

Short Communication

## Self-reported impulsivity and mood states predict cue-induced food craving in adults with obesity: A cross-sectional study

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### ABSTRACT

**Objectives:** To determine the relationship of mood state and impulsivity with cue-induced food craving.

**Materials and Methods:** Forty obese adults (group average age $\pm$ SD; 42.68 $\pm$ 11.62 years) participated in this cross-sectional study. Each participant was assessed for (i) positive and negative mood states, (ii) impulsivity, and (iii) cue-induced food craving (FC).

**Results:** Linear regression analysis showed a significant negative association between a more positive and less negative mood state and cue-induced FC, while a positive association between impulsivity and FC.

**Conclusion:** A more positive and less negative mood state is negatively associated with FC, whereas state impulsivity is positively associated with FC in obese persons.

**Keywords:** Addiction-like eating behaviours, Mood state, Multiple linear regressions, Obese adults, State food craving, State impulsivity

### INTRODUCTION

Addiction-like eating behaviours have been frequently reported as a major contributing factor to overeating and weight gain.<sup>[1]</sup> Food craving is one such addiction-like eating behaviour characterised by an intense and frequent desire to consume specific foods that are particularly high in fat and sugar with low nutritional value.<sup>[2-6]</sup> Food craving was positively associated with uncontrolled eating and emotional eating in a large sample ( $n = 1065$ ) of adults.<sup>[7]</sup> A quantitative predictive meta-analysis of 45 studies involving 3292 participants concluded a moderate association of food craving with food cue reactivity and body mass index (BMI) ( $r = 0.33$ , 11% variance).<sup>[8]</sup> With this, there is an increasing interest in understanding the behavioural factors that are associated with or contribute to food cravings.<sup>[9]</sup>

A negative mood state has been linked to substance and behavioural addictions.<sup>[10]</sup> For example, a systematic review and meta-analysis of 14 studies, including 2257 participants, concluded a moderate association between negative mood states and craving for substance use.<sup>[10]</sup> Apart from this, a negative mood state has been positively correlated with hedonic eating or eating for pleasure.<sup>[11]</sup>

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The association of negative mood states with substance and behavioural addictions has been attributed to impulsivity.<sup>[12]</sup> Impulsivity refers to the tendency to respond without full consideration of consequences in situations where a thoughtful response is more appropriate.<sup>[13]</sup> A review of empirical evidence examining how negative mood states perpetuate substance addictions reported that impulsivity modulates the effect of negative mood states on substance and behavioural addictions.<sup>[12]</sup> Apart from this, impulsivity has been linked to poor eating habits. For example, higher self-reported impulsivity was associated with unhealthy food choices, overeating and eating for emotional reasons.<sup>[14,15]</sup>

Considering that both negative mood states and impulsivity have been linked to substance and behavioural addictions and that food craving resembles addictive behaviour, the present study aimed at determining the association of (i) self-perceived state impulsivity and (ii) mood state with cue-induced food craving in obese adults. Pictures of two energy-dense food items consumed in India (i.e., *samosa*, a deep-fried savoury pastry with rich fillings and *jalebi*, a sweet pastry fried and served in sugar syrup) were used to induce state food cravings during the assessment of food cravings in the present study.

## MATERIALS AND METHODS

### Participants

Forty obese adults (BMI  $\geq 25$  kg/m<sup>2</sup>)<sup>[16]</sup> of both genders (M: F = 23:17) were recruited from a wellness centre in north India. Recruitment was carried out by announcements in the wellness centre. There was no incentive to take part in the study. Participants were included if they (i) were aged between 20 and 60 years and (ii) had a BMI  $\geq 25$  kg/m<sup>2</sup>.<sup>[16]</sup> Participants were to be excluded if they had (i) a History of type 2 diabetes mellitus, (ii) regular medication which influences hunger and satiety and (iii) regular consumption of alcohol or tobacco (in any form). None of the participants were excluded due to these reasons. The baseline characteristics of the participants are given in Table 1. A signed informed consent form was obtained from each participant. The study had prior approval from the Institutional Ethics Committee (number PRF/YRD/22/019).

### Study design

This cross-sectional study was designed to determine the association of cue-induced food craving with (i) self-reported impulsivity and (ii) mood states in obese adults.

### Assessments

#### Food craving state

State food craving was measured using the original version of the Food Cravings Questionnaire-State (FCQ-S) developed

**Table 1:** The baseline characteristics of the participants.

S. No.	Characteristics	No. of participants (n=40)
1.	Group average age	42.68±11.62
2.	Male: Female	23 : 17
3.	Anthropometric measures	
3.1.	BMI (kg/m <sup>2</sup> )	29.82±4.48
4.	FCQ-S	
4.1.	Total FCQ-S scores	46.1±13.61
4.2.	Desire to eat	7.56±4.07
4.3.	Positive reinforcement	17.69±5.3
4.4.	Negative relief	7.49±2.9
4.5.	Lack of control	8.46±3.87
4.6.	Craving/hunger as physiological state	8.51±3.74
5.	STIMP	
5.1.	Impulsivity and control of behaviour	18.01±8.09
5.2.	Control of thoughts	12±9.4
5.3.	Feeling of impatience	10.92±9.47
5.4.	Total STIMP	40.93±20.43
6.	BMIS	
6.1.	Pleasant-unpleasant mood score	52.85±8.51
6.2.	Aroused-calm mood score	30.82±3.75
6.3.	Positive-tired mood score	23.56±3.3
6.4.	Negative-relaxed mood score	10.33±4.41

