

Association between Stressful Events, Sleep Patterns, Night-time Eating Behaviors, and BMI among Female University Students in Saudi Arabia

Afnan H. Saaty*, Noha M. Almoraie, Najlaa M. Aljefree, Israa M. Shatwan

Food and Nutrition Department, Faculty of Human Sciences and Design, King Abdulaziz University, Jeddah, Saudi Arabia

*Corresponding author: ahsatee@kau.edu.sa

Received December 01, 2025; Revised January 01, 2026; Accepted January 08, 2026

Abstract Healthy eating behaviors promote overall health and well-being. University students often experience lifestyle transitions that may increase the risk of poor dietary habits. Although it is known that factors such as stress, irregular sleep routines, and night-time eating patterns can adversely affect nutritional status and body mass index (BMI), the specific associations are unclear. This study aimed to examine the associations between stress, sleep patterns, night-time eating behaviors, and BMI among female university students at King Abdulaziz University, Jeddah, Saudi Arabia. Using a comparative design, data were collected at two time points during the examination period, representing stressful event and at the start of the semester, representing control period. The participants were mostly single (90%) and academically high-performing students, exhibiting varied sleep habits, with 51.6% sleeping 7–8 h/night. Approximately 41% of the participants considered themselves to be slightly physically active. Analysis of BMI-related data revealed no significant differences between BMI and most variables. However, breakfast consumption varied among weight categories, with students who were underweight consuming breakfast less frequently. Students who were underweight displayed the highest Three Factor Eating Questionnaire scores (53.6 ± 7.9). The prevalence of night-eating habits remained stable between the control and stress (examination) periods, with moderate perceived stress levels. Sleep patterns significantly influenced night-time eating behaviors. Additionally, students with sleep disorders demonstrated elevated night-time eating and stress scores during the control period. Therefore, targeted interventions that promote healthier eating habits and overall well-being are needed, potentially mitigating the impact of stress and irregular sleep patterns on eating behaviors and BMI.

Keywords: Body Mass Index (BMI), female, night eating syndrome, stress, sleep disorder

Cite This Article: Afnan H. Saaty, Noha M. Almoraie, Najlaa M. Aljefree, and Israa M. Shatwan, "Association between Stressful Events, Sleep Patterns, Night-time Eating Behaviors, and BMI among Female University Students in Saudi Arabia." *Journal of Food and Nutrition Research*, vol. 14, no. 1 (2026): 7-15. doi: 10.12691/jfmr-14-1-2.

1. Introduction

For students, life in a university represents a transitional stage marked by significant changes, including increased independence and the adoption of eating behaviors that can shape lifelong habits. [1] Recently, there has been growing interest in understanding the complex interplay between various factors that contribute to the well-being and health of university students. Among these, stress, sleep patterns, night eating behaviors, and body mass index (BMI) have been widely investigated. [2,3] College life is often associated with various stressors, such as academic pressure, social adjustment, and personal challenges, which can significantly influence an individuals' eating behavior and overall well-being. [1] Academic burnout and eating disorders can negatively affect a student's health. In addition to stress and sleep patterns, night-time eating behavior is a potential

contributing factor to weight-related issues among university students. Night eating syndrome (NES), characterized by a pattern of regular night-time eating accompanied by diminished appetite in the morning, has been associated with a higher BMI and related health problems. [4] NES was first described as morning anorexia, evening hyperphagia, and insomnia, and its onset is related to stressful events. [5] The prevalence of night eating, particularly among university students, has raised concerns regarding its potential implications for weight management and overall well-being. [6] Approximately 25% of university students worldwide are overweight or obese. [7] Several factors contribute to excess weight among these students, including but not limited to dietary habits, mental health issues, and high stress levels. [8,9,10] These factors often coexist and reinforce each other. [11,12] For example, heightened stress is associated with unhealthy eating behaviors such as increased carbohydrate and fat intake, [13,14] frequent consumption of sweet foods, [15] and a lower intake of

fruits and vegetables. [16] Conversely, an intervention study revealed a temporal connection between stress and dietary choices, as a stress management program led to a decrease in the consumption of sweet snacks. [17]

Research investigating the occurrence of NES, particularly among college students, is limited. This population is known to experience increased levels of stress, anxiety, and sleep disruptions compared with the general population. [18] NES severity is associated with higher perceived stress among college students [19] and is generally more prevalent among younger adults than older adults. [20] Among college students, elevated Beck depression scores have been linked to various NES characteristics, such as the urge to eat upon waking and cravings for food at night. Stressful events significantly influence an individual's eating habits and ability to manage weight [21]; however, studies focusing on the relationships between stressful events, sleep patterns, night eating behaviors, and body weight, particularly among female university students in Saudi Arabia, remain limited. Existing research has reported gender differences, where female students are often more vulnerable than male students in engaging in stress-related and emotional eating. They also suffer from sleep disturbances that influence eating behaviors, and report elevated signs of eating disorders. [22,23] The inclusion of only female students helps in maintaining sample homogeneity while reducing the confounding influence of gender on the study variables. Therefore, this study aimed to investigate the association between stressful events, sleep patterns, nighttime eating behaviors, and BMI among female university students in Saudi Arabia. The insights gained from this study may contribute to elucidating the factors influencing eating habits and can inform the development of targeted interventions to promote the overall well-being of university students.

