Household Food Insecurity is Associated with Binge-Eating Disorder and Obesity

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Abstract

Background: Food insecurity stems from limited financial resources. Yet, paradoxically, food insecurity is associated with overeating and excess weight. One subcategory of overeating is binge eating, which includes eating an unusually large amount of food while feeling a concurrent sense of loss of control. Associations between binge-eating disorder and food insecurity are not known, yet this is important to examine because binge eating is associated with more severe mental and physical health problems than overeating or obesity alone.

Methods: Survey respondents ($N = 1250$) were recruited online. Participants were categorized into study groups: healthy weight (HW), binge-eating disorder (BED), and obesity (OB). Using HW as a reference group, hierarchical logistic regressions evaluated the extent to which low and very low food security were associated with BED and OB.

Results: Low food security and very low food security were both associated with increased likelihood of BED and OB group membership.

Conclusions: Results highlight the need to devote resources towards policy revisions, preventative interventions, and psychiatric treatments aimed at decreasing the overall association of food insecurity with BED and obesity among low-income Americans.

Keywords

food insecurity; binge-eating disorder; obesity

Introduction

Household food insecurity is characterized by a shortage of nutritionally-adequate food and difficulty acquiring adequate food in socially-acceptable ways (Bickel, Nord, Price, Hamilton, & Cook, 2000). Indicators of food insecurity include being unable to afford nutritionally-balanced foods, worrying that purchased food would run out, and cutting meal

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sizes or skipping meals because of food shortages. More serious markers of food insecurity include skipping meals for an entire day and intentionally eating less food than one thinks one should due to lack of access to food (Coleman-Jensen, Rabbitt, Gregory, & Singh, 2017). Though rates of food insecurity have declined, 12.3% of US households are estimated to have limited access to regular sources of food (Coleman-Jensen et al., 2017).

Food insecurity can lead to poor nutritional intake and detrimental health outcomes (Gundersen & Ziliak, 2015; Laraia, 2013; Ramsey, Giskes, Turrell, & Gallegos, 2012) including paradoxical increased risk for *overeating* and excess weight (i.e., BMI > 25 kg/m²) (Adams, Grummer-Strawn, & Chavez, 2003; Basiotis & Lino, 2003; Franklin et al., 2012). Food insecurity also increases the risk of weight-related health problems including diabetes, metabolic syndrome, and cardiovascular disease (Cook, 2002; Holben & Pheley, 2006; Seligman, Bindman, Vittinghoff, Kanaya, & Kushel, 2007; Seligman, Laraia, & Kushel, 2010; Taye & Zizza, 2009). Yet, evidence of an association between food insecurity and obesity is equivocal and some studies have failed to find a clear association between food insecurity and obesity (Larson & Story, 2011). Relations between food insecurity and obesity appear to differ when stratified by race (Adams et al., 2003; Bhattacharya, Currie, & Haider, 2004; Franklin et al., 2012). For example, in a diverse sample of approximately 24,000 respondents, food insecurity and obesity were associated among White and Hispanic individuals, but not Black individuals (Bhattacharya et al., 2004). Overall, these findings suggest a potential relation between food insecurity and increased weight, however, inconsistencies necessitate further research to clarify the association between food insecurity and obesity.

Food insecurity may be linked to increased weight through a cyclical pattern of food restriction followed by problematic eating behaviors including overeating, decreased fruit and vegetable intake, and increased consumption of high-sugar beverages, fast food, and other low-nutrition, energy-dense foods (Bruening, MacLehose, Loth, Story, & Neumark-Sztainer, 2012; Cook, 2002; Dinour, Bergen, & Yeh, 2007; Franklin et al., 2012; Sirotin, Hoover, Shi, Anastos, & Weiser, 2014). The pattern of dietary restriction and overconsumption is a familiar cycle for many low-income individuals and is also characteristic of binge-eating disorder (BED). Previous research has hypothesized that the pattern of binge eating following poverty-induced food restriction may be related to cyclical access to food through monthly paychecks or allocation of food stamps (Bove & Olson, 2006; Burns, 2004; Cook, 2002; Dinour et al., 2007; Wilde & Peterman, 2006). Indeed, a recent study found that among individuals with food insecurity in the United States (US), the severity of food insecurity was associated with binge-eating frequency, as well as other forms of eating-disorder psychopathology and internalized weight bias (Becker, Middlemass, Taylor, Johnson, & Gomez, 2017). The “food stamp cycle” hypothesis notes that binge-eating behaviors may occur at the beginning of the month when access to food increases, and individuals may involuntarily restrict their food at the end of the month when financial and food resources run low. Although the literature provides evidence of an association between food insecurity and increased risk for binge-eating and overeating episodes (Bove & Olson, 2006; Bruening et al., 2012), no studies have explored whether these episodes of binge eating have the characteristics of or are frequent enough to meet a diagnostic threshold for BED. Defined in the *DSM-5* as recurrent episodes of eating an

