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Relationships of eating competence, sleep behaviors and quality, and overweight status among college students

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Abstract

Little is known about the relationships between eating competence (intra-individual approach to eating and food-related attitudes and behaviors that entrains positive bio-psychosocial outcomes), and sleep behaviors and quality in college students, a high risk group for poor eating habits, weight gain and inadequate sleep. Thus, data from full-time college students (N=1035; 82% White; 61% female) aged 18-24 years from 5 U.S. universities were obtained from online questionnaires (eating competence (ecSI), Pittsburg Sleep Quality Index (PSQI), physical activity, demographics) and physical assessments (measured height, weight), to explore sleep behavior and quality between eating competent (EC; ecSI score ≥ 32) and non-EC groups (ecSI < 32). Generalized linear models controlling for gender, body mass index, and physical activity were utilized. A higher proportion of those in the EC group reported adequate sleep quality (67% vs. 57% in non-EC, p=0.001), sleep duration of ≥ 7 hours nightly (58% vs. 50% in non-EC, p=0.007),

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and infrequent daytime dysfunction (72% vs. 65% in non-EC, p=0.02). When ecSI scores were grouped as tertiles, those in the highest tertile reported a higher prevalence of no sleep disturbances (7% vs. 2% in the lowest ecSI tertile, p=0.006) and lower prevalence of sleep medication use (10% vs. 15% in the lowest ecSI tertile, p=0.04). Results suggest that competent eaters are more likely to have better overall sleep quality and fewer sleep-related issues, compared to less competent eaters. These findings may inform future longitudinal studies, and health promotion and weight management interventions for young adults.

Keywords

eating; sleep; behavior; college; students

1. Introduction

Lack of sleep is a major public health problem because it is associated with several health problems such as hypertension, diabetes and obesity (Institute of Medicine, 2006). Although the Centers for Disease Control and Prevention recommend adults to sleep at least 7 hours per night (Centers for Disease Control and Prevention, 2015) more than 40 percent of U.S. adults report sleeping less than 7 hours per night on weekdays (National Sleep Foundation, 2011), and this percentage has increased over the last 30 years (Centers for Disease Control and Prevention, 2005) . Concurrently, unhealthy eating behaviors and rates of obesity have increased over this same time period (Drewnowski and Popkin, 1997; Ogden et al., 2004).

Indeed, cross-sectional and prospective studies have found adequate sleep is positively associated with health-related behaviors such as adopting a healthy diet among children (Moreira et al., 2010), adolescents (Al-Disi et al., 2010; Weiss et al., 2010), and adults (Grandner et al., 2010), and inadequate sleep is negatively associated with health-related behaviors (Quick et al.). For example, among college students where sleep deprivation is common (Lund et al., 2010), inadequate sleep (<7 hours/night) was associated with negative eating attitudes, poor internal regulation of food, and binge eating behaviors (Quick et al.). Individuals with less sleep are also more likely to consume energy-rich foods with higher proportions of calories from fats or refined carbohydrates, consume lower amounts of fruits and vegetables, and have irregular meal patterns than those with more sleep (Al-Disi et al., 2010; Grandner et al., 2010; Moreira et al., 2010; Weiss et al., 2010). Additionally, being overweight/obese is significantly associated with poor sleep quality and low eating competence (Quick et al., 2014) as defined by the Satter Eating Competence Model (esSatter) (Satter, 2007a).

Eating competence, as defined by ecSatter, is an intra-individual approach to eating, and food-related attitudes and behaviors that entrains positive bio-psychosocial outcomes (Satter, 2007a). ecSatter advocates for nutrition education that emphasizes eating enjoyment; internal regulation of food intake and letting body weight be dictated by lifestyle and genetics; using skills to provide meals regularly; and eating a variety of foods for pleasure, rather than to meet dietary guidelines alone (Satter, 2007b). Prior research has found competent eaters to have better diet quality with greater intakes of fiber, most vitamins (A,

C, E, B) and some minerals (magnesium, iron, zinc, potassium) (Lohse et al., 2012). Additionally, competent eaters have fewer risks for cardiovascular disease (Lohse et al., 2010; Psota et al., 2007); lower BMI; greater body weight satisfaction; (Greene et al., 2011; Krall and Lohse, 2009; Lohse et al., 2007); better sleep quality (Shoff et al., 2009); and fewer correlates with disordered eating (Krall and Lohse, 2009; Lohse et al., 2007).