2. Materials and Methods

2.1. Study Design and Participants

Female students from King Abdulaziz University in Jeddah were recruited through online and classroom announcements. Participants were selected through a stratified random sampling method from the pool of students enrolled in various academic years and colleges. Stratification was carried out according to the students' academic units, which included the Foundation Year, the Faculties of Education, Health Sciences, Humanities and Management, and Sciences. The official enrollment records provided by the university were used as the sampling frame. Invitations to participate were sent via email, directing students to an online self-administered questionnaire. The email also contained an introductory statement outlining the study's objectives, emphasizing voluntary participation, and assuring participants of data confidentiality and anonymity. Eligible participants were female students aged 18–25 years, enrolled during the study period, without chronic diseases, and not pregnant or lactating. Those meeting the inclusion criteria were informed about the study's aims and procedures and

provided written informed consent prior to participation. According to the Deanship of Admission and Registration at King Abdulaziz University, [24] the total female student population in 2021 was approximately 39,913, and the sample size calculator indicated that the sample size needed to achieve sufficient statistical power was 207, which was based on a 5% margin error, 85% confidence level, and response distribution of 50%. [25] A total of 225 female students were deemed eligible and consented to participate. Using a comparative design, data were collected from participants on two separate occasions: during the examination period (representing a stressful event) and at the beginning of the semester (the control period), before exposure to major academic stressors. Data collection took place between September 2021 and May 2022.

Ethical approval was obtained from the Biomedical Ethics Research Committee of King Abdulaziz University (approval number: 540-22), and the study was conducted in accordance with the principles outlined in the Declaration of Helsinki.

2.2. Questionnaire Design

The online survey gathered information using an Arabic questionnaire. The survey questions were based on previous research that investigated various factors related to NES such as stressful events, sleep patterns, night eating behavior, and BMI among university students in different countries. [26,27] The questionnaire was subjected to a pilot test to ensure clarity before being submitted online. Subsequently, the final version of the questionnaire was developed and distributed using Google Forms.

2.3. Demographic and Lifestyle Questionnaires

Participant lifestyle data was collected, such as age, marital status (married, single, divorced), monthly household income (<5000, 5000–15,000, >15,000 Saudi Riyals [SR]), academic year (first, second, third, fourth, fifth, and sixth), academic GPA, smoking status (non-smoker, smoker, and ex-smoker), and physical activity level (1–2 times a week, 3–4 times a week, >4 times a week, and none). Sleep patterns, including sleep duration (<6, 6–8, and >8 h), sleeping time (at night or during the day), and presence of sleeping disorders (yes or no), were evaluated. Questions about the participants' dietary habits included the number of main meals consumed per day (1, 2, or 3) and the number of times breakfast was consumed per week (rarely, 1–2 times, 3–4 times, or daily).

2.4. Anthropometric Data

Self-reported height and weight were used to calculate the participants' BMI, with BMI computed as the weight in kilograms divided by the square of the height in meters (kg/m^2). Participants were categorized into four groups: underweight (BMI: $<18.5 \text{ kg/m}^2$), normal weight (BMI: $18.5\text{--}24.9 \text{ kg/m}^2$), overweight (BMI: $25\text{--}29.9 \text{ kg/m}^2$), and obese (BMI: $\geq 30 \text{ kg/m}^2$). [28]

2.5. Night Eating Questionnaire

The Night Eating Questionnaire (NEQ), developed by Allison et al. in 2008 [29] and Peker et al. in 2016, [30] is a 17-item questionnaire specifically designed to evaluate night eating behaviors. The questionnaire covers various aspects such as eating and sleeping schedules, self-perception as a night eater, awareness of night eating, and distress associated with eating behaviors. The answers were scored on a five-point Likert scale (0–4), with a total NEQ score ranging from 0 to 52 points. A total score of ≥ 25 indicated that a person has difficulty with NES. We modified the NEQ because no established Arabic version exists. Content validity assessment was performed to ensure the suitability of the NEQ for the Saudi culture before it was translated into Arabic. Five experts in the field of food and nutrition reviewed and confirmed the questionnaire. The translation process followed the "forward-backward" technique to ensure the accuracy and appropriateness of the translated phrases. Additionally, a pilot study involving 10 participants was conducted to identify any challenges or difficulties encountered while completing the questionnaire.

