Appetite 72 (2014) 106–113

Contents lists available at ScienceDirect

Appetite

journal homepage: www.elsevier.com/locate/appet

Research report

The role of emotional eating and stress in the influence of short sleep on food consumption ☆

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ARTICLE INFO

Article history:
Received 16 August 2013
Received in revised form 19 September 2013
Accepted 4 October 2013
Available online 19 October 2013

Keywords:
Emotional eating
Stress
Eating behavior
Sleep deprivation
Sleep quality
BMI

ABSTRACT

Short sleep duration is associated with elevated body mass index (BMI) and increased energy consumption. The present studies were conducted to determine what role emotional eating and stress might play in these relationships. The first was an exploratory questionnaire study in which sleep quality and duration were measured in conjunction with the Dutch Eating Behavior Questionnaire in 184 women. Emotional and external eating scores were significantly higher in those who reported poor sleep quality (but were not related to sleep duration). In a second study of 64 women who were provided with snacks in the laboratory under stressed and control conditions, elevated food consumption was observed in those who scored high on emotional eating and who reported short sleep (a significant stress × emotional eating × sleep duration interaction) but not in those who reported poor sleep quality. No effects were found in liking or wanting of food and few effects were found on appetite. BMI was not related to sleep duration or sleep quality in either study. The results suggest that the relationship between short sleep and elevated food consumption exists in those who are prone to emotional eating. An external stressor elevated consumption in normal sleepers to the level observed in short sleepers, however, it did not significantly elevate consumption in short sleepers. Future examinations of the effects of sleep duration and quality on food consumption should examine emotional eating status.

Introduction

Short sleep duration has been associated with elevated body mass index (BMI, Gangwisch, Malaspina, Boden-Albala, & Heymsfield, 2005), disordered eating (Hicks & Rozette, 1986), emotional stress (Vgontzas et al., 2008), and neuroendocrine control of appetite (Van Cauter et al., 2007). It is likely that the higher BMI associated with short sleep is due to increased food consumption as there is little evidence for significantly reduced energy expenditure (Chaput & Tremblay, 2012).

Cross-sectional studies using self-report questionnaires indicate linear negative relationships between insufficient sleep and BMI in adults (Kohatsu et al., 2006; Wheaton et al., 2011) although the relationship is more mixed in adults than in children (Patel & Hu, 2008). In children, short sleep duration is associated with concurrent obesity and risk for elevated adult BMI (for a review, see Patel & Hu, 2008). Chaput and Tremblay (2012) concluded that children and adolescents may be more vulnerable to the effects of short sleep. However, long sleep (>8 h) may also increase risk for obesity; cross-sectional data show U-shaped relationships between sleep duration and BMI (Chaput, Després, Bouchard, & Tremblay, 2007; Gangwisch et al., 2005). These BMI changes may suggest changes in energy consumption and/or expenditure.

Short sleep has been associated with increased energy consumption. In a 1-year longitudinal study of obese middle-aged adults, those who slept less reported higher daily energy consumption (Galli et al., 2013). Several studies have shown that an acute severe restriction (by allowing up to 4 h of sleep except where noted) in sleep can elevate energy consumption (from snack in overweight men and women limited to 5.5 h of sleep, Nedeltcheva et al., 2009; from breakfast in normal weight men, Brondel, Romer, Nougues, Touyarou, & Davenne, 2010; from daily intake in normal and overweight men and women, St-Onge et al., 2011) and increase hunger (in men, Brondel et al., 2010; Spiegel, Tasali, Penev, & Van Cauter, 2004) compared to those who slept 8–9.5 h. However, the results of other studies are not consistent with these findings. For example, men subjected to 2 consecutive nights of 4 h of sleep did not differ in breakfast and morning snack consumption from when they experienced 2 consecutive nights of 8 h of sleep

☆ *Acknowledgments:* The authors thank Leah LaPrate, Lauren Bernardo, Albane Bajraktari, and Jaclyn Sheldon for their assistance in data collection and coding (Experiment 1). The authors are grateful for the funding provided by the Wagner College Office of the Provost.

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0195-6663/$ - see front matter © 2013 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.appet.2013.10.001

(Schmid et al., 2009), and male and female undergraduates who were instructed to restrict their sleep to 4 h or less for 1 night reported (in food diaries) consuming fewer calories following the sleep deprivation than when they had normal sleep (Wells & Cruess, 2006).

Changes in food choice and eating behavior are associated with short sleep. Shorter sleep in children (Westerlund, Ray, & Roos, 2009) and fewer than 7 h of sleep in adults (Stamatakis & Brownson, 2008) are associated with consumption of fewer fruits and vegetables and more energy-rich, nutritionally empty foods. Adolescents who report sleeping fewer than 8 h per night also tend to eat more total calories (Garaulet et al., 2011), and more energy from fats rather than carbohydrates (Weiss et al., 2010). A preference for calories derived from fats over carbohydrates has been observed in those experimentally restricted to 4 h of sleep (St-Onge et al., 2011) and those who reported sleeping fewer than 7 h per day (Shi, McEvoy, Luu, & Attia, 2008). Not only may short sleepers eat differently, they differ from normative duration sleepers in when they eat. Studies of college students (Hicks, Mc Tighe, & Juarez, 1986) and women (Kim, DeRoo, & Sandler, 2011) with short sleep (report fewer than 7 h per night) show a trend towards snacking rather than eating during conventional meal times. Increased snacking may be due to increased time for eating at later hours. Adults experimentally restricted to no more than 5.5 h of sleep who were presented with snacks *ad libitum* ate significantly more calories during the nighttime than in the daytime (Nedeltcheva et al., 2009). Thus, there may be an upregulation of appetite as mediated by the presence of food and modified eating patterns related to short sleep duration; studies of normal weight humans have reported high levels of the orexigenic hormone ghrelin and low levels of the anorectic hormone leptin when restricted to 5 h of sleep (see Chaput & Tremblay, 2012 for review).

