blood flow and neural networks. The results are expected during early 2017.

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**Group Information:** Members of the ACCORD MIND Study Group have been published in the article by Williamson et al.<sup>1</sup>

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## Why Are We Consuming So Much Sugar Despite Knowing Too Much Can Harm Us?

**To the Editor** In the article by Yang et al,<sup>1</sup> a relationship between intake of added sugars and risk of cardiovascular disease was demonstrated. The study revealed that almost 75% of the US population consumes more than 10% of calories from added sugars. Despite it becoming increasingly known that added sugars can have detrimental effects on health, people persist in consuming them in excess.

How the intake of highly palatable foods (ie, those with added sugars) influences reward-related brain regions and behaviors is being actively investigated. In light of the findings reported by Yang et al,<sup>1</sup> we think it important to emphasize that one potential cause of excessive sugar intake may relate to findings from laboratory animal and human studies, which suggest that addiction-like behaviors and related brain changes may perpetuate overeating highly palatable foods.<sup>2</sup>

Animal models indicate that excess sugar intake produces signs of tolerance, druglike withdrawal when sugar is unavailable, and craving-like behaviors. Concomitantly, changes occur in dopamine and opioid systems in reward-related brain regions, similar to animals using substances like alcohol or nicotine. In humans, studies of obese individuals show that brain areas associated with drug reward are activated by anticipation and receipt of food, with favorite food-related craving and associated brain-reward responses linked to insulin resistance in obesity.<sup>3</sup> To study further addiction-like characteristics as related to food, the Yale Food Addiction Scale, which is adapted from the substance dependence disorder criteria in the *Diagnostic and Statistical Manual of Men-*

*tal Disorders* (Fourth Edition, Text Revision), was recently used in the Nurses' Health Study II cohort, showing an 8.4% prevalence of addiction-like responses to food.<sup>4</sup> Moreover, the prevalence of addiction-like responses to food is greater in participants with binge-eating disorder or obesity<sup>5</sup> and in those with greater impulsivity or emotional reactivity. Finally, functional magnetic resonance imaging studies correlate higher food addiction scores with greater activation of brain regions associated with addiction and craving during food anticipation and consumption.

From these clinical studies and observed neurochemical changes in reward systems in humans and laboratory animals, addictive behaviors associated with food intake very likely contribute to rising obesity rates and subsequent comorbidities (eg, cardiovascular disease). The high prevalence of added-sugar consumption found in the study by Yang et al<sup>1</sup> is very likely influenced by and a result of addictive behaviors incited by reward system activation after overeating highly palatable foods. Considering the impact of food addiction and the findings by Yang et al<sup>1</sup> could advance treatment, prevention, and policy initiatives.

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**In Reply** We appreciate the suggestion by Avena and colleagues that addiction-like behaviors and related brain changes may perpetuate overeating highly palatable foods that tend to contain high amounts of added sugars. This interesting hypothesis needs to be tested in well-designed interventions and mechanistic studies. Although the high consumption of added sugars in the US population (on average, approximately 22 teaspoons per day) is possibly related to the “addictive” property of the palatable foods and the reward system in the brain, the abundance of added sugars in the current food environment and influential advertising by the food industry may also play an important role.<sup>1</sup>

Our data indicate that the majority of US adults consumed more added sugars than is recommended for a healthy diet. Our results, along with the findings of many other studies,<sup>2-5</sup> support current recommendations to reduce the intake of added sugars in US diets.<sup>6</sup>

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