2.6. Perceived Stress Scale

The Perceived Stress Scale (PSS) is a self-assessment tool that measures the psychological stress experienced in the past month. It comprises 10 items, with six items focusing on negative aspects, such as lack of control and negative reactions, and four items assessing an individual's ability to cope with stressors. Each item is rated on a 5-point Likert scale ranging from "never" to "very often." The scores for positive items were reversed, with higher scores indicating higher stress levels. The total score ranged from 0 to 40, with higher scores indicating greater perceived stress. A score of ≥ 10 indicated moderate-to-high perceived stress. The Arabic version of the PSS-10 was derived and modified based on previous studies. [31,32]

2.7. Three Factor Eating Questionnaire

The Three Factor Eating Questionnaire (TFEQ) is a comprehensive instrument designed to assess three distinct domains: cognitive restraint, uncontrolled eating, and emotional eating, with the revised 18-item version (TFEQ-R18) providing a shorter, validated format for evaluating these domains. Within the TFEQ-R18, uncontrolled eating, emotional eating, and cognitive restraint are assessed through nine, three, and six items, respectively. Respondents used a Likert scale to rate the items. Items 1 to 17 were rated on a 4-point Likert scale,

whereas item 18 employed an 8-point Likert scale. The 8-point scale for item 18 was transformed into a 4-point scale to facilitate data analysis and interpretation. This conversion involved assigning the following values: 1–2 = 1, 3–4 = 2, 5–6 = 3, and 7–8 = 4. By applying this conversion format, the responses to item 18 were aligned with the 4-point Likert scale utilized for the rest of the items in the questionnaire. This scoring methodology enabled the calculation of mean scores for each item, providing insights into the levels of cognitive restraint, uncontrolled eating, and emotional eating experienced by individuals. Furthermore, items 14–17 in the questionnaire were reverse-coded, meaning that their scoring direction was opposite to that of the other items. This reverse coding ensured the accurate interpretation and analysis of the responses. [33]

2.8. Analysis

Data were analyzed using the statistical analysis software program SPSS version 28.0 (IBM Corp., Armonk, NY, USA). Descriptive data are presented as frequencies and percentages, and quantitative variables are presented as means and standard deviations. The normality of the variables was checked using the Kolmogorov–Smirnov test, and all variables were normally distributed. The one-way analysis of variance was used to compare BMI categories for quantitative variables. For categorical variables, the chi-squared test was used to compare BMI categories. Univariate linear regression analysis was performed to predict all the associations presented in the study tables, including those between academic examination stress, sleep duration, sleeping time, sleeping disorders, night eating behavior, perceived stress, and the TFEQ scores. The confounders in the model were age, marital status, BMI, family income, smoking, physical activity, educational level, major status, and academic GPA. Statistical significance was set at 0.05.

3. Results

Table 1 presents the baseline (beginning of the semester) characteristics of the study population. The mean age, BMI, and academic GPA were 21.2 ± 1.4 years, 22.5 ± 4.7 , and 4.2 ± 0.4 out of 5 (considered a high GPA), respectively. The majority of female students in the current study were single (90%) and in their fourth year of study (38.7%). Approximately all of the students were from middle-class families (family income: 5000–15000 SAR), and 41% were slightly physically active. Regarding sleeping patterns, 51.6% slept 7–8 h/day, 83.6% slept at night, and 51.1% did not suffer from sleep disorders.

Table 1. Baseline characteristics of female university students according to BMI categories (n = 225)

Characterization	Total	Underweight (n=46)	Normal weight (n=124)	Obese (n=55)	P-value
Age, years	21.2 $\pm$ 1.4	21.2 $\pm$ 1.1	21.2 $\pm$ 1.5	21.3 $\pm$ 1.4	0.82
Material status					
Single	203 (90.2)	44 (95.7)	112 (90.3)	47 (85.5)	0.41
Married	21 (9.3)	2 (4.3)	11 (8.9)	8 (14.5)	
Divorced	1 (0.5)	0	1 (0.8)	0	
Body mass index, kg/m ²	22.5 $\pm$ 4.7	17.2 $\pm$ 0.9	21.5 $\pm$ 1.9	29.3 $\pm$ 3.5	<0.001