unusually large amount of food accompanied by a sense of lack of control (American Psychiatric Association, 2013), BED has a conceptualized cyclical pattern of dietary restraint and binge eating (Fairburn, Cooper, & Shafran, 2003; Fairburn, Stice, et al., 2003). The psychopathology of BED is typically studied in the context of restrained eating due to intentional dieting for the purpose of weight loss; however, little is known about the etiology of BED as developed through involuntary, poverty-induced food restriction, as seen in food insecurity.

The absence of literature exploring whether the eating episodes associated with food insecurity meet criteria for BED, and the mixed findings regarding the association between food insecurity and obesity, serve as rationale to explore the possible risk factor of food insecurity in relation to these concerning public health and psychiatric outcomes. Given that food insecurity appears to influence weight, dietary restriction, and binge eating, it is crucial to understand the complex association between limited food resources and the outcomes of both BED and obesity. The primary aim of the current study was to examine the relation between low and very low food security and BED. The secondary aim was to assess the association between food security and obesity in the absence of binge eating. Respondents were categorized into three study groups: individuals with healthy weight (HW), individuals with core BED symptomatology (BED), and individuals with obesity but not BED (OB). Using HW as a reference group, analyses examined whether food security status increased the likelihood of BED and OB group membership. We hypothesized that individuals with low and very low food security would have increased likelihood of BED and OB study group membership compared with HW group membership. We further hypothesized that this relation would persist after adjusting for factors typically associated with increased weight and binge-eating behaviors (i.e., age, sex, education level, race/ethnicity).

Methods

Participants

Survey respondents ($N = 1250$) were recruited from Amazon's Mechanical Turk, a web-based recruitment platform. Data from participants recruited from this site has demonstrated comparable reliability and validity compared with data from participants recruited using more conventional methods such as psychology student subject pools (Buhrmester, Kwang, & Gosling, 2011). Mechanical Turk has been used in many studies, including those focusing on both eating-disorder psychopathology and food security (Leung, Musicus, Willett, & Rimm, 2017; Pearl & Puhl, 2014; Tylka, Russell, & Neal, 2015). Participants were English- and Spanish-speaking individuals from the US. Participants were included in study groups if they provided valid responses for self-reported height and weight, as well as food security survey items. Analysis was restricted to US respondents due to potentially contrasting contextual food environments between the US and other countries. The study was approved by the institutional review board. All participants provided informed consent prior to initiating the online survey.

Measures

Body Mass Index (BMI).—BMI (kg/m^2) was calculated using participants' self-reported weight and height. Previous research has demonstrated the validity of self-reported weight and height as an alternative to in-person measurement (Spencer, Appleby, Davey, & Key, 2002; Stunkard & Albaum, 1981) and has shown that differences between self-reported and measured BMI are not related to psychopathology (White, Masheb, & Grilo, 2010).

US Household Food Security Survey Module: Six-Item Short Form.—Food security was assessed via the United States Department of Agriculture (USDA) Food and Nutrition Service's U.S. Household Food Security Survey Module: Six-Item Short Form, which explored financial influences on food consumption behaviors over the previous 12 months (National Center for Health Statistics, 2008). The six-item module characterized respondents within three categories: "food secure," "low food security/food insecure without hunger," and "very low food security/food insecure with hunger." Item-level scoring is described in the original measure publication (National Center for Health Statistics, 2008) and consistent with those recommendations, the sum of the six items was interpreted as food security (total score 0 or 1), low food security (total score 2 through 4), or very low food security (total score 5 or 6). That is, households were described as having food security if they demonstrated no signs of difficulty affording regular, nutritious meals, low food security if they modified food quality, variety, or desirability to satisfy hunger (Coleman-Jensen et al., 2017), and very low food security if members within the household reduced food adequacy or quality to the point of repeated instances of physiological hunger (Bickel et al., 2000).

