






# Food insecurity associated with elevated eating disorder symptoms, impairment, and eating disorder diagnoses in an American University student sample before and during the beginning of the COVID-19 pandemic

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## Abstract

**Objective:** This study tested the association between food insecurity and eating disorder (ED) pathology, including probable ED diagnosis, among two cohorts of university students before and during the beginning of the COVID-19 pandemic.

**Method:** Students ( $n = 579$ ) from a large Midwestern American university completed self-report questionnaires assessing frequency of ED behaviors, ED-related impairment, and individual food insecurity as measured by the Eating Disorder Diagnostic Scale 5, Clinical Impairment Assessment, and Radimer/Cornell, respectively. Chi-square tests and MANOVA with post-hoc corrections were conducted to compare demographic characteristics, ED pathology, and probable ED diagnosis prevalence between students with and without individual food insecurity.

**Results:** Partially supporting hypotheses, MANOVA indicated significantly greater frequency of objective binge eating, compensatory fasting, and ED-related impairment for students with food insecurity compared with individuals without food insecurity. Chi-squared tests showed higher prevalence of ED diagnoses among individuals with food insecurity compared with those without food security (47.6 vs. 31.1%, respectively,  $p < .01$ ,  $NNT = 6.06$ ), specifically bulimia nervosa and other specified feeding and eating disorder. There were no differences in food insecurity before or during the beginning of the COVID-19 pandemic.

**Discussion:** Consistent with prior literature, food insecurity was associated with elevated ED psychopathology in this sample. Findings emphasize the importance of proper ED screening for college students vulnerable to food insecurity and EDs.

## KEYWORDS

COVID-19, eating disorders, food insecurity, university students

Food insecurity, or limited or uncertain access to nutritionally adequate food needed to sustain health, is a significant public health concern that is associated with numerous physical and mental health

problems, including diabetes, depression, anxiety, suicidal ideation, and eating disorder pathology (Gundersen & Ziliak, 2015; Holben & Pheley, 2006; Myers, 2020). Food insecurity has been associated with

greater frequency of binge eating (e.g., Becker, Middlemass, Gomez, & Martinez-Abrego, 2019; Becker, Middlemass, Taylor, Johnson, & Gomez, 2017; Bruening, MacLehose, Loth, Story, & Neumark-Sztainer, 2012; Rasmusson, Lydecker, Coffino, White, & Grilo, 2019) and compensatory behaviors (e.g., Becker et al., 2017, 2019), as well as increased shape and weight concerns (Hooper, Telke, Larson, Mason, & Neumark-Sztainer, 2020; Stinson et al., 2018; West, Goldschmidt, Mason, & Neumark-Sztainer, 2019; Zickgraf et al., 2019). This may occur because food insecurity often leads to alternating periods of food deprivation and food access, which may mimic the physiological and behavioral effects of dieting and promote overeating behaviors due to the effects of increased hunger drives. Overeating, in turn, may further promote compensatory and dieting behaviors in an effort to prevent the effects of binge eating on body weight and shape (Stinson et al., 2018; West et al., 2019). Indeed, dieting leads to increased likelihood of binge eating due to prolonged physiological hunger and abstinence violation effects. Binge eating, in turn, further reinforces the perceived need to diet to compensate for calories consumed in cultures that emphasize thinness (e.g., Steiger & Bruce, 2007; Stein et al., 2007).

Consequently, individuals with food insecurity are at a higher risk for eating disorders (EDs). For example, two studies found that approximately 17% of individuals with severe food insecurity met criteria for an ED (Becker et al., 2017, 2019). Furthermore, people with food insecurity were more likely to have a diagnosis of bulimia nervosa (Lydecker & Grilo, 2019) or binge-eating disorder (Rasmusson et al., 2019) compared with those who were food secure.

## 1 | FOOD INSECURITY IN UNIVERSITY STUDENT POPULATIONS

University students may be vulnerable to experiencing food insecurity due to demands on financial resources, such as high costs of tuition, housing, and books (Carnevale, Smith, Melton, & Price, 2015; Senack & Donoghue, 2016; Walizer, 2018). Such demands could lead to lower food budgets, reduced food intake, and consumption of inexpensive, energy-dense foods (e.g., soft drinks, fast food) that have low nutritional value (Bruening et al., 2012). College students also must balance the time commitments of employment with their studies, which limits their earning power. A multi-institution study of food insecurity prevalence among college students found that approximately 19% of participants were food insecure, with an additional 25.3% at risk for food insecurity (El Zein et al., 2019). Furthermore, Payne-Sturges, Tjaden, Caldeira, Vincent, and Arria (2018) found prevalence of food insecurity in an undergraduate sample to be higher than the prevalence of food insecurity among community members in the same area.