Characterization	Total	Underweight (n=46)	Normal weight (n=124)	Obese (n=55)	P-value
Education level					
1 st	12 (5.3)	3 (6.5)	7 (5.6)	2 (3.6)	0.26
2 nd	48 (21.3)	4 (8.7)	31 (25)	13 (23.6)	
3 rd	31 (13.8)	7 (15.2)	19 (15.3)	5 (9.1)	
4 th	87 (38.7)	24 (52.2)	44 (35.5)	19 (34.5)	
5 th	25 (11.1)	4 (8.7)	14 (11.3)	7 (12.7)	
6 th	22 (9.8)	4 (8.7)	9 (7.3)	9 (16.4)	
GPA	4.2 ± 0.4	4.4 ± 0.3	4.2 ± 0.4	4.2 ± 0.4	0.06
Family income					
< 5000	26 (11.6)	5 (10.9)	13 (10.5)	8 (14.5)	0.85
5000–15000	116 (51.6)	24 (52.2)	67 (54)	25 (45.5)	
> 15000	83 (36.9)	17 (37)	44 (35.5)	22 (40)	
Smoking status					
Non-smoker	214 (95.1)	44 (95.7)	120 (96.8)	50 (90.9)	0.34
Smoker	8 (3.6)	2 (4.3)	2 (1.6)	4 (7.3)	
Ex-smoker	3 (1.3)	0	2 (1.6)	1 (1.8)	
Physical activity, per week					
Inactive	64 (28.4)	17 (37)	36 (29)	11 (20)	0.52
1–2 times	93 (41.3)	19 (41.3)	48 (38.7)	26 (47.3)	
3–4 times	48 (21.3)	8 (17.4)	27 (21.8)	13 (23.6)	
> 4 times	20 (8.9)	2 (4.3)	13 (10.5)	5 (9.1)	
Sleep duration					
< 6 h	70 (31.1)	15 (32.6)	38 (30.6)	17 (30.9)	0.77
7–8 h	116 (51.6)	21 (45.7)	64 (51.6)	31 (56.4)	
> 8 h	39 (17.3)	10 (21.7)	22 (17.7)	7 (12.7)	
Sleeping Time					
Night	188 (83.6)	36 (78.3)	107 (86.3)	45 (81.8)	0.42
Day	37 (16.4)	10 (21.7)	17 (13.7)	10 (18.2)	
Sleeping disorder					
No	115 (51.1)	17 (37)	67 (54)	31 (56.4)	0.09
Yes	110 (48.9)	29 (63)	57 (46)	24 (43.6)	
Main meals					
1 meal	30 (13.3)	7 (15.2)	18 (14.5)	5 (9.1)	0.84
2 meals	147 (65.3)	29 (63)	79 (63.7)	39 (70.9)	
3 meals	48 (21.3)	10 (21.7)	27 (21.8)	11 (20)	
Breakfast, per week					
Rarely	79 (35.1)	12 (26.1)	49 (39.5)	18 (32.7)	0.04
1–2 days	49 (21.8)	17 (37)	18 (14.5)	14 (25.5)	
3–4 days	54 (24)	8 (17.4)	30 (24.2)	16 (29.1)	
Daily	43 (19.1)	9 (19.6)	27 (21.8)	7 (12.7)	
NEQ score	19.9 ± 5.2	19.8 ± 4.1	20 ± 5.4	19.8 ± 5.5	0.95
PSS score	21.4 ± 6	22.7 ± 5.8	20.8 ± 6.2	21.4 ± 5.6	0.21
TFEQ score	50.7 ± 8.8	53.5 ± 8.9	50.8 ± 8.6	48.1 ± 8.4	0.007

Data are presented as frequencies and percentages for categorical variables and as means and standard deviations for continuous variables. Differences between BMI categories were calculated using the chi-squared test for categorical variables and the one-way analysis of variance for continuous variables.

Abbreviations: NEQ, Night Eating Questionnaire; PSS, Perceived Stress Scale; TFEQ, Three Factor Eating Questionnaire.

Data were stratified based on BMI. Overall, no significant differences were observed among BMI categories. However, a significant difference in breakfast consumption frequency between BMI categories was observed ($P=0.04$), with 37% of students who were underweight consuming breakfast 1–2 times/week compared with 39.5% and 32.7% of students with normal

weight and obesity, respectively, who rarely consumed breakfast. Significant differences were observed in the TFEQ score among students who were underweight (53.6 ± 7.9) compared with those who were normal weight (51.1 ± 8.9) and overweight (48.1 ± 8.4 , $P=0.01$). The percentages of night time-eating students were 19.4% and 18.4% during the control and academic examination stress periods, respectively ($P>0.05$). The majority of students had a moderate level of perceived stress (68.8 %), followed by high stress (21.8 %) and low stress (8.4%). Academic examinations did not affect the level of stress among students (data not shown).

Table 2 presents the effects of academic examination stress on the NEQ, PSS, and TFEQ scores, and BMI. No significant differences were observed in any of these scores between the control and exam periods, suggesting

that short-term examination stress did not affect eating behaviors, perceived stress or weight status among participants.