BMIS: Brief mood introspection scale, STIMP: State impulsivity scales, BMI: Body mass index, FCQ-S: Food cravings questionnaire-State

by Cepeda-Benito *et al.*<sup>[17-19]</sup> The FCQ-S has 15 items as statements that describe the intensity of food craving state on a five-point Likert scale ranging from 1 = strongly disagree to 5 = strongly agree. Each item of the FCQ-S is given a weighted score of 1–5. The possible scores range between 15 and 75, where higher scores represent an overall higher intensity of state food craving. Pictures of two energy-dense food items consumed in India (i.e., *samosa*, a deep-fried savoury pastry with rich fillings and *jalebi*, a sweet pastry fried and served in sugar syrup) were used to induce state food craving during the administration of the FCQ-S in the present study.

#### Self-reported state impulsivity

State impulsivity was assessed using the state impulsivity scale.<sup>[20]</sup> The scale consists of 14 visual analogue scales that are designed to measure impulsive mood states.

#### Mood state

Positive and tired mood state was assessed using the positive-tired mood sub-scale of the brief mood introspection scale

**Table 2:** Results for step-wise multiple linear regression analysis.

Dependent variable	Step	Step change in R <sup>2</sup>	P-value for step change in R <sup>2</sup>	Beta for final model (only significant predictor variables shown)	P-value
State impulsivity questionnaire scores	First	0.227	0.002	0.399	0.007
Positive-tired subscale scores of the brief mood introspection scale	Second	0.087	0.037	-0.305	0.037
Adjusted R <sup>2</sup> for model=0.277					

(BMIS).<sup>[21]</sup> The sub-scale consists of seven mood adjectives. Of these, five items are related to positive mood states (i.e., lively, caring, peppy, loving and active), while the remaining two items are related to negative mood states (i.e., tired and drowsy). The participants were asked to rate the intensity of each mood adjective on a four-point rating scale. The higher scores on the scale show greater positive and less tired mood states.

### Data analysis

Multiple linear regression analyses using a forward conditional selection criterion (with a probability-of-F-to-enter  $\leq 0.05$ ) were carried out using the Statistical Package for the Social Sciences (Version 24.0) to determine the association of self-perceived state impulsivity scores and the positive-tired mood sub-scale scores of the BMIS with food craving state. Positive-tired mood sub-scale scores of the BMIS and self-perceived state impulsivity scores were entered in the first and second steps, respectively, in the model. Tolerance values and variance inflation values for the independent variables in the final regression models were examined to determine the collinearity. Tolerance values of  $< 0.1$  and variance inflation factor values of more than 5 were considered to suggest problematic collinearity. No problems with collinearity were found within the analyses carried out. Statistical significance was set at  $P < 0.05$  level.

## RESULTS

Forty obese male and female participants (m: f = 23:17) aged between  $42.68 \pm 11.62$  years completed the study. The baseline characteristics of the participants are provided in Table 1.

Self-perceived state impulsivity scores were significantly associated with state food craving ( $P = 0.002$ ; 22.7% of variance). Furthermore, positive-tired mood sub-scale scores of the BMIS were significantly associated with state food craving ( $P = 0.037$ ; 8.7% of variance). The results of the final steps of the multiple regression analyses are presented in Table 2.

## DISCUSSION

The purpose of the present study was to examine the association of mood state and self-perceived state impulsivity with state food craving in obese persons. The results showed a negative association of state food craving with more

positive and less negative mood states (Beta =  $-0.305$ ), while a positive association between self-perceived impulsivity and state food craving (Beta = 0.399).

The negative association of more positive and less negative mood states with food cravings in the present sample of obese persons is consistent with previous reports on addictive behaviours.<sup>[22]</sup> For example, smokers with a negative mood state had a higher self-reported craving for cigarettes compared to those with a neutral mood state.<sup>[22]</sup>

Furthermore, the findings of the present study (i.e., a positive association of state food craving with state impulsivity) resemble the results of the previous studies on substance and behaviour addictions.<sup>[13]</sup> For example, a recent systematic meta-review of six meta-analyses that examined neurocognitive functions central to impulsive-compulsive behaviours across substance and behavioural addictions concluded that impulsivity plays an important role in both types of addiction.<sup>[13]</sup>

It has been hypothesised that a negative mood state increases impulsivity, which, in turn, leads to addictive behaviours.<sup>[12]</sup> This may explain the association of food craving with mood states and impulsivity in this study, as food craving resembles addictive behaviour.

Given that mood states influence impulsivity, the findings of this study suggest that dietary interventions for obesity should include strategies to improve mood states, as a positive mood state is associated with low cue-induced state food cravings. This may prevent weight gain resulting from overeating associated with state food cravings.

The findings of the present study are limited by the small sample size and that the assessments were based on self-reports. To address these limitations, future research should focus on different dimensions of impulsivity and mood states.

## CONCLUSION

A more positive and less negative mood state is negatively associated with food craving, whereas state impulsivity is positively associated with food craving in obese persons.

**Ethical approval:** The research/study was approved by the Institutional Review Board at Patanjali Research Foundation (Trust), number PRF/YRD/22/019, dated 7th September 2023.

**Declaration of patient consent:** The authors certify that they have obtained all appropriate patient consent.

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