



Carbohydrate craving: A double-blind, placebo-controlled test of the self-medication hypothesis

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ABSTRACT

Carbohydrate craving, the overwhelming desire to consume carbohydrate-rich foods in an attempt to improve mood, remains a scientifically controversial construct. We tested whether carbohydrate preference and mood enhancement could be demonstrated in a double-blind, placebo-controlled self-administration trial. Overweight females who met strict operational criteria for carbohydrate craving participated in two 3-day discrete choice trials over a 2-week period. Participants reported their mood before and at several time points after undergoing a dysphoric mood induction and ingesting, either a carbohydrate beverage or a taste and calorie-matched protein-rich balanced nutrient beverage. Every third testing day, participants were asked to self-administer the beverage they preferred based on its previous mood effect. Results showed that, when rendered mildly dysphoric, carbohydrate cravers chose the carbohydrate beverage significantly more often than the protein-rich beverage and reported that carbohydrate produced greater mood improvement. The carbohydrate beverage was perceived as being more palatable by the carbohydrate cravers, although not by independent taste testers who performed the pre-trial taste matching. This study, performed under rigorous study conditions, supports the existence of a carbohydrate craving syndrome in which carbohydrate self-administration improves mildly dysphoric mood.

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1. Introduction

The carbohydrate-craving syndrome is often defined as a disorder of disturbed appetite and mood, characterized by an almost irresistible desire to consume sweet or starchy foods in response to negative mood states (Wurtman, 1990). Carbohydrate ingestion appears to trigger mood improvement in the carbohydrate craver (Lieberman, Wurtman, & Chew, 1986; Rosenthal et al., 1989) while non-carbohydrate cravers generally report fatigue after carbohydrate ingestion (Spring, Lieberman, Swope, & Garfield, 1986; Spring, Maller, Wurtman, Digman, & Cozolino, 1982–3). Accordingly, it is theorized that the carbohydrate craver preferentially selects and ingests carbohydrate-rich foods in an attempt to self-medicate negative mood (Liebenluft, Fiero, Bartko, Moul, & Rosenthal, 1993; Wurtman & Wurtman, 1995). Mood improvement following carbohydrate ingestion is thought to occur via a tryptophan-mediated increase in brain serotonin (Gendall & Joyce, 2000; Sayegh et al., 1995; Velasquez-Mieyer et al., 2003; Wurtman & Wurtman, 1995), potentially alleviating a functional deficiency in brain serotonin and thus serving as self-medication (Pijl et al., 1993; Spring, Chiodo & Bowen, 1987; Wurtman, 1990; Wurtman & Wurtman, 1995).

The carbohydrate-craving construct remains controversial, however, and many of the early studies that support the theory have been criticized on the grounds of methodology and interpretation. A major limitation in the research literature on carbohydrate craving has been the absence of a standardized, reliable operational definition of carbohydrate foods and the carbohydrate-craving

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construct itself (Drewnowski, 1987; Fernstrom, 1988; Lieberman et al., 1986). Moreover, a significant design flaw in many studies has been that the high-carbohydrate and high-protein foods have differed not only in macronutrient content but in hedonic and sensory value, with the carbohydrate options perceived as being more hedonically appealing (e.g. cookies versus beef jerky). Consequently, a competing theory posits that greater preference for carbohydrate results from the higher sweet and/or fat content of these foods (Drewnowski, 1987; Drewnowski, Kurth, Holden-Wiltse & Saari, 1992; Fernstrom, 1988). A final important, albeit smaller, design flaw has been the failure to standardize the timing of testing in relation to the menstrual cycle in female participants. Menstrually-related effects on mood, appetite, and food craving are well-documented (Lieberman et al., 1986; Lissner, Stevens, Levitsky, Rasmussen & Strupp, 1988) and represent a potential confound to the study of macronutrient effects on mood.

There have also been some failures to replicate the finding that carbohydrate intake acutely improves mood in carbohydrate cravers (Christensen & Redig, 1993; Gendall, Joyce, & Abbott, 1999; Toornvliet et al., 1997) even in the presence of food choices equated for taste and hedonic appeal (Toornvliet et al., 1997). In most studies, carbohydrate effects on mood were assessed in the presence of repeated blood draws. In this case, there is a likelihood that conditioned aversion responses to venipuncture (Redd et al., 1991) overrode any potential dietary effects on mood.

Given these methodological challenges, it remains unclear whether the carbohydrate-craving self-medication theory remains viable or clinically useful. However, given that (a) many people attribute their weight management difficulties to carbohydrate craving, (b) carbohydrate craving has been associated with increased weight (Spring, Pingitore, & Zaragoza, 1997; Wurtman, 1987; Wurtman & Wurtman, 1995), (c) there is an epidemic of overweight and obesity in the United States (Mokdad et al., 2000), and (d) carbohydrate craving appears to be a predictor of poor response to weight loss treatment (Bray, York, & DeLany, 1992; Goodrick & Foreyt, 1991; Sitton, 1991), there is a heightened need to understand the mechanisms associated with overweight as well as difficulties with weight loss and weight loss maintenance (Yanovski, 2003).

The aim of this study was to test the validity of the carbohydrate-craving construct by evaluating whether carbohydrate preference and subsequent mood improvement could be objectively demonstrated under double-blind conditions in a sample of overweight women who self-identified as carbohydrate cravers and met strict operational criteria for carbohydrate craving. Hypotheses were that when rendered dysphoric and given a choice between hedonically, palatability and calorically-matched novel beverages, carbohydrate cravers will (1) self-administer a carbohydrate-rich, protein-free beverage in preference to a beverage that balances carbohydrate and protein, and (2) report greater mood elevation after consuming the carbohydrate beverage as compared to the protein-rich nutrient-balanced beverage.

2. Methods

2.1. Overview of study design

A repeated measures, double-blind self-administration protocol (based on a discrete trials choice paradigm) was used to test the carbohydrate self-administration construct. Participants meeting our stringent criteria for carbohydrate craving were told they would participate in a 2-week trial designed to study the effects of two novel beverages on mood. Two taste-matched beverages, one pure carbohydrate, one protein-rich but nutrient balanced were administered across two sets of 3-day discrimination trials just after participants underwent a dysphoric mood induction. The discrete trials chart is presented in Table 1.

Mood, hunger, and cravings were assessed for a period of 3 h after macronutrient ingestion. All participants provided informed consent to participate in the study and were paid 150.00 for completing the protocol. This protocol was reviewed and approved by the Institutional Review Boards of Rosalind Franklin University of Medicine and Science and the University of Illinois at Chicago.

2.2. Participants

Potential participants were women from the Chicagoland area who responded to advertisements soliciting overweight women who crave sweet or starchy foods. Eligibility criteria required that participants were female, age 20–45, overweight, and met our stringent criteria for carbohydrate craving. Candidates were excluded from the study if they had diabetes, thyroid disease, anorexia nervosa or bulimia nervosa, a recent weight loss >5%, currently used antidepressants, anti-anxiety agents or other medications that might affect mood or appetite, or had an active drug or alcohol abuse problem in the past year. Also excluded were candidates who were pregnant, lactating, perimenopausal, or had undergone hysterectomy. A total of 80 women were initially screened for the study; the most frequent reason for study ineligibility was a higher BMI than specified in the protocol.

Table 1
Sequence of testing days

	Test day	Trial
Week 1	1 (Monday)	Exposure A
	2 (Tuesday)	Exposure B
	3 (Wednesday)	Choice
Week 2	4 (Monday)	Exposure B
	5 (Tuesday)	Exposure A
	6 (Wednesday)	Choice

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