There has been little investigation of psychological variables associated with susceptibility to short sleep effects. Chaput, Després, Bouchard, and Tremblay (2011) examined the role of disinhibition (the loss of suppression of food consumption as measured by the Three Factor Eating Questionnaire, TFEQ) in a large sample of adults in a 6-year longitudinal study and reported that those with high disinhibition scores experienced weight gains that were 2.5 times higher than those with low disinhibition scores. They also reported higher energy consumption. Perhaps sleep deprivation results in a loss of inhibition of food consumption or increases stress-related (emotional) eating in those who are prone to stress-related eating. The disinhibition factor of the TFEQ has a significant emotional eating component (Hyland, Irvine, Thacker, Dann, & Dennis, 1989). Thus, two studies examining the relationship between sleep duration and quality and emotional eating were conducted.

The purpose of the first study was to examine whether there is an association between sleep duration and quality, BMI, and emotional and external eating. Emotional eating in particular has been associated with excessive (sometimes pathological) eating and obesity (Lindeman & Stark, 2001). Stress has been associated with both emotional and external eating and it was expected that these would be associated with sleep disturbances. Following that, a second study was conducted in order to determine to what degree emotional eating status, sleep duration, and sleep quality interact with a stressor to influence actual food consumption. Because students commonly report short sleep (Buboltz et al., 2009), no experimental sleep manipulation was performed; the sleep patterns of the students were measured by self-report. While it would be interesting to assign some students to short sleep, these manipulations are often more severe than what would be the "natural" amount of deprivation and would be difficult to sustain outside of the laboratory (Horne, 2008).

Experiment 1

Method

Participants

A sample of 184 undergraduate women volunteered to participate as one option to fulfill a course research requirement. Women were selected for study due to their higher rates of emotional eating (van Strien, Frijters, Bergers, & Defares, 1986). Their anthropometric characteristics are presented in Table 1. When asked to describe racial identification, 1.1% described themselves as Asian, 2.7% as Black, 83.7% as White, 0.6% as Pacific Islander, 3.8% as mixed race, and 5.4% reported "other" or did not answer. On a separate question, 5.0% described themselves as Latina.

Dependent measures

The Dutch Eating Behavior Questionnaire (DEBQ; van Strien et al., 1986) was used to measure emotional eating (eating in response to aroused emotional states), external eating (eating in response to the presentation of food regardless of hunger), and dietary restraint (intentional control of food intake). The DEBQ is composed of 33 items, all based on a 5-point scale ranging from "never" to "very often." The test has high internal consistency with reliability between 0.80 and 0.95 and factorial validity (van Strien et al., 1986).

Sleep Measures: The Sleep Quality Index (SQI; Urponen, Partinen, Vuori, & Hasan, 1991), a validated brief questionnaire containing 8 items to indicate the weekly frequency of various sleep disturbances over previous 3 months, was used to measure sleep quality. Higher scores on this measure indicate poorer sleep quality: scores of 0 or 1 indicate good sleep quality, scores from 2 to 8 indicate occasional sleep difficulties, and scores ranging from 9 to 16 indicate poor sleep quality. The SQI has acceptable reliability of .71 in a US sample (Buboltz et al., 2009) and .74 in a European sample (Urponen et al., 1991). The Sleep Habits Questionnaire (SHQ; Lack, 1986) is composed of 9 questions about usual amounts of sleep, bedtimes, wake-up times, sleep latency, among other measures and was used to determine sleep duration. Sleep duration was calculated by subtracting the sleep latency from the difference between reported bedtime and wake time.

Procedure

After providing informed consent, participants were administered the DEBQ and SQI/SHQ in counterbalanced order in small groups settings. Each participant was seated alone at a table to afford privacy. An additional questionnaire was administered to collect data on height, weight, age, sex, and ethnicity. While direct

Table 1
Participant characteristics (mean ± SEM) and categorization of participants by sleep duration and BMI for both experiments.

Characteristic	Experiment 1	Experiment 2
N	184	64
Age (years)	18.6 ± 0.1	18.8 ± 0.4
DEBQ		
Emotional	2.6 ± 0.1	2.5 ± 0.1
External	3.0 ± 0.1	3.2 ± 0.1
Restraint	3.0 ± 0.1	2.8 ± 0.1
BMI (kg/m^2)	22.7 ± 0.3	24.5 ± 0.6
Underweight BMI	3.8%	1.6%
Normal BMI	78.7%	64.1%
Overweight BMI	13.1%	18.8%
Obese BMI	4.4%	15.6%
Sleep Duration[a]	7.3 ± 0.1	6.7 ± 0.1
Short sleep	45.8%	71.9%
Normal sleep	54.2%	28.1%

[a] *N* = 131 for sleep duration analysis in Experiment 1.