Food insecurity among university students also has been associated with a myriad of negative educational outcomes such as lower academic achievement and grade point averages, behavioral and attention problems, adverse psychosocial development, and greater risk of leaving college without graduating (e.g., Alaimo, Olson, & Frongillo, 2001; Cook & Frank, 2008; Maroto, Snelling, & Linck, 2015;

Martinez, Frongillo, Leung, & Ritchie, 2018; Silva et al., 2017). Additionally, because race and ethnicity are correlated with socioeconomic status in the United States, some racial and ethnic minority students may have an increased likelihood of experiencing food insecurity, impacting academic achievement among these groups and highlighting institutional disparities (Payne-Sturges et al., 2018; West et al., 2019).

A recent study on food insecurity in college students found that individuals with food insecurity are more likely to screen positive for an ED (Barry, Sonnevill, & Leung, 2019); however, this study utilized the SCOFF measure (Morgan, Reid, & Lacey, 2000), which does not provide information about specific diagnoses. The present study will attempt to replicate prior work suggesting that food insecurity status is associated with increased ED pathology and frequency of ED behaviors (e.g., binge eating, purging, compensatory fasting, excessive exercise), as well as extend prior research to include a rigorous screening measure that indicates probable specific diagnoses in a university sample.

## 2 | FOOD INSECURITY DURING THE TIME OF COVID-19

In addition, we will evaluate the influence of the COVID-19 stay-at-home orders on food security status. In an online survey conducted in Vermont following a statewide “stay-at-home” order (March 24, 2020), researchers found that, among 3,219 respondents, there was a 32.3% increase in food insecurity between the year preceding the COVID-19 pandemic and after the outbreak (Niles et al., 2020). The authors hypothesized that increasing barriers to food access, such as lower food availability, loss of access to food programs, and increased food and/or food delivery costs may exacerbate food insecurity. University students may be particularly vulnerable to food insecurity, as they depend on university meal plans and cafeterias for a reliable source of nutrition. Thus, this study will additionally examine changes in food insecurity prevalence from December 2019 to early March 2020 compared with mid-April 2020, when economic strains from COVID-19 were beginning to appear. Finally, given the emerging research suggesting that people are reporting increased ED symptoms during the COVID-19 pandemic as compared with before the pandemic (e.g., Phillipou et al., 2020), this study will also test for differences in prevalence of ED diagnoses between the two cohorts.

**H1.** : We predicted that there would be significantly more people with food insecurity in the subset of students sampled during COVID-19 stay-at-home orders (mid-April 2020) compared with those who were sampled before the beginning of the crisis (December 2019 to early March 2020), after controlling for demographic differences between the two samples.

**H2.** : We predicted that, compared with those with no food insecurity, students with food insecurity would report more objective binge-eating episodes, subjective binge-eating episodes, and

compensatory behaviors. Furthermore, we predicted that students with food insecurity would report higher levels of impairment from ED symptoms.

**H3.** : We predicted that students with food insecurity would be more likely to have a diagnosis of bulimia nervosa, binge-eating disorder, or other specified feeding or eating disorder than students with no food insecurity.

### 3 | METHODS

#### 3.1 | Participants

Two samples of students from the University of Kansas (KU) were recruited to take part in an online study of eating concerns, body image issues, and weight concerns in university students ( $N = 579$ ;  $M_{\text{age}} = 21.75$ ,  $SD = 5.27$ , range = 18–78). Of the 723 initiated surveys, 583 surveys were completed. The final analytic sample consisted of 579 responses (Table 1). With regards to general characteristics of KU students, median family income is \$125,000 (Aisch, Buchana, Cox, & Quealy, 2017) and 69% of students receive some type of financial aid (University of Kansas, 2017). In terms of racial diversity, in 2020, 68.3% of students identified as White, 4.4% as Black or African-American, 8.5% as Hispanic, and 5.1% as Asian (University of Kansas Analytics and Institutional Research, 2020).

#### 3.2 | Procedures

The institutional review board approved all study procedures. Participants were recruited through mass emails to random subsets of university students sent by KU's Office of Analytics and Institutional Research (AIR). AIR randomly generated subsets of students from the master list of enrolled students, stratified by race, ethnicity, and gender. Participants were also recruited from fliers, bus ads, and social media ads. Participants were informed that the purpose of the study was to assess disordered eating in university students and were encouraged to participate even if they did not have eating, body image, and weight concerns. After providing informed consent, participants completed all questionnaire measures online using Qualtrics or the REDCap database system. The survey was confidential and voluntary. Participants had the option to provide their first name, email, and phone number to be contacted for ED treatment or participation in future research. The first sample was recruited from December 9 to March 5, 2020. The second sample was recruited from April 13 to 27, 2020. Both samples received identical recruitment materials and group membership was non-overlapping.