To date, little is known about the relationships of eating competence with sleep behaviors and quality among young adults. The purpose of this study was to explore the associations of eating competence with sleep behavior and quality among college students.

2. Materials and Methods

2.1 Design

University partners in the United States Department of Agriculture (USDA) Multistate Healthy Campus Research Consortium participated in Project WebHealth, a 3-month nutrition and physical activity intervention at eight geographically diverse universities in the United States. Participating students were surveyed pre, post- and follow-up (3 and 15-months). This study used baseline data to examine the relationship of sleep behavior and quality with eating competence. Additional information on the study can be found elsewhere (Greene et al., 2012).

2.2 Participants and Procedures

Participants were full-time students, aged 18-24 years, enrolled at eight universities. Eligibility criteria for Project WebHealth included the following: Body Mass Index (BMI) ≥ 18.5 kg/m^2, not nutrition or exercise science majors, free from health conditions that could interfere with diet and exercise changes, and not pregnant or lactating. This study was approved by the institutional review boards at all participating universities. Only a sub-set of five universities collected sleep data.

Students were recruited using a variety of methods directing potential participants to a Web site for initial screening (e.g. posters, flyers, mass emails, class announcements) and were surveyed pre-, post- (3 months), and follow-up (15 months). Students meeting eligibility criteria in the initial screening, provided informed consent then completed an online questionnaire including the ecSI, and made an appointment for a physical assessment (Greene et al., 2011). During the physical assessment, trained researchers conducted anthropometric assessments. At baseline, n=1689 eligible participants enrolled in Project WebHealth. The sleep questionnaire (described below) was administered as a sub-study at 5 of the 8 institutions. It was completed by n=1083 during the physical assessments; the study sample consists of n=1035 (96%) with complete baseline, eating competence and sleep data.

2.3 Questionnaires

2.3.1 Eating Competence (EC)—The ecSI is a valid and reliable measure of eating competence ($\alpha = 0.81$) (Quick et al., 2014). Respondents select from 5 response options (never, rarely, sometimes, often, always), which are scored on a 4-point scale from 0 (never/rarely) to 3 (always), then summed for a total score (possible range 0 to 48). A score greater

than or equal to 32 is defined as being EC. Four scales define each EC component (i.e., Eating Attitudes [5 items], Food Acceptance [3 items], Internal Regulation [3 items], and Contextual Skills [5 items]). The Eating Attitudes scale measures the degree to which an individual has a positive and flexible orientation towards eating (score range 0-15). The Food Acceptance scale measures inclination to try new foods and learn one's own unique food preferences (score range 0-9). The Internal Regulation scale measures awareness of and responsiveness to cycles of hunger, appetite, and satiety (score range 0-9). The Contextual Skills scale measures engagement with eating, ability to organize and provide routine meals and snacks (score range 0-15) (Lohse et al., 2007; Satter, 2007a). The Ellyn Satter Institute website provides more detail on the ecSI (Satter, 2015).

2.3.2 Sleep Behavior—The Pittsburgh Sleep Quality Index (PSQI) (Buysee et al., 1989) was completed during the physical assessment appointment. It is a validated instrument with seven scales that assess Subjective Sleep Quality (i.e., perception of one's own sleep quality), Sleep Latency (i.e., how long it usually takes to fall asleep per night), Sleep Duration (i.e., average number of hours of actual sleep per night), Habitual Sleep Efficiency (i.e., actual hours of sleep versus hours spent in bed), Sleep Disturbances (i.e., factors that cause individuals to wake up in the middle of the night or early morning), Sleep Medication Use (i.e., prescribed or "over the counter"), and Daytime Dysfunction (i.e., difficulty staying awake during the day) due to sleep quality over the past month. Traditional scoring methods were used as described by Buysee et al. (1989). That is, each of the scales is equally weighted with score ranges from 0 to 3. Scales are then summed to generate a global index score that reflects quantitative aspects of sleep, (e.g., sleep duration and latency) and subjective aspects (e.g., restfulness of sleep). Global scores range from 0 to 21, with higher scores reflecting poorer sleep quality. A global score of 5 or higher is indicative of a poor-quality sleeper. The PSQI adequately differentiates between good and bad sleepers (Grandner et al., 2006). Additionally, previous research among college students has indicated the PSQI is a reliable measure ($\alpha = 0.73$) (Lund et al., 2010).