Table 3 shows the associations between sleep duration and NEQ, PSS, TFEQ scores, and BMI during the control and exam periods. Students who slept < 6 h or > 8 h exhibited slightly greater NEQ and PSS mean scores, compared to the group who slept 7–8 h; however, these differences were not statistically significant. In contrast, BMI showed a significant association with sleep duration; BMI decreased as sleeping duration increased during the exam period ($P = 0.03$). The BMI for students sleeping > 8 h and < 6 h was $20.7 \pm 3.4 \text{ kg/m}^2$ and $23.3 \pm 5.2 \text{ kg/m}^2$, respectively. The same trend was observed during the control period but it is not statistically significant ($P = 0.19$). Furthermore, sleep duration did not affect the NEQ, PSS, and TFEQ scores.

Table 2. Association between academic examination stress and NEQ, PSS, TFEQ scores, and BMI

Items	Control period	Exam period	Crude model	Model 1	Model 2
NEQ score	19.9 ± 5.2	20.1 ± 5.2	0.83	0.84	0.80
PSS score	21.4 ± 6	21.5 ± 5.1	0.81	0.83	0.94
TFEQ score	50.7 ± 8.8	50.8 ± 9.3	0.94	0.89	0.66
Emotional eating	8.30 ± 2.5	8.23 ± 2.5	0.78	0.74	0.86
Uncontrolled eating	24.8 ± 5.1	25 ± 5.6	0.75	0.81	0.36
Cognitive eating	17.5 ± 3.3	17.5 ± 3.2	0.97	0.97	0.91
BMI	22.5 ± 4.7	22.5 ± 4.8	0.91	0.96	0.89

P-values were calculated using linear regression analysis.

Model 1 was adjusted for age, marital status, BMI, family income, smoking status, and physical activity.

Model 2 was adjusted for Model 1 and education level, major status, and academic GPA.

Abbreviations: BMI, body mass index; NEQ, Night Eating Questionnaire; PSS, Perceived Stress Scale; TFEQ, Three Factor Eating Questionnaire.

Table 3. Association between sleep duration and NEQ, PSS, TFEQ scores, and BMI

Items	Control period				Exam period			
	< 6 h	7–8 h	> 8 h	P-value	< 6 h	7–8 h	> 8 h	P-value
NEQ score	20.6 ± 4.7	19.2 ± 5.7	20.7 ± 4.1	0.21	20.8 ± 4.7	19.2 ± 5.4	20.5 ± 5.4	0.14
PSS score	21.7 ± 5.9	20.5 ± 5.9	23.1 ± 6.3	0.14	22.2 ± 5.4	20.9 ± 4.8	21.8 ± 5.5	0.21
TFEQ score	50.1 ± 8.8	51.1 ± 8.6	50.6 ± 9.2	0.93	51.9 ± 9.5	49.6 ± 9.2	51.5 ± 9.1	0.20
BMI	23.2 ± 5.2	22.5 ± 4.6	21.5 ± 4.1	0.19	23.3 ± 5.2	22.5 ± 4.8	20.7 ± 3.4	0.03

P-values were calculated using linear regression analysis. P-values were adjusted for age, marital status, BMI, family income, smoking, physical activity, education level, major status, and academic GPA.

Abbreviations: BMI, body mass index; NEQ, Night Eating Questionnaire; PSS, Perceived Stress Scale; TFEQ, Three Factor Eating Questionnaire.

Sleeping time (night vs. day) influenced night eating habits (Table 4). Students who slept during the day had higher NEQ scores than those who slept at night ($P = 0.02$). This effect was similar to that observed during the control and exam periods, which suggests a consistent association between daytime sleep and night eating.

Table 4. Association between sleeping time and NEQ, PSS, TFEQ scores, and BMI

Items	Control period			Exam period		
	Night	Day	P-value	Night	Day	P-value
NEQ score	19.5 ± 5.1	22 ± 5.6	0.02	19.5 ± 5.4	21.6 ± 4.2	0.02
PSS score	21.5 ± 5.9	22.1 ± 6.3	0.55	21.4 ± 4.9	21.7 ± 5.8	0.55
TFEQ score	50.8 ± 8.8	50 ± 8.8	0.88	50.8 ± 9.2	50.5 ± 9.5	0.83
BMI	22.6 ± 4.8	22.1 ± 4.4	0.61	22.7 ± 5.0	21.9 ± 4.1	0.26

P-values were calculated using linear regression analysis. P-values were adjusted for age, marital status, BMI, family income, smoking, physical activity, education level, major status, and academic GPA.

Abbreviations: BMI, body mass index; NEQ, Night Eating Questionnaire; PSS, Perceived Stress Scale; TFEQ, Three Factor Eating Questionnaire.