At KU, the decision to move to a fully online format for the remainder of the spring 2020 semester was communicated by the Chancellor on March 17, 2020 and student housing began closing through a tiered process on March 20 (University of Kansas Student Housing, 2020). All students living in university housing, except those with extenuating circumstances (e.g., international students, those

**TABLE 1** demographic characteristics of sample

	<i>n</i>	<i>M (SD)</i>
Age	563	21.8 (5.3)
BMI	574	25.1 (5.9)
	<i>n</i>	%
Gender		
Male	128	22.2
Female	440	76.3
Other gender identity	9	1.6
Ethnicity		
Hispanic	52	9.0
Non-Hispanic	527	91.0
Race		
White	487	84.1
Black or African American	20	3.5
American Indian or Alaskan native	6	1.0
Asian or Pacific islander	32	5.5
Multiracial	30	5.2
Did not indicate	4	0.7
Timing of survey		
Pre-COVID-19	222	38.3
COVID-19 lockdown	357	61.7
Years of post-high school education		
<1 year	117	20.3
1 year	108	18.7
2 years	112	19.4
3 years	127	22.0
4 years	57	9.9
5 years	14	2.4
6 or more years	29	5.0
Continuing education student	13	2.3
Food insecurity status		
No food insecurity	306	52.8
Household food insecurity only	38	6.6
Individual food insecurity	235	40.6

*Note:* Table 1 contains the demographic characteristics of the analytic sample ( $N = 579$ ). The sample sizes varied due to missing values for the following variables: age ( $n = 563$ ), BMI ( $n = 574$ ), gender ( $n = 577$ ), and education ( $n = 577$ ).

with health or safety risks at their permanent address) were required to leave student housing for the remainder of the semester. In the 2019–2020 school year, 60.6% of the student body was from Kansas (University of Kansas Analytics and Institutional Research, 2020). The Governor of Kansas established a statewide stay-at-home order from March 28 to May 3 (Executive Order No. 20–24, 2020); furthermore, as of the date of the survey, all but 10 American states had statewide stay-at-home orders (Mervosh & Lu, 2020). Therefore, the majority of the second sample respondents were likely to be under stay-at-home orders at the time of survey completion.

### 3.3 | Measures

The present study is a secondary analysis of data collected during a screening of ED behaviors among students. Thus, the collected questionnaire measures reflect the aims of the original study.

#### 3.3.1 | Questionnaires

##### *Demographics*

Participants answered questions regarding age, race, ethnicity, gender, and level of education.

##### *The Clinical Impairment Assessment*

The Clinical Impairment Assessment (CIA) assesses the extent to which ED psychopathology interferes with an individual's functioning (Bohn et al., 2008). Respondents consider their experiences within the past 28 days when selecting their response. The CIA consists of 16 self-report items rated on a 4-point Likert scale, ranging from 0 ("Not at all") to 3 ("A lot"). A global score is calculated by summing scores on all items, with greater scores indicating higher levels of impairment. The CIA global score has been found to be a reliable measure of overall severity of impairment due to eating-related concerns and has demonstrated moderate to strong discriminant and convergent validity (Raykos, Erceg-Hurn, McEvoy, & Byrne, 2019; Reas, Rø, Kapstad, & Lask, 2010). Reas, Stedal, Dahlgren, and Rø (2016) found excellent accuracy of the global CIA score and recommended the use of a cut-off score of 16 to predict the presence of an ED. In this sample, internal consistency of the CIA was excellent,  $\alpha = .9525$ .

##### *Eating Disorder Diagnostic Scale 5*

The Eating Disorder Diagnostic Scale (EDDS) is a 22-item self-report measure that assesses DSM-5 (American Psychiatric Association, 2013) symptoms of EDs (Stice, Telch, & Rizvi, 2000). For the purposes of this study, an additional question assessing subjective binge episodes was added, while the night eating question was not used. Consistent with previous work by Becker et al. (2017, 2019), the EDDS was used to generate variables for ED behavior (i.e., objective binge eating, subjective binge eating, self-induced vomiting, laxative/diuretic use, and fasting) frequency counts and to generate probable ED diagnoses.

##### *Radimer/Cornell*

To measure food insecurity, we utilized eight items from the original version of the Radimer/Cornell hunger and food insecurity measure (Radimer, Olson, & Campbell, 1990). Each item is rated on a 5-point Likert scale, ranging from "Not at all" or "Never" to "Always." The Radimer/Cornell measure categorizes respondents into one of four categories: food secure, household food insecurity, individual food insecurity, or child hunger household. According to this framework, child hunger household (i.e., those in which children in the home experience food insecurity) is considered the most severe, followed by individual food insecurity, and household food insecurity, respectively. Following scoring recommendations made by the authors, we

classified our participants as having no food insecurity, household food insecurity, or individual food insecurity. Of note, in this scoring system, people are placed in the most severe group for which they meet criteria (e.g., someone who meets criteria for household food insecurity and individual food insecurity would be classified as having individual food insecurity).