Questionnaire on Eating and Weight Patterns-5 (QEWP-5).—The QEWP-5 assesses eating-disorder behaviors and attitudes that align with *DSM-5* diagnostic criteria (Yanovski, Marcus, Wadden, & Walsh, 2015) and is the recommended instrument to assess binge eating in the NIH ADOPT initiative to collect systematic data on patients with obesity in research (Sutin et al., 2018). Participants rated the frequency of binge-eating episodes on a six-point scale from 1 = *Less than 1 episode per week* through 6 = *14 or more episodes per week*; 2 corresponded to *1 episode per week*, which is the minimum frequency required for BED (American Psychiatric Association, 2013). The measurement of distress is rated on a five-point scale from 1 = *Not at all* through 5 = *Extremely*; 3 corresponded to *Moderately*, which is the minimum level of distress related to binge eating required for BED diagnosis. The QEWP-5 follows the QEWP-R (that corresponded to DSM-IV criteria) and shows evidence of validity discriminating between individuals with and without binge eating in community (Nangle, Johnson, Carr-Nangle, & Engler, 1994) and primary care (Barnes, Masheb, White, & Grilo, 2011) settings.

Algorithms

Study group algorithms were defined using QEWP-5 survey items and Centers for Disease Control and Prevention (CDC) BMI categorization for healthy weight (18.5 to $<24.9 \text{ kg/m}^2$) and obesity ($>30 \text{ kg/m}^2$) (Centers for Disease Control and Prevention, 2016; Yanovski et al., 2015). Respondents met BED group study criteria as defined by at least weekly binge-eating episodes (eating an unusually large amount of food and perceiving eating to be out of

control) over the past three months (“1 episode per week” through “14 or more episodes per week” endorsed), at least moderate distress about overeating and feeling out of control (“moderately” through “extremely” endorsed), and denial of weekly inappropriate compensatory behaviors over the past three months (vomiting/laxative misuse/diuretic misuse/fasting/excessive exercise/diet pill misuse; “no” endorsed). Individuals in the obesity group and healthy-weight group denied weekly binge eating (“no” or “less than 1 episode per week” endorsed), inappropriate compensatory behaviors (“no” endorsed), and distress about overeating and loss of control while eating (“not at all” or “slightly” endorsed). Additionally, individuals in the OB group reported a BMI $>30 \text{ kg/m}^2$, and participants in the HW group reported a BMI 18.5 to $<24.9 \text{ kg/m}^2$. Individuals in the BED group did not have BMI limitations.

Statistical Analysis

Differences in the demographic characteristics of participants in the HW, BED, and OB groups were assessed using chi-square tests for categorical variables (sex, education level, and ethnicity (Non-Hispanic White, Hispanic, and Non-Hispanic Other) and analyses of variance (ANOVAs) for continuous variables (age and BMI). Associations between HW, BED, and OB groups, categorical demographic variables, and low and very low food security status were assessed using chi-square tests. Group differences were compared with post-hoc tests. Hierarchical logistic regressions evaluated associations between food security status and study groups (HW vs. BED group and HW vs. OB group). Subsequent hierarchical logistic regressions adjusted for age, sex, education level, and ethnicity, because of the associations among these factors and increased weight and binge-eating behaviors. Results were considered significant at $\alpha < .05$ threshold.

Results

The cross-sectional sample included responses from 1,251 individuals (HW $n = 710$, 56.8%; BED $n = 85$, 6.8%; OB $n = 456$, 36.5%). Across the entire sample, 33.7% of participants ($n = 422$) met criteria for food insecurity: 18.5% ($n = 231$) had low food security and 15.3% ($n = 191$) had very low food security. Differences in demographic characteristics across HW, BED, and OB groups and post-hoc group differences are summarized in Table 1. HW, BED, and OB groups did not significantly differ by sex ($p = .58$) or race/ethnicity ($p = .06$). Education ($p = .003$) and age ($p < .001$) significantly differed across groups. As expected because HW and OB study group algorithms were defined using BMI, there were significant differences in BMI between study groups ($p < .001$). Categorically, all HW participants had a BMI between 18.5 and 24.9 kg/m^2 and all OB participants had a BMI above 30 kg/m^2 . Among participants in the BED study group, 17.6% ($n=15$) had a BMI below 25 kg/m^2 ; 17.6% ($n=15$) had a BMI between 25 and 29.9 kg/m^2 ; and 64.7% ($n=55$) had a BMI above 30 kg/m^2 .