Table 5 indicates that students suffering from sleep disorders had higher NEQ scores (21.7 ± 5.3) than those not suffering from sleep disorders (18.2 ± 4.5 ; $P < 0.001$) (Table 5). This trend remained throughout the academic examination period. At baseline (control period), students suffering from sleep disorders exhibited higher PSS scores (23.1 ± 5.8) than those not suffering from sleep disorders (19.7 ± 5.8 , $P < 0.001$).

Table 5. Association between sleeping disorders and NEQ, PSS, TFEQ scores, and BMI

Items	Control period			Exam period		
	No	Yes	P-value	No	Yes	P-value
NEQ score	18.2 ± 4.5	21.7 ± 5.3	<0.001	18 ± 4.8	21.7 ± 4.9	<0.001
PSS score	19.7 ± 5.8	23.1 ± 5.8	<0.001	20.7 ± 5.3	22.1 ± 5	0.13
TFEQ score	51 ± 8.4	50.4 ± 9.2	0.54	50.4 ± 9	51 ± 9.6	0.88
BMI	23.1 ± 5.0	21.9 ± 4.4	0.10	23.1 ± 4.9	22.0 ± 4.7	0.10

P-values were calculated using linear regression analysis. P-values were adjusted for age, marital status, BMI, family income, smoking, physical activity, education level, major status, and academic GPA.

Abbreviations: BMI, body mass index; NEQ, Night Eating Questionnaire; PSS, Perceived Stress Scale; TFEQ, Three Factor Eating Questionnaire.

4. Discussion

To the best of our knowledge, this is the first study to investigate the relationship among night eating behavior,

sleep patterns, perceived stress, and three factors eating scores during control and exam periods among female university students. We found no significant relationship between night eating behavior and perceived stress among the participants, indicating no direct association between night eating and perceived stress during exam periods.

In this study, the data were stratified based on BMI categories. Students who were underweight (37%) consumed breakfast 1–2 times/week, compared with students who were normal weight (39.5%) or obese (32.7%), who rarely consumed breakfast. This suggests that the frequency of breakfast consumption may be associated with BMI in our study population. This finding is consistent with previous studies conducted on a large sample of university students in Iran. An inverse association has been reported between breakfast consumption and the possibility of being overweight or obese among university students. [34] Hence, students who regularly consumed breakfast had a lower probability of being overweight or obese than those who skipped or rarely consumed breakfast. These findings further emphasize the importance of breakfast in maintaining a healthy weight. Regular breakfast consumption was associated with better appetite control, improved satiety, and healthier food choices throughout the day. [35,36] Individuals beginning the day with a balanced meal are less likely to overeat or consume unhealthy snacks later in the day, preventing weight gain and promoting weight management. [36,37] Students who were underweight had higher TFEQ scores compared with those of students with normal weight or obesity. This indicates that students who were underweight exhibited a different eating pattern from students in the other weight categories. These findings are consistent with previous studies that have reported an association between being underweight and eating disorders. [38,39]

Regarding night-time eating habits, no significant difference in the percentage of students eating at night at baseline and during academic examination stress was observed. Despite the potential for increased stress during exam periods, participants in the current study demonstrated stability in both eating habits and weight. These findings suggest that moderate stressors of a short duration, particularly in students who have already experienced recurrent academic stress, may not change eating behavior to a large extent. Most students reported a moderate level of perceived stress (68.8%), followed by high (21.8%) and low stress levels (8.4%). Academic examination stress did not have a significant effect on stress levels among the students. Furthermore, no significant changes in night eating behavior or perceived stress were noted among the participants, indicating no direct association between night eating and perceived stress during the exam period. Research on the impact of stress on eating behavior has yielded inconsistent results, with some studies showing a correlation while others finding no significant relationship. [2,40,41,42] However, similar to our findings, a study showed that most students reported moderate levels of perceived stress, suggesting that the academic environment may contribute to stress levels. [43] Other factors, such as individual coping mechanisms, social support, and personal circumstances, could influence an individual's response to stress and

eating behavior. [44,45]