We present analyses related to individual food insecurity only. This is because college students frequently reside in dorms or with unrelated roommates; therefore, the household subscale may not appropriately capture their food insecurity experience. We did not administer the scale items specific to child hunger, as the majority of college students do not have children; however, it should be noted that this means that students with children who may have been classified as having a child hunger household were included instead in the individual food insecurity group. In this sample, internal consistency of the individual food insecurity subscale was acceptable,  $\alpha = .75$ .

#### 3.3.2 | Probable eating disorder diagnosis

To determine probable ED diagnosis, we used information from the EDDS and CIA questionnaires. We classified individuals as having probable anorexia nervosa (AN), bulimia nervosa (BN), binge-eating disorder (BED), or other specified feeding or eating disorder (OSFED) based on their self-reported eating disorder symptoms (EDDS) and impairment resulting from their symptoms (CIA). Individuals who met the full criteria for AN, BN, or BED, as determined by the EDDS, and scored greater than or equal to 16 on the CIA were classified as having these disorders. Individuals who reported ED behaviors that did not meet the criteria for AN, BN, or BED (e.g., low-frequency BED, purging disorder, etc.) and reported significant impairment (i.e.,  $\geq 16$  on the CIA) were classified in the OSFED category. Thus, we utilized a conservative threshold for determining diagnosis, as individuals who did not report significant impairment from their symptoms were not classified as having EDs, even if behavioral symptoms were at diagnostic threshold for frequency.

Our research group has previously used similar criteria for identifying individuals with probable EDs with low rates of false positive diagnoses (i.e.,  $< 2\%$ ; Forbush et al., 2017, 2018). In an ongoing treatment study using this university student sample, the rate of false positive diagnosis (confirmed via intake interview) has been 5.1%. In the present study, the procedure used was even more conservative, in that probable diagnosis required a CIA impairment score greater than or equal to 16; whereas in our other published studies and ongoing treatment study, participants were screened if they met behavioral frequency criteria but not CIA impairment thresholds (Forbush et al., 2017, 2018).

### 3.4 | Statistical analysis

To maintain high data integrity, we utilized several data cleaning procedures. We flagged potentially invalid items (e.g., BMI of 0.8) and

responses with inconsistent patterns (e.g., discrepancies between responses measuring the same construct, such as reporting no interference in relationships on the CIA and high interference on the EDDS). We removed five participants due to potentially invalid responses.

In our analyses, we compared demographic characteristics and eating pathology of students with individual food insecurity to students without food insecurity. Of note, 6.6% of the sample ( $n = 38$ ) met criteria for household food insecurity only; because the household questions may not appropriately capture experiences of food insecurity in university students, we do not report the analyses with this group. To test differences in food insecurity status in the pre-COVID-19 and COVID-19 stay-at-home samples, we conducted stepwise logistic regression entering age in step one and timing of survey in step two. We examined differences between the food insecure and food secure samples on demographic characteristics by conducting chi-square tests (gender, ethnicity, and race) or using MANOVA (age and BMI). We chose to examine race and ethnicity specifically because these variables may have captured some of the variance associated with income level, which was not assessed in this study. Further, previous studies have found that Black and Hispanic students may be at greater risk for negative outcomes due to past and present disenfranchisement and economic barriers related to discrimination (Payne-Sturges et al., 2018; West et al., 2019).

In our MANOVA, we compared frequencies of ED behaviors (i.e., objective binge-eating episodes, subjective binge-eating episodes, excessive exercise, laxative/diuretic use, self-induced vomiting, and fasting to influence shape/weight) and ED-related impairment by food insecurity status. Finally, we conducted two chi-square tests for differences in prevalence of ED diagnoses by food insecurity status. In the first chi-square test, we compared prevalence of any ED diagnosis to no diagnosis and in the second, we compared prevalence of AN, BN, BED, OSFED, and no diagnosis. For the chi-square tests, if expected cell sizes were smaller than five, we reported the results using Fisher's exact test. We utilized post-hoc corrections to examine differences in proportions when multiple groups were included in the chi-square model (i.e., race, ED diagnosis). Missing data were handled using pairwise deletion.