Demographic and clinical characteristics by food security status and post-hoc group differences are summarized in Table 2. Although food insecurity was present in all three study groups, low and very low food security was more common in BED than HW and OB groups. Within the BED study group, 28.24% of respondents met low food security and

18.82% of respondents met very low food security criteria. Food security status did not significantly differ by sex ($p = .21$) but did significantly differ by age ($p < .001$) such that participants with low food security were younger than those with food security. Food security also significantly differed by education ($p < .001$): individuals with a college degree (9.4%) and post-college degree (10.9%) were less likely to have very low food security relative to individuals with a high school degree (25.0%) or some college education (19.9%). Individuals with very low food security had significantly higher mean BMI ($M = 29.86$ kg/m², $SD = 8.75$) relative to individuals with food security ($M = 27.46$ kg/m², $SD = 7.91$); individuals with low food security ($M = 28.50$ kg/m², $SD = 7.70$) did not significantly differ from other groups.

Figure 1 depicts the percentage of respondents within BED, HW, and OB groups endorsing specific food security items. A greater proportion of individuals within the BED and OB study groups endorsed the following food security items relative to participants in the HW group: “Cut size of meal or skipped meal” and “Ate less than felt should.” A larger proportion of individuals within the OB group endorsed “Food bought did not last,” “Could not afford balanced meal,” and “Hungry but did not eat,” compared with participants in the BED and HW groups.

Results of hierarchical logistic regressions are summarized in Table 3 (HW vs BED; HW vs OB). Hierarchical logistic regressions evaluated the extent to which low and very low food security contributed to group classification. Step 1 variables included sex, age, education level, and ethnicity. Food security was entered in Step 2 to assess whether food security status influenced the OB and BED group membership above and beyond the effect of demographic variables entered previously. Low food security (OR 2.45, CI 1.42 – 4.24) and very low food security (OR 1.91, CI 1.01 – 3.61) were associated with BED group membership. Sex, age, and education were not significantly associated with BED group membership.

Low food security (OR 1.56, CI 1.13 – 2.15) and very low food security (OR 1.55, CI 1.10 – 2.18) were associated with increased likelihood of OB group membership. Age (OR 1.03, CI 1.02 – 1.04) was associated with increased likelihood of OB group membership. College (OR 0.54, CI 0.37 – 0.81) and post-college (OR 0.64, CI 0.42 – 0.98) education were associated with decreased likelihood of classification in the OB group compared with high school/GED education (reference group). Sex and race/ethnicity were not significantly associated with OB study group membership.

Discussion

Although food insecurity in the US has declined since the recession of the late 2000s and early 2010s, an estimated 15.6 million households continue to have difficulty affording enough food to support regular, balanced meals (Coleman-Jensen et al., 2017). The current study demonstrated that food insecurity, both low food security and very low food security, were associated with classification in the BED group and OB group compared with the HW group. Previous literature has shown that food insecurity was associated with overeating and binge-eating episodes (Becker et al., 2017; Bruening et al., 2012); however, the current study

is the first to explore food insecurity as a potential risk factor for recurrent binge-eating episodes with the frequency and distress that is required for BED using *DSM-5* diagnostic criteria.

Low food security and very low food security were more likely to be associated with the BED study group above and beyond the relative associations of demographic variables. These findings support the theory that food insecurity can contribute to possible risk for BED, which is conceptualized to relate to cycles of restriction and binge-eating (Fairburn, 2013), even when restriction is externally (i.e., due to financial hardship) rather than internally (i.e., intentional dietary restraint for weight loss) imposed. Therefore, it is possible that food insecurity that results in fluctuations of meal size and frequency may facilitate recurrent binge-eating episodes that characterize BED and potentially contribute to weight gain. As our research was cross-sectional, future research should examine eating patterns longitudinally and in greater detail to determine if cyclical restriction triggers binge-eating episodes among individuals with food insecurity, and to examine whether other forms of eating-disorder psychopathology are associated with food insecurity. Future research should also examine reasons for restriction to separate dietary restriction that is externally or internally imposed and their relative associations with binge eating, particularly given recent findings suggesting overlapping motivations for restriction that are both externally and internally imposed (Becker et al., 2017). Given past research that suggests food insecurity severity may be directly associated with eating-disorder psychopathology severity (Becker et al., 2017), it would also be important to assess this relation longitudinally and in relation to changes in weight.