Our results indicate an association between shorter sleep duration and greater BMI, which is consistent with research linking sleep restriction to metabolic disruption and weight gain. Specifically, lack of sleep causes an increased appetite through hormonal changes, including increased ghrelin and decreased leptin, which can lead to increased caloric intake and preference for calorie-dense foods. [46,47] Sleeping time possibly influences night-time eating habits. [48] Students who slept in the morning had higher NEQ scores than those who slept at night. Students with sleep disorders also had higher NEQ scores and perceived stress levels than those without sleep disorders. These results indicate that a disrupted sleep pattern, rather than sleep duration is strongly linked to night-eating behavior and perceived stress in female university students. Several studies have indicated that inadequate sleep duration and poor sleep quality can disrupt the regulation of appetite-controlling hormones, such as leptin and ghrelin, which regulate hunger and satiety, leading to an increased risk of overeating, particularly during night-time hours when individuals may be awake owing to sleep difficulties. [49] Sleep deprivation has been associated with increased hunger, appetite, and cravings, particularly for high-calorie and carbohydrate-rich foods. [50] This disruption of appetite regulation may contribute to the development of unhealthy eating habits, including night eating habits. [48] Moreover, individuals with sleep disorders such as insomnia or sleep apnea are more likely to experience disturbances in appetite regulation and exhibit unhealthy eating patterns. [48,51] Furthermore, the relationship between sleep disturbance and perceived stress is well established. Chronic sleep deprivation or poor sleep quality can significantly increase stress levels and impair an individual's ability to cope with daily challenges. [52] Heightened stress levels can further exacerbate unhealthy eating behaviors, as individuals use food as a coping mechanism or experience emotional eating episodes. [48,50] Our findings support the hypothesis that sleep patterns, sleep disorders, and NEQ scores are interconnected among student populations. This highlights the importance of considering sleep habits and potential sleep disorders when examining night-time eating behaviors and stress levels. Further research in this area could help to elucidate the underlying mechanisms and explore potential interventions to address these issues among students.

Our study had a few limitations. First, data collection relied on self-reporting, which introduced the possibility of reporting bias. Participants may have provided responses that they believed were socially desirable or may have inaccurately recalled their eating habits or stress levels. Future studies using objective measures or additional assessments could strengthen the validity of our findings. Second, the sample size of the study was relatively small. The limited sample size may have reduced the statistical power of the analysis and hindered the ability to detect significant relationships or differences. Consequently, caution should be exercised when generalizing these findings to larger populations. The sample included only female university students, which limits the generalizability of the findings to the broader

student population. Although this approach helped maintain sample homogeneity and reduce gender-related confounding factors, it restricted comparisons between male and female students. Future studies should include a larger and more diverse sample, incorporating both male and female participants, to enable gender-based comparisons and enhance the generalizability of the results. Despite these limitations, the findings of this study make a valuable contribution to the existing literature on the association among sleep habits, perceived stress, and night eating behaviors among young adults. This research topic has received limited attention; hence, our findings elucidate the complex interplay between these factors. Future studies with a larger and more diverse sample incorporating objective measures would further validate our findings.

5. Conclusion

Our study highlights the significance of considering the impact of sleep disorders on eating behaviors, particularly among specific populations, such as students experiencing heightened stress during exams. Further investigations could explain the relationships among sleep patterns, sleep disorders, night eating, and perceived stress. Addressing sleep disorders may provide potential support that can help student regulate their appetite and reduce the possibility of night-time eating, especially during stressful periods when students are more susceptible to unhealthy eating habits. Moreover, we demonstrated how sleep timing is associated with periods of heightened stress, such as exams. During such periods, students may face increased pressure, anxiety, and disrupted sleep, which can influence their eating behavior. Longitudinal studies can help establish temporal relationships and assess how changes in sleep quality and patterns affect eating behaviors over time. Comprehensively elucidating these factors may encourage educational institutions to promote students' overall well-being and support healthy habits that extend beyond academic periods.

ACKNOWLEDGEMENTS

Authors are deeply grateful to the study participants who generously shared their time and insights for this research.

Funding Sources

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Conflicts of Interest

The authors do not have any conflict of interest.

Data Availability Statement

The manuscript incorporates all datasets produced or examined throughout this research study.

Ethics Statement

Ethical approval was obtained from the Biomedical Ethics Research Committee of King Abdulaziz University (approval number: 540-22), and the study was conducted in accordance with the principles outlined in the Declaration of Helsinki.

Informed Consent Statement

Informed consent was obtained from all study participants.

Clinical Trial Registration

This research does not involve any clinical trials.
Permission to Reproduce Material from other Sources
Not Applicable.