## 4 | RESULTS

### 4.1 | Demographic differences

#### 4.1.1 | Pre-COVID-19 and COVID-19 stay-at-home

There were no significant differences in gender, race, ethnicity, BMI, prevalence of ED diagnosis, or prevalence of specific ED diagnoses between the pre-COVID-19 ( $n = 222$ ) and COVID-19 stay-at-home ( $n = 357$ ) cohorts; however, there was a significant difference in age, such that the pre-COVID cohort was older (Table 2).

#### 4.1.2 | Food insecurity compared with no food insecurity

Students with food insecurity ( $n = 235$ ; 52.8%) did not differ significantly from those without food insecurity ( $n = 306$ ; 40.6%) in terms of age and gender (Table 3). There were significant ethnic differences such that individuals who identified as Hispanic were more likely to report individual food insecurity than individuals who identified as non-Hispanic. Given that there were lower counts of American Indian/Alaskan Native participants and participants who did not identify their racial identity, we used Fisher's exact test to examine racial differences in food insecurity. We found that participants who identified as Black were significantly more likely to report individual food insecurity relative to other racial groups or participants who did not indicate race. Students with higher BMIs were more likely to report food insecurity than students with lower BMIs.

Logistic regression revealed no significant association between individual food insecurity status and timing of survey completion relative to the COVID-19 pandemic when adjusting for age. Our hypothesis that individual food insecurity would be higher in the COVID-19 stay-at-home sample (April 2020) compared with the pre-COVID-19 sample (December to February 2020) was not supported.

#### 4.1.3 | Individual food insecurity and eating disorder pathology

MANOVA indicated a significant overall effect of food insecurity on frequency of ED behaviors and related impairment (Table 4). Specifically, students with food insecurity reported significantly greater ED-related impairment and more frequent episodes of objective binge eating and compensatory fasting (for analyses examining the difference in the presence or absence of ED behaviors in people with and without food insecurity, refer to Supporting Information). This was consistent with our hypothesis that students with food insecurity would report increased binge eating, and partially consistent with our hypothesis that students with food insecurity would report increased compensatory behaviors compared with students without food insecurity.

Individuals with food insecurity reported significantly higher prevalence of any ED diagnosis, such that 47.6% of individuals with individual food insecurity scored positive for an ED as compared with 31.1% of individuals without food insecurity ( $p < .01$ ,  $NNT = 6.06$ ). In terms of specific diagnoses, within the food insecurity subsample, the most common ED diagnosis was OSFED (29.3%), followed by BN (16.2%), BED (1.7%), and AN (0.4%). For the food security subsample, the same order was observed, but with different frequencies: OSFED (19.3%), followed by BN (8.2%), BED (2.6%), and AN (1.0%).

As there were lower counts of individuals with AN ( $n = 4$ ) or BED ( $n = 12$ ) in this sample, we used Fisher's exact test and found that there were significant differences in ED diagnosis by food insecurity status. Students with food insecurity reported significantly higher prevalence of BN and OSFED and significantly lower prevalence of no

**TABLE 2** Demographic characteristics of pre-COVID-19 and COVID-19 stay-at-home cohort

	Pre-COVID-19 cohort (n = 222)		COVID-19 stay-at-home cohort (n = 357)		Test statistics
	n	M (SD)	n	M (SD)	
Age	214	22.8 (6.5)	349	21.1 (4.2)	$t(325.3) = 3.29, p < .01, 95\% \text{ CI} = .66, 2.62, d = -.31$
BMI	221	25.2 (6.4)	353	25.0 (5.6)	$t(572) = .48, p = .62, 95\% \text{ CI} = -.74, 1.28, d = .03$
			<b>n</b>	<b>%</b>	
Gender					<i>Fisher's exact test</i> = 1.97, $p = .37$ , <i>Cramer's V</i> = .06
Male			55	25.0	
Female			161	73.2	
Other gender identity			4	1.8	
Ethnicity					$\chi^2(1) = .80, p = .88, \psi = -.01$
Hispanic			19	8.6	
Non-Hispanic			203	91.4	
Race					<i>Fisher's exact test</i> = 7.29, $p = .19$ , <i>Cramer's V</i> = .11
White			178	80.2	
Black or African American			12	5.4	
American Indian or Alaskan native			3	1.4	
Asian or Pacific islander			16	7.2	
Multiracial			11	5.0	
Did not indicate			2	0.9	
Eating disorder diagnosis					$\chi^2(1) = 1.0, p = .34, \psi = .04$
Any eating disorder diagnosis			82	37.3	
No diagnosis			138	62.7	
Eating disorder diagnoses					<i>Fisher's exact test</i> = 2.43, $p = .69$ , <i>Cramer's V</i> = .07
Anorexia nervosa			1	0.5	
Bulimia nervosa			30	13.6	
Binge-eating disorder			6	2.7	
Other specified feeding or eating disorder			45	20.3	

Note: Percentages are reported using total for each cohort (pre-COVID-19 or COVID-19 stay-at-home) as the denominator.