The results from the present study also provide evidence for the association between food insecurity and obesity. BMI significantly differed across food security groups such that the average BMI was significantly greater for participants with very low food insecurity compared with those with food security (Table 2). Within the current study, hierarchical analyses found that low food security and very low food security were associated with OB study group membership even after adjusting for the effects of age, sex, education, and race/ethnicity. Clinically, this is vital information for health care providers such as those in primary care settings. Recognizing food insecurity as associated with BED may help identify individuals who could benefit from services to improve access to food and who could benefit from treatment for BED. Frontline healthcare providers should be aware of eating behaviors including loss of control and overeating episodes among individuals with food insecurity that could require additional resources or referrals for specialized treatment, particularly as many individuals with eating disorders do not receive mental health treatment (Marques et al., 2011). Primary care providers who serve individuals with limited financial resources who may experience food insecurity might consider implementing screening protocols to assess for binge eating.

Additionally, food insecurity should be evaluated among treatment-seeking individuals with BED. Eating patterns associated with food insecurity have the potential to complicate BED treatment because they are externally-driven and may require additional services to mitigate. Evidence-based treatments for BED typically involve recommendations for prescriptive planning of regular meals to reduce dietary restraint that may contribute to a restriction-

binge cycle. For example, cognitive-behavioral therapy (CBT) for BED includes recommendations for structured eating (three planned meals each day plus two or three planned snacks; rarely any 4-hour intervals between eating episodes) (Fairburn, 2008). For individuals with uncertain timing and quality of upcoming meals, adhering to structured meals plans may require addressing additional barriers or else they could increase individuals' stress or feelings of helplessness.

Future clinical research should focus on the development of preventative interventions for low-income and food-insecure individuals who are vulnerable to worsening poverty-related restriction, binge eating, and obesity. Increased development of tertiary psychiatric treatments tailored towards individuals with food insecurity is necessary to address inherent limitations of current BED treatment options. To improve understanding of how to provide adequate treatment to this vulnerable population, further qualitative and quantitative work should focus on uncovering the mechanism by which poverty can trigger binge-eating episodes. It could be hypothesized that low-income individuals with food insecurity may engage in binge-eating because of restriction-related hunger, as an emotional coping strategy, in the expectation of future deprivation, or a combination of these and other reasons.

There are strengths associated the design of the present study. The utilization of Mechanical Turk as a participant recruitment platform allowed for a geographically-diverse US sample of respondents. Previous research has acknowledged the ability of Mechanical Turk to access difficult-to-reach individuals that are critical to the study of food security including low-income individuals and individuals across diverse age groups (Buhrmester et al., 2011; Leung et al., 2017).

The current findings should also be understood in the context of its limitations. Eating-disorder psychopathology, food insecurity, and height/weight were all self-reported. Importantly, research suggests that the measures included in our study demonstrate validity and reliability when compared to in-person assessments (Berg et al., 2012; Keenan, Olson, Hersey, & Parmer, 2001; Kuehn, Wilson, Perry, & Martinez, 1999). For example, the self-administered US Household Food Security Survey resulted in high agreement when compared to interviewer-administered methods within low-income populations (Kuehn et al., 1999). Moreover, measures of binge eating have reasonable agreement with interviewer-administered methods (i.e., Structured Clinical Interview for DSM Disorders (SCID) and Eating Disorder Examination interview (EDE)) among primary care patients with BED and obesity, and racially/ethnically diverse patients with BED (Barnes et al., 2011; Lydecker, White, & Grilo, 2016). Another potential limitation was the use of self-reported height and weight; research has shown, however, that reported and measured height and weight are highly correlated and that discrepancies are not related to psychopathology (White et al., 2010). Although there is no empirical evidence to support that individuals with food insecurity are more likely to have inaccuracies in reporting height and weight, this should be examined in future research.

The cross-sectional design precludes any interpretation or speculation whether there was a causal pattern of restriction and binge eating triggered by food insecurity. Future research

should seek to clarify the longitudinal relation between food security and BED, for example, by tracking fluctuations in food availability that can correspond to federal nutrition assistance programs. This understanding, in turn, could inform the development of better budgeting for predicting periods throughout the month in which risk for dietary restriction and binge eating is highest. Generalizability of our findings to those outside of the US is not known.