Author Contributions

- Afnan H. Saaty: Conceptualization, Project administration, Methodology, Resources, Data curation, Writing-original draft preparation, Writing-review and editing
- Noha M. Almoraie: Conceptualization, Methodology, Resources, Data curation, Writing—original draft preparation
- Najlaa M. Aljefree: Conceptualization, Methodology, Resources, Data curation, Writing-review and editing
- Israa M. Shatwan: Conceptualization, Methodology, Formal analysis, Software, Resources, Data curation, Writing-original draft preparation

References

- [1] Sogari, G., Velez-Argumedo, C., Gómez, M.I. and Mora, C., "College students and eating habits: A study using an ecological model for healthy behavior", *Nutrients*, 10 (12). 1823. 2018.
- [2] Choi, J., "Impact of stress levels on eating behaviors among college students", *Nutrients*, 12 (5). 1241. 2020.
- [3] Campbell, F., Blank, L., Cantrell, A., et al., "Factors that influence mental health of university and college students in the UK: A systematic review", *BMC public health*, 22 (1). 1778. 2022.
- [4] Lavery, M.E. and Frum-Vassallo, D., "An updated review of night eating syndrome: An under-represented eating disorder", *Current obesity reports*, 11 (4). 395-404. 2022.
- [5] Allison, K.C., Latzer, Y., Tzischinsky, O. and Vinai, P., "What is night eating syndrome? New directions toward a unified definition", *International Journal of Child and Adolescent Health*, 2 (2). 175-184. 2009.
- [6] Kim, Y., Kwak, J.H. and Paik, J.K., "Association of night eating habits with health-related quality of life (HRQoL) in university students", *Healthcare*, 10 (4). 640. 2022.
- [7] Peltzer, K., Pengpid, S., Samuels, T.A., et al., "Prevalence of overweight/obesity and its associated factors among university students from 22 countries", *International journal of environmental research and public health*, 11 (7). 7425-7441. 2014.

- [8] Asif, S., Mudassar, A., Shahzad, T.Z., Raouf, M. and Pervaiz, T., "Frequency of depression, anxiety and stress among university students", *Pakistan journal of medical sciences*, 36 (5). 971-976. 2020.
- [9] Du, C., Zan, M.C.H., Cho, M.J., et al., "Health behaviors of higher education students from 7 countries: Poorer sleep quality during the COVID-19 pandemic predicts higher dietary risk", *Clocks & sleep*, 3 (1). 12-30. 2021.
- [10] Jiang, N., Yan-Li, S., Pamanee, K. and Sriyanto, J., "Depression, anxiety, and stress during the COVID-19 pandemic: Comparison among higher education students in four countries in the Asia-Pacific region", *Journal of Population and Social Studies*, 29. 370-383. 2021.
- [11] Jang, H.J., Kim, B.S., Won, C.W., Kim, S.Y. and Seo, M.W., "The relationship between psychological factors and weight gain", *Korean journal of family medicine*, 41 (6). 381-368. 2020.
- [12] León-Muñoz, L.M., García-Esquinas, E., Soler-Vila, H., Guallar-Castillón, P., Banegas, J.R. and Rodríguez-Artalejo, F., "Unhealthy eating behaviors and weight gain: A prospective study in young and middle-age adults", *Obesity*, 24 (5). 1178-1184. 2016.
- [13] Vidal, E.J., Alvarez, D., Martinez-Velarde, D., et al., "Perceived stress and high fat intake: A study in a sample of undergraduate students", *PLOS one*, 13 (3). e0192827. 2018.
- [14] Zellner, D.A., Loaiza, S., Gonzalez, Z., et al., "Food selection changes under stress", *Physiology and behavior*, 87 (4). 789-793. 2006.
- [15] Sung, M.J. and Chang, K.J., "Correlations among life stress, dietary behaviors and food choice of college students", *Journal of the East Asian Society of Dietary Life*, 16 (6). 655-662. 2006.
- [16] Radavelli-Bagatini, S., Blekkenhorst, L.C., Sim, M., et al., "Fruit and vegetable intake is inversely associated with perceived stress across the adult lifespan", *Clinical nutrition*, 40 (5). 2860-2867. 2021.
- [17] Errisuriz, V.L., Pasch, K.E. and Perry, C.L., "Perceived stress and dietary choices: The moderating role of stress management", *Eating behaviors*, 22. 211-216. 2016.
- [18] Graves, B.S., Hall, M.E., Dias-Karch, C., Haischer, M.H. and Apter, C., "Gender differences in perceived stress and coping among college students", *PloS One*, 16 (8). e0255634. 2021.
- [19] Hamdan, M., Badrasawi, M., Zidan, S., Thawabteh, R., Mohtaseb, R. and Arqoub, K.A., "Night eating syndrome is associated with mental health issues among Palestinian undergraduate students-cross sectional study", *Journal of eating disorders*, 11 (1). 1. 2023.
- [20] Striegel-Moore, R.H., Franko, D.L., Thompson, D., Affenito, S. and Kraemer, H.C., "Night eating: Prevalence and demographic correlates", *Obesity*, 14 (1). 139-147. 2006.
- [21] Guo, F., Tian, Y., Cui, Y., and Huang, C., "The FITYou project focuses on night-eating syndrome and depressive symptoms among college freshmen, aiming to improve fitness in youths," *Psychology Research and Behavior Management*, 13, 185–191. 2020..
- [22] Du, C