ED as compared with students without food insecurity. Our prediction that individuals with food insecurity would report higher prevalence of EDs was supported by these findings; however, we did not observe differences in prevalence of BED, contrary to previous research (Lydecker & Grilo, 2019; Rasmussen et al., 2019).

## 5 | DISCUSSION

The purpose of this study was to evaluate the impact of the COVID-19 pandemic on food insecurity in a large two-cohort sample of university students and to replicate and extend previous studies linking food insecurity to EDs. We found that students surveyed during the initiation of the COVID-19 stay-at-home period did not report more food insecurity relative to students surveyed prior to COVID-19. We also found that students with food insecurity reported

greater ED-related impairment, more frequent objective binge eating, and more frequent compensatory fasting relative to students without food insecurity. Students with food insecurity had a higher prevalence of any probable ED diagnosis than those without food insecurity. Students with and without food insecurity did not differ on frequency of purging behaviors or excessive exercise. The results of our study thus partially supported our hypotheses.

Our first study hypothesis—that students would report more food insecurity during the COVID-19 stay-at-home than pre-COVID-19—was not supported, even after adjusting for cohort differences in age. There are several reasons why our first hypothesis may not have been supported. First, as the data show, the prevalence of food insecurity was high in this university sample, regardless of survey timing, with an overall prevalence of 40.6% of students meeting criteria for individual food insecurity. Past studies found that 15–21% of college students from public universities were food insecure with an additional

**TABLE 3** Demographic differences by food insecurity status

	No food insecurity (n = 306)		Food insecurity (n = 235)		Test statistics
	M (SD)		M (SD)		
Age	21.4 (4.4)		22.0 (5.1)		<i>Partial <math>\eta^2</math> = .00, p = .15</i>
BMI	24.6 (5.4)		25.9 (6.7)		<b><i>Partial <math>\eta^2</math> = .01, p = .02</i></b>
	<i>n</i>	<i>%</i>	<i>n</i>	<i>%</i>	
Gender					<i>Fisher's exact test = 3.88, p = .15, Cramer's V = .08</i>
Male	77	25.2	43	18.5	
Female	225	73.5	185	79.4	
Other gender identity	4	1.3	5	2.1	
Ethnicity					<b><i><math>\chi^2</math> (1) = 4.11, p = .05, <math>\psi = -.09</math></i></b>
Hispanic	20	6.5	27 <sup>a</sup>	11.5	
Non-Hispanic	286	93.5	208	88.5	
					<b><i>Fisher's exact test = 16.78, p &lt; .01, Cramer's V = .17</i></b>
White	264	86.3	194	82.6	
Black or African American	3	1.0	15 <sup>a</sup>	6.4	
American Indian or Alaskan native	2	0.7	3	1.3	
Asian or Pacific islander	22	7.2	8	3.4	
Multiracial	14	4.6	14	6.0	
Did not indicate	1	0.3	1	0.4	
Timing of survey <sup>b</sup>					<i>B = -.17, SE = .18, p = .36, OR = .85</i>
Pre-COVID-19	109	35.6	98	41.7	
COVID-19 stay-at-home	197	64.4	137	58.3	

Note: Bolded values indicate statistically significant test statistics. Percentages are reported using total for each sample (no food insecurity or individual food insecurity) as the denominator. The sample sizes for age and BMI varied due to missing values (no food insecurity group  $n = 287$ , food insecurity group  $n = 213$ ).

<sup>a</sup>Indicates a statistically significant higher prevalence in this group after post-hoc corrections compared with expected values.

<sup>b</sup>Age entered as a control variable in logistic regression.

16–24% “at risk” of food insecurity (Chaparro, Zaghoul, Holck, & Dobbs, 2009; Payne-Sturges et al., 2018); 56% of students attending urban community colleges (Bruening, Brennhofner, Van Woerden, Todd, & Laska, 2016) and 59% of students attending rural colleges reported food insecurity (e.g., Patton-López, López-Cevallos, Cancel-Tirado, & Vazquez, 2014). Given that we found high prevalence of food insecurity across cohorts, there may have been range restriction that prevented detection of significant effects between groups. Extraneous contextual variables also may have influenced our ability to detect cohort-based differences in food insecurity. For example, in our first cohort, many students were tested toward the end of the semester (December), whereas for the second cohort, students were tested during mid-semester (April). To the extent that students receive “lump sum” financial aid that includes money for lodging and food, students' funds may be more likely to run out at the end of the term, which would impact ability to afford food. Lack of funds for food is particularly salient for students who are not residing in the dorm and pay for their food per diem, instead of paying for a full semester of residence dining. Indeed, approximately 6% more students reported food insecurity in the first cohort versus the second cohort, which may indicate semester timing effects affected our results. In addition, we surveyed students 2 weeks after the COVID-19 shelter-in-place