2.3.3 Demographics and Physical Activity—Demographic data included self-reports of age, sex, year in school, race/ethnicity and physical activity using the USDA exercise self-assessment categories (i.e., <30 minutes/day, 30-60 minutes/day, or ≥60 minutes/day).

2.4 Physical Assessments

2.4.1 Anthropometrics—Participants were instructed to refrain from eating or drinking caloric beverages for 4 hours and to avoid high intensity exercise for 24 hours prior to the physical assessment, and to wear light clothing. Trained research personnel used standardized procedures (Lohman et al., 1988) and measured the participants' weight (lb) and height (in) in duplicate. Weight was measured to the nearest 1/4 lb. with a calibrated digital or balance beam scale and height was measured to the neared 1/16 in. using a wall-mounted stadiometer. BMI (kg/m^2) was calculated and categorized (normal 18.5 to <25 kg/m^2, overweight 25 to <30 kg/m^2, and obese 30 to <35 kg/m^2) (U.S. Department of Health and Human Services, 1998).

2.5 Data Analysis

All analyses were performed using SPSS (version 21.0, SPSS, Inc., Chicago, IL). In the baseline sample of participants (N=1035), ecSI scores were divided into tertiles and also dichotomized as EC (≥ 32) or not (<32). Tertile profiles were developed using analysis of variance, multiple comparison test using Scheffe's method, and chi-square for demographics and self-report physical activity. Dichotomized ecSI scores were compared for demographics, BMI and physical activity using t-test and chi-square analyses. Generalized linear models controlling for gender, BMI, and physical activity level examined significant differences among eating competence (tertiles and dichotomized) of sleep behavior and quality. Additionally, a multivariate logistic regression model that estimated associations of eating competence and sleep with being overweight/obese was conducted. Beta standard errors, Odds ratios (OR), and 95% confidence intervals (CI) for each independent variable in the model predicting overweight/obese status were computed.

3. Results

Most participants were White (82.4%), female (61%), with an average age of 19.1 ± 1.1 years, and average BMI within normal range (23.5 ± 3.6 kg/m^2). Comparison of participant characteristics by eating competence revealed that males, White race/ethnicity, normal BMI and increased physical activity were significantly associated with greater eating competence (Table 1). Internal consistency scores for ecSI and PSQI were acceptable (Eating Attitudes α = 0.85; Food Acceptance α = 0.75; Internal Regulation α = 0.71; Contextual Skills α = 0.72; ecSI total α = 0.80; PSQI total α = 0.62).

All sleep behaviors and quality characteristics were significantly associated with eating competence after controlling for gender, BMI, and physical activity level, except for habitual sleep efficiency and sleep medication use in ecSI dichotomized models (Table 2). That is, competent eaters were more likely to report better overall sleep quality, sleep > 7 hrs/night, and report less sleep disturbance and daytime dysfunction in the past month.

Findings from the multivariate logistic analysis showed sex (female) (OR=1.92; SE β=0.16, CI: 1.41-2.60), age (OR=1.32; SE β= 0.07, CI: 1.15, 1.51), Global PSQI (OR=1.08; SE β=0.03, CI: 1.02-1.14), and Eating Competence Total score (OR=0.95; SE β= 0.01, CI: 0.93-0.97) were each significantly ($p<0.01$) associated with overweight/obese status. Physical activity was not significantly associated with overweight/obesity status when included in the model.

4. Discussion

Findings from this cross-sectional study suggested college students who were competent eaters, were more likely to have better overall sleep quality and fewer sleep-related issues such as sleep disturbance and daytime dysfunction, compared to less competent eaters. Additionally, poor sleep quality and low eating competence were associated with overweight/obese status even after multivariable adjustment for socio-demographic characteristics and physical activity. To the authors' knowledge, this is the first study to examine this relationship among college students. The relationship between eating

competence and better sleep quality is informative for researchers and health professionals developing health promotion interventions for this population.

Other reports on sleep duration and eating behaviors strengthen our study findings (Kant and Graubard, 2014; Peuhkuri et al., 2012). For example, Kant and Graubard found among adults that meal patterns were significantly different between short duration and average duration sleepers (Kant and Graubard, 2014). Additionally, a regular habit of snacking, which is related to an energy-rich diet, is associated with short sleep duration (Kim et al., 2011). Similarly, findings from our study reveal lower eating competence among short duration sleepers, and higher BMI in those with lower eating competence. Comparable to prior studies (Lohse et al., 2013), our study also found lower eating competence to be associated with decreased physical activity. Independently, physical activity, eating competence and sleep play an important role in overall health and wellness. Future longitudinal studies are needed to better explore and theorize how these factors influence each other.

