Altered brain correlates of response inhibition and error processing in females with obesity and sweet food addiction: A functional magnetic imaging study

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Received 25 February 2017; accepted 21 April 2017

KEYWORDS
Obesity;
Sweet food addiction;
Response inhibition;
Impulsivity;
Error processing;
Insula

Summary
Background: The aim of the present study was to evaluate the impulsivity and brain correlates of response inhibition and error processing among females with obesity and sweet food addiction (O & SFA).
Methods: We evaluated the response inhibition and error processing by functional magnetic resonance imaging (fMRI) in subjects with O & SFA and controls. Twenty females with O & SFA and 20 controls were recruited. All subjects performed the event-related designed Go/No-go task under fMRI and completed questionnaires related to food craving and impulsivity.
Results: The O & SFA group exhibited a higher score for impulsivity than did the control group. The O & SFA also exhibited lower brain activation when processing response inhibition over the right Rolandic operculum and thalamus than controls.

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http://dx.doi.org/10.1016/j.orcp.2017.04.011
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Both O & SFA and control groups exhibited activation of the insula and caudate during error processing. The activation over the left insula, precuneus, and bilateral putamen were higher in the subjects with O & SFA than for those in the control group. Conclusion: Our results support the fact that the fronto-striatal network is involved in response inhibition, and the caudate and insula contributes to error processing. Furthermore, women with O & SFA have impaired rolandic operculum when processing response inhibition and have greater insular and putamen activation in maintain their error processing function.

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Introduction

Overweight and obesity are each responsible for nearly 1 in 10 deaths and have become an important health risk factor in modern society [1]. Their mechanisms include altered endocrine function, temperature, sleep, and reproductive factors [2]. Aside from these physiological mechanisms, the addictive potential of food has been raised as being one possible factor of obesity [3]. However, whether overeating behaviour itself owns the characteristics of addictive has not been validated. Investigation of the neurobiological underpinnings of overeating behaviours is necessary to justify whether classification of obesity and binge eating as an addictive disorder is merited [4].

The core definition of addictive behaviour is repeatedly loss of control in a behaviour with acknowledgement of negative consequences [5]. Previous studies have shown the similarities between compulsive eating and other addictive behaviours, such as uncontrolled eating, preoccupation, and withdrawal symptoms [6]. The rewarding potential of foods saturated with sugar and high-calories plays an essential role in uncontrolled eating behaviour [7]. The similarity of brain processes that are being activated during addictive drug and food cue exposure [8] suggest the possibility of food addiction. Thus, the concept of food addiction is proven essential for understanding and solving the problem of obesity [6]; however, the mechanism responsible for food addictive behaviour has not been comprehensively understood.

Previous studies show that obesity is more prevalent among women in developing countries [9]. Women often report consuming more sugar-laden foods than men [9]. Food itself plays an important role in rewarding eating behaviour. Sugar and sweet food cues can drive rewarding response and craving that are comparable to illicit substances, such as cocaine [10]. "Hyper-palatable" industrial foods saturated with sugar have higher potential to reward eating behaviour and result in higher risk of addiction [6]. As overconsumption of sweet food has been reported among women with obesity and food addiction [11], it is necessary to evaluate the mechanism of sugar addiction among females.

Impaired cognitive control and impulsivity are essential mechanisms of most addictive behaviours [12,13]. Impaired cognitive control and error processing have been found in obese children [14]. Lower cognitive control ability appeared associated with greater intake of carbohydrates and sugars during a snack test [15]. A functional MRI study demonstrated that impulse control in the dorsolateral prefrontal cortex was associated with response to diet control among obese subjects [16]. These results all support the possible role of cognitive control in excessive eating behaviour. However, the brain function of cognitive control and error processing has not been well evaluated among obesity women fulfilling the criteria of sweet food addiction (SFA).

The ability to suppress the prepotent motor responses is an important indicator of cognitive control, which has been repeatedly tested with the Go/No-go task [17]. The event-related design of an fMRI study allows the separation of the Go, the successful No-go, and the failed inhibited No-go trials in simple mixed designs, and has been preferred for assessing the functional anatomy of cognitive control and error processing [18]. Thus, the aim of the study was to evaluate the brain correlates of cognitive control and error processing in the Go/No-go task using event-related functional MRI in women with obesity and sweet food addiction (O&SFA) and...
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