orders went into effect in Kansas. Although the majority of the United States was under stay-at-home orders at the time of survey administration, the timing of our survey may have been too early to observe effects of food insecurity on university students. Finally, KU had several resources in place at the time to address student food insecurity; however it is unclear to extent to which this may have impacted food insecurity differences between the two cohorts. The KU Campus Cupboard (free food pantry) closed in March 2020 at the onset of the pandemic; however students could apply to the KU Emergency Aid Network for funds to cover food and housing expenses due to lost employment opportunities. KU additionally awarded 45 meal plans after March 16, 2020 to aid students experiencing food insecurity.

Our second and third hypotheses were related to associations of food insecurity with eating-disorder-related variables. Most of our hypotheses were supported. Specifically, we found that students reporting food insecurity had significantly more objective binge-eating episodes, compensatory fasting episodes, and ED-related clinical impairment compared with their non-food-insecure counterparts. We also found that students with food insecurity were more likely to meet diagnostic criteria for probable bulimia nervosa or “other specified feeding or eating disorder.” Overall, we found higher prevalence of probable EDs in the food insecure group as compared with the

**TABLE 4** Eating disorder pathology by food insecurity status

	No food insecurity ( <i>n</i> = 306)		Food insecurity ( <i>n</i> = 235)		Test statistics
	<i>M</i> ( <i>SD</i> )		<i>M</i> ( <i>SD</i> )		
<i>Eating disorder behaviors</i>					
Objective binge-eating episode	1.6 (3.6)		2.5 (4.3)		<b>Partial <math>\eta^2 = .02, p = .01</math></b>
Subjective binge-eating episode	2.2 (3.9)		2.8 (4.3)		Partial $\eta^2 = .01, p = .13$
Self-induced vomiting	0.4 (1.9)		0.5 (1.8)		Partial $\eta^2 = .00, p = .62$
Laxative or diuretic use	0.3 (1.6)		0.4 (1.7)		Partial $\eta^2 = .00, p = .42$
Compensatory fasting	2.7 (4.4)		3.9 (5.1)		<b>Partial <math>\eta^2 = .02, p &lt; .01</math></b>
Excessive exercise	2.4 (4.3)		2.6 (4.3)		Partial $\eta^2 = .00, p = .65$
<i>Eating disorder-related impairment</i>	13.5 (11.1)		17.9 (11.5)		<b>Partial <math>\eta^2 = .04, p &lt; .01</math></b>
	<i>n</i>	%	<i>n</i>	%	
<i>Eating disorder diagnosis (dichotomous)</i>					
Any eating disorder diagnosis	95	31.1	109 <sup>a</sup>	47.6	<b><math>\chi^2(1) = 14.99, p &lt; .01, NNT = 6.06</math></b>
No diagnosis	210	68.9	120	52.4	
<i>Eating disorder diagnoses</i>					
Anorexia nervosa	6	2.0	1	0.4	<b>Fisher's exact test = 22.39, <i>p</i> &lt; .01, Cramer's <i>V</i> = .21</b>
Bulimia nervosa	25	8.2	37 <sup>a</sup>	16.2	
Binge-eating disorder	8	2.6	4	1.7	
Other specified feeding or eating disorder	56	18.4	67 <sup>a</sup>	29.3	

Note: Bolded values indicate statistically significant test statistics. Percentages are reported using total for each sample (no food insecurity or individual food insecurity) as the denominator. For the analysis examining ED behaviors, the sample sizes varied due to missing values (no food insecurity group *n* = 287, food insecurity group *n* = 213).

<sup>a</sup>Indicates a statistically significant higher prevalence rate in this group after post-hoc corrections compared with expected values.

food secure group (47.6 vs. 31.1%, respectively). Our results generally supported past studies that found higher prevalence of binge eating among food insecure populations (Becker et al., 2017, 2019). However, contrary to our hypotheses and past research, we did not find an association between food insecurity and frequency of purging or excessive exercise (Becker et al., 2017, 2019). This important difference relative to Becker and colleagues' research may reflect the greater severity of their samples (i.e., greater representation of individuals with child hunger food insecurity). Therefore, it is possible that greater severity of food insecurity is associated with more frequent purging and excessive exercise, whereas lower levels of food insecurity are not. Importantly, our sample was significantly different from that of Becker et al. who recruited a low-income, marginalized population from a local food bank. By contrast, our study sample was younger, less ethnically and racially diverse, reported higher levels of education, and had a higher percentage of women.