Eating competence was significantly lower for poor sleepers. Less competent eaters had greater sleep disturbances and daytime dysfunction and worse sleep quality compared to competent eaters. It is possible that both sleep quality and eating competence are affected by student's level of stress (emotional, social, financial), social support and perceived success as an independent young adult that may act as mediators in this relationship; however, more research is needed to explore other potential mediators or moderators of this relationship. In general, health issues associated with poor sleep quality are congruent with characteristics of low eating competence, including those related to weight. Thus, health care professionals should consider screening for inadequate sleep behaviors and provide nutrition education programs that focus on skills to improve eating competence, especially in young adults who are at risk for weight gain (Flegal et al., 2010).

Several limitations were identified in this study. As with all human research of this type, study participants self-selected themselves to participate, so findings may not be generalizable to all college populations. Additionally, there may have been biases in self-reports of sleep and eating competence; however, previous research has found these instruments are reliable in college populations (Quick et al., 2014). Because this is a cross-sectional study it does not permit the determination of temporality in the associations among eating competence and sleep quality of college students. Despite these limitations, a major strength is this is first study to examine associations between eating competences and sleep behaviors and quality among a large sample of college students from five unrelated institutions of higher education. Furthermore, height and weight were measured using standardized procedures.

In conclusion, findings from this study suggest competent eaters are more likely to have better overall sleep quality and fewer sleep-related issues, compared to less competent eaters. Furthermore, poor sleep quality and not being eating competent were associated with overweight/obesity. Findings from this study may help to inform future longitudinal studies and health promotion and weight management interventions for young adults.

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Highlights

- Competent eaters have better overall sleep quality than less competent eaters
- Competent eaters have less sleep disturbances than less competent eaters
- Low eating competence and poor sleep quality is associated with overweight status
- Study findings may inform future weight management interventions for young adults

Table 1

Participant characteristics by eating competence (ecSI) (N=1035)

	Low Tertile[§] (n=319)	Middle Tertile[§] (n=331)	High Tertile[§] (n=385)	Not Eating Competent[†] (n=536)	Eating Competent[†] (n=499)
Gender***, N (%)					
Male	88 (27.6)	135 (40.8)	182 (47.3)	180 (33.6)	225 (45.1)
Female	231 (72.4)	196 (59.2)	203 (52.7)	356 (66.4)	274 (54.9)
Race*, N (%)					
White (non-Hispanic)	249 (78.1)	277 (83.7)	327 (84.9)	426 (79.5)	427 (85.6)
Black (non-Hispanic)	19 (6.0)	8 (2.4)	5 (1.3)	25 (4.7)	7 (1.4)
Hispanic/Latino	17 (5.3)	9 (2.7)	11 (2.9)	24 (4.5)	13 (2.6)
Asian/Pacific Islander	18 (5.6)	25 (7.6)	27 (7.0)	37 (6.9)	33 (6.6)
Other	9 (2.8)	5 (1.5)	7 (1.8)	12 (2.2)	9 (1.8)
Not reported	7 (2.2)	7 (2.1)	8 (2.1)	12 (2.2)	10 (2.0)
Year in school, N (%)					
Freshman	76 (23.8)	105 (31.7)	128 (33.2)	145 (27.1)	164 (32.9)
Sophomore	143 (44.8)	122 (36.9)	151 (39.2)	225 (42.0)	191 (38.3)
Junior	100 (31.3)	102 (30.8)	102 (26.5)	164 (30.6)	140 (28.1)
Senior	0 (0.0)	2 (0.6)	4 (1.0)	2 (0.4)	4 (0.8)
Age (years), mean ± SD	19.2±1.0	19.1±1.1	19.1±1.0	19.2±1.1	19.1±1.0
Body mass index (kg/m^2)***, mean ± SD	24.4±4.1[a]	23.5±3.6[b]	22.9±2.9[b]	24.1±4.0	22.9±3.0
Body mass index categories***, N (%)					
<25	210 (65.8)	247 (74.6)	311 (80.8)	367 (68.5)	401 (80.4)
25-29.9	77 (24.1)	64 (19.3)	57 (14.8)	123 (22.9)	75 (15.0)
≥ 30	32 (10.0)	20 (6.0)	17 (4.4)	46 (8.6)	23 (4.6)
Physical activity*** (minutes/day) N (%)					
< 30	116 (36.4)	84 (25.4)	85 (22.1)	180 (33.6)	105 (21.0)
30-60	150 (47.0)	183 (55.3)	185 (48.1)	268 (50.0)	250 (50.1)
> 60	53 (16.6)	64 (19.3)	115 (29.9)	88 (16.4)	144 (28.9)
esCI***, mean ± SD	22.9±4.0	30.6±1.6	38.2±3.5	25.7±4.6	36.9±3.9