Theories supporting the food stamp cycle as a potential mechanism for binge-eating behaviors following food insecurity suggest that monthly allocation of federal food benefits have the potential to exacerbate the risk of BED among low-income individuals (Bove & Olson, 2006; Burns, 2004 ; Cook, 2002; Dinour et al., 2007; Wilde & Peterman, 2006). Current systems in place for distribution for federally-funded nutrition benefits could be adjusted to better accommodate the reality of food insecurity. For example, staggered allocation of food benefits or educational resources focused on household budgeting could potentially alleviate the strain of cyclical food deprivation and abundance associated with food insecurity among individuals receiving nutrition assistance. To further support policy revisions, qualitative research found that recipients of the federal Supplemental Nutrition Assistance Program (SNAP) program favored increased benefit allowance, funding in support of nutrition education programs, and checks in place to incentivize healthy food and de-incentivize unhealthy foods as potential ways to increase the effectiveness of the program (Leung et al., 2017).

The present study demonstrated that overconsumption associated with food insecurity has the subjective loss of control, frequency, and psychopathology that are consistent with binge-eating episodes as defined by diagnostic criteria for BED. Further, our results add to the literature that suggests food insecurity is associated with obesity. These findings emphasize food insecurity as a pressing public health issue with the potential to impart physical and psychiatric harm among low-income Americans. Therefore, health care professionals and policy makers should intervene to prevent food-insecurity-related obesity and BED and, ultimately, improve the health of this vulnerable population. These findings highlight the need to devote resources towards policy revisions and research aimed at clarifying mechanisms involved in the relation between food insecurity, weight, and BED. The development of preventative interventions and psychiatric treatments would aid in decreasing the overall impact of food insecurity and the associated possible risk of BED and obesity among low-income Americans with food insecurity.

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Figure1:
Percentage of respondents within BED, HW, and OB study groups endorsing food security items

Table 1.
Demographic characteristics of participants in Binge-eating disorder (BED), Healthy-weight (HW), and Obesity (OB) groups

Characteristic	BED (<i>n</i> = 85)	HW (<i>n</i> = 710)	OB (<i>n</i> = 456)	^a <i>p</i>	^b <i>Post-hoc tests</i>
Age (years)	34.44 ± 10.15	34.16 ± 11.29	37.45 ± 11.76	< .001	HW < OB
Sex				.576	
Male	23 (27.06%)	232 (32.68%)	147 (32.31%)		<i>ns</i>
Female	62 (72.94%)	478 (67.32%)	308 (67.69%)		<i>ns</i>
Ethnicity				.057	
Non-Hispanic White	62 (72.94%)	461 (64.93%)	317 (69.52%)		<i>ns</i>
Hispanic / Latino	18 (21.18%)	146 (20.56%)	94 (20.61%)		<i>ns</i>
Non-Hispanic Other	5 (5.88%)	103 (14.51%)	45 (9.86%)		HW > BED, OB
BMI (kg/m ²)	33.41 ± 8.54	22.12 ± 1.71	36.21 ± 5.74	< .001	OB > BED > HW
Education				.003	
High school/GED	10 (11.76%)	76 (10.70%)	74 (16.23%)		HW < OB
Some college/associate	33 (38.82%)	225 (31.69%)	169 (37.06%)		<i>ns</i>
College degree	32 (37.65%)	272 (38.31%)	131 (28.73%)		HW > OB
Post-college	10 (11.76%)	137 (19.30%)	82 (17.98%)		<i>ns</i>

Note. Table values are mean ± standard deviation for continuous variables and *n* (column %) for categorical variables. HW = healthy-weight; BED = binge-eating disorder; OB = obesity; BMI = body mass index. BMI was calculated using self-reported height and weight.

^a *p*-value is for ANOVA (continuous variables) or chi-square test (categorical variables).

^b post-hoc tests for continuous variables used a Tukey HSD correction for multiple comparisons; *ns* = not significant.

Table 2.