We also did not observe significant differences between food insecure and non-insecure students on subjective binge eating, whereas other research found that food insecure populations reported higher loss-of-control eating (Becker et al., 2017; Stinson et al., 2018). However, Stinson et al. (2018) did not directly measure subjective binge eating; therefore, it is possible that Stinson et al.'s findings were driven by the relationship between objective binge eating and food insecurity rather than a specific association between subjective binge eating and food insecurity. In contrast, Becker

et al. (2017) measured subjective binge eating and reported a relationship between subjective binge eating and food insecurity; therefore, the possibility of a unique relationship between subjective binge eating and food insecurity warrants further investigation.

Finally, students with food insecurity did not differ from non-food-insecure students on prevalence of binge-eating disorder, which is at odds with previous research that linked binge-eating disorder to food insecurity in adults (Rasmusson et al., 2019). One reason for this contrast could be that Rasmusson et al. (2019) utilized a web-recruited sample rather than a university sample. Relatedly, the mean age for our sample was over 10 years younger than that of Rasmusson et al. Our results for binge-eating disorder may also differ from previous studies because we had relatively low prevalence of binge-eating disorder in our sample (*n* = 12), which may have limited our ability to detect significant association with food insecurity due to low power. Similarly, we had few participants with anorexia nervosa (*n* = 7) in our sample, making it difficult to test for differences in the prevalence of this diagnosis.

## 6 | LIMITATIONS

This study's focus on associations between food insecurity and ED symptoms in university students is timely, given the impact of COVID-19 on food security status and higher education in the United



States. Nevertheless, several limitations should be considered when interpreting the findings. First, we used the original version of the Radimer/Cornell Scale that differs slightly in wording and scoring from the validated version of this instrument (Kendall, Olson, & Frongillo Jr, 1995). The measure also did not contain an instruction about time frame, which means that participants may have interpreted the question differently, influencing their responses. Second, because this was a secondary analysis of data collected in a study screening for ED prevalence, we did not have information about household composition or place of residence (e.g., dorm, apartment, living at home with family), which limited our ability to examine household food security status. The primary study also did not collect information about financial assistance participants might have been receiving from the university or outside sources. Third, although we employed a rigorous approach to determining probable ED diagnoses that incorporated both symptom status and clinical impairment, our reliance on self-report questionnaires may have inflated estimations of ED psychopathology in the sample relative to a diagnostic interview. However, some research suggests that increased symptom reporting on questionnaire assessments may be due, in part, to participants' increased candor when they feel their responses are more anonymous rather than artificial inflation of psychopathology (Keel, Crow, Davis, & Mitchell, 2002). Furthermore, due to the recruitment method, our sample may have been subject to sampling bias, such that people with more severe ED symptoms completed the survey; however, this concern may be mitigated because we were studying the association between food insecurity and ED symptoms, which has shown linear relationships in previous studies. Fourth, these are cross-sectional associations and not longitudinal, therefore we cannot determine the directionality of the association between food insecurity and ED symptoms. Finally, systems of higher education vary across countries and the financial burdens experienced by university students in the United States—and their potential impacts on food security status—may not apply in other nations. Future studies that include samples from multiple countries are needed to explicate potential cross-national differences in prevalence of food insecurity, and associations between food insecurity and ED symptoms, among university students. Additionally, our study was relatively homogeneous in terms of race and ethnicity and had lower representation of Black, Asian, and Hispanic students compared with national university enrollment statistics (US Census Bureau, 2017). This is a limitation given that food insecurity is more prevalent among Black and Hispanic Americans (Hernandez, Reesor, & Murillo, 2017) and limits generalizability.

## 7 | CONCLUSIONS

The present study highlights the associations between food insecurity and disordered-eating behaviors and impairment in American university students. As research continues to replicate the association between food insecurity and disordered eating (e.g., Barry et al., 2019; Becker et al., 2017, 2019; Lydecker & Grilo, 2019; Rasmusson et al., 2019), the ED field must grapple with the

significance of this public health issue. The high prevalence of food insecurity found in this study suggests the ongoing need for resources, such as food pantries and affordable dining plans, for university students. Furthermore, the finding that individuals with food insecurity are at a higher risk for EDs highlights the importance of providing ED screening for students who access these resources so that they can be referred to treatment. It is possible that by implementing ED screening, organizations that address food insecurity will be able to catch vulnerable individuals with EDs who otherwise may slip through the cracks.

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### CONFLICT OF INTEREST

The authors declare no conflicts of interest.

### DATA AVAILABILITY STATEMENT

De-identified data and statistical analysis syntax are available upon reasonable request.

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#### SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of this article.

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