** P < 0.01;

c denote post hoc differences significant at P < 0.05. Like superscripts indicate non-significant differences.

* P < 0.05;

*** P < 0.001

[a] denote post hoc differences significant at P < 0.05. Like superscripts indicate non-significant differences.

[b] denote post hoc differences significant at P < 0.05. Like superscripts indicate non-significant differences.

[§] Eating competent tertiles (low tertile esSI<28; middle tertile ecSI 28 to <34; high tertile ecSI ≥34).

[†] Not eating competent ecSatter Inventory score <32; Eating competence denoted by ecSatter Inventory score≥32.

Table 2

Sleep behaviors and quality* by eating competence (ecSI) level of college students at baseline (N=1035)

Measure	Low Tertile§ (n=319)	Middle Tertile (n=331)	High Tertile (n=385)	*P-value* ‡	Not Eating Competent† (n=536)	Eating Competent (n=499)	*P-value* ‡
	N (%)	N (%)	N (%)		N (%)	N (%)	
Sleep Behaviors							
Subjective sleep quality							
Very or fairly good	250 (78.4)	295 (89.1)	349 (90.6)	<0.001	448 (83.6)	446 (89.4)	0.007
Very or fairly bad	69 (21.6)	36 (10.9)	36 (9.4)		88 (16.4)	53 (10.6)	
Sleep Duration							
≥7 hours per night	141 (44.2)	193 (58.3)	225 (58.4)	<0.001	268 (50.0)	291 (58.3)	0.007
<7 hours per night	178 (55.8)	138 (41.7)	160 (41.6)		268 (50.0)	208 (41.7)	
Habitual Sleep Efficiency							
≥85% Efficient	247 (77.4)	276 (83.4)	312 (81.0)	0.273	434 (81.0)	401 (80.4)	0.804
<85% Efficient	72 (22.6)	55 (16.6)	73 (19.0)		102 (19.0)	98 (19.6)	
Sleep Disturbance							
0 times in last month	6 (1.9)	20 (6.0)	26 (6.8)	0.006	20 (3.7)	32 (6.4)	0.051
≥ 1 time in last month	313 (98.1)	311 (94.0)	359 (93.2)		516 (96.3)	467 (93.6)	
Sleep Medication Use							
0 times in last month	271 (85.0)	300 (90.6)	347 (90.1)	0.037	471 (87.9)	447 (89.6)	0.387
≥ 1 time in last month	48 (15.0)	31 (9.4)	38 (9.9)		65 (12.1)	52 (10.4)	
Daytime Dysfunction							
< 4 times in past month	183 (57.4)	244 (73.7)	278 (72.2)	<0.001	348 (64.9)	357 (71.5)	0.023
≥ 4 times in past month	136 (42.6)	87 (26.3)	107 (27.8)		188 (35.1)	142 (28.5)	
Global PSQI							
Poor sleep quality (>5)	163 (51.1)	110 (33.2)	122 (31.7)	<0.001	230 (42.9)	165 (33.1)	0.001
Adequate sleep quality (≤5)	156 (48.9)	221 (66.8)	263 (68.3)		306 (57.1)	334 (66.9)	
Mean PSQI, mean±SD	6.1±2.6	4.9±2.3	4.8±2.3	<0.001	5.5±2.5	4.9±2.4	<0.001

*Measured by the Pittsburgh Sleep Quality Index (PSQI).

§Eating competent tertiles (low tertile esSI<28; middle tertile ecSI 28 to <34; high tertile ecSI ≥34).

†Not eating competent ecSatter Inventory score <32; Eating competence denoted by ecSatter Inventory score≥32.

‡Generalized linear models controlling for gender, BMI, and physical activity level.