Unadjusted Associations between Study Variables and Food Security Status

Characteristic	<i>n</i>	Food Secure (<i>n</i> = 829)	Low Food Secure (<i>n</i> = 231)	Very Low Food Secure (<i>n</i> = 191)	^a <i>p</i>	Post-hoc tests ^b
Study Group						
Healthy Weight (HW)	710	503 (70.85%)	115 (16.20%)	92 (12.96%)	.001	FS > L, VL
Binge-eating Disorder (BED)	85	45 (52.94%)	24 (28.24%)	16 (18.82%)		FS > L
Obesity (OB)	456	281 (61.76%)	92 (20.22%)	83 (18.20%)		FS > VL
Age (years)	1251	36.26 ± 11.61	32.91 ± 10.62	34.53 ± 11.49	< .001	FS > L
Sex						
Male	402	280 (69.65%)	69 (17.16%)	53 (13.18%)	.209	<i>ns</i>
Female	848	549 (64.74%)	162 (19.10%)	137 (16.16%)		<i>ns</i>
Race/ethnicity						
Non-Hispanic White	940	580 (69.13%)	139 (16.57%)	121 (14.40%)	.044	FS > L
Hispanic / Latino	258	154 (59.69%)	58 (22.48%)	46 (17.83%)		FS > L
Non-Hispanic Other	153	95 (62.09%)	34 (22.22%)	24 (15.69%)		<i>ns</i>
BMI	1251	27.46 ± 7.91	28.50 ± 7.70	29.86 ± 8.75	< .001	FS < VL
Education						
High school/GED	160	90 (56.25%)	30 (18.75%)	40 (25.00%)	< .001	FS, L > VL
Some college/associate's	427	253 (59.25%)	89 (20.84%)	85 (19.91%)		FS > L, VL
College degree	434	315 (72.58%)	79 (18.20%)	41 (9.43%)		FS, L > VL
Post-college	229	171 (74.67%)	33 (14.41%)	25 (10.92%)		FS > L, VL

Note. Table values are mean ± standard deviations for continuous variables and *n* (row %) for categorical variables. FS = food security; L = low food security; VL = very low food security; BMI = body mass index. BMI was calculated using self-reported height and weight.

^a *p*-value is for ANOVA (continuous variables) or chi-square test (categorical variables).

^b post-hoc tests for continuous variables used a Tukey HSD correction for multiple comparisons; *ns* = not significant.

Table 3.

Hierarchical logistic regression: multivariable associations between food security status, binge-eating disorder and obesity

	Step 1		Step 2	
	<i>p</i>	OR (95% CI)	<i>p</i>	OR (95% CI)
HW vs. BED				
Female	.426	1.23 (0.74 – 2.05)	.473	1.21 (0.72 – 2.02)
Age	.924	1.00 (0.98 – 1.02)	.583	1.01 (0.99 – 1.03)
Hispanic	.611	0.86 (0.48 – 1.54)	.547	0.84 (0.47 – 1.50)
Non-Hispanic/Non-White	.041	0.38 (0.15 – 0.96)	.035	0.36 (0.14 – 0.93)
Some college	.831	1.09 (0.51 – 2.32)	0.758	1.13 (0.52 – 2.43)
College	.724	0.87 (0.41 – 1.87)	0.941	0.97 (0.45 – 2.12)
Post-college	.225	0.56 (0.22 – 1.42)	0.354	0.64 (0.25 – 1.64)
Low Food Security			.001	2.45 (1.42 – 4.24)
Very Low Food Security			.046	1.91 (1.01 – 3.61)
HW vs. OB				
Female	.704	0.95 (0.74 – 1.23)	.600	0.93 (0.72 – 1.21)
Age	<.001	1.02 (1.01 – 1.03)	<.001	1.03 (1.02 – 1.04)
Hispanic	.995	1.00 (0.74 – 1.36)	.817	0.96 (0.71 – 1.31)
Non-Hispanic/Non-White	.067	0.70 (0.47 – 1.03)	.042	0.67 (0.45 – 0.99)
Some college	.185	0.77 (0.53 – 1.13)	.224	0.79 (0.54 – 1.16)
College	.001	0.50 (0.34 – 0.74)	.002	0.54 (0.37 – 0.8)
Post-college	.017	0.59 (0.39 – 0.91)	.042	0.64 (0.42 – 0.98)
Low Food Security			.007	1.56 (1.13 – 2.15)
Very Low Food Security			.013	1.55 (1.10 – 2.18)

Note. Step 1 variables included sex, age, education level, and ethnicity. Food security was entered in Step 2 to assess whether food security status influenced the OB and BED group membership above and beyond the effect of demographic variables entered previously. Bolded values indicate significant odds ratios (OR). Reference groups for categorical variables were: male (sex), White (race/ethnicity), high school (education), food security (food insecurity). Bolded values indicate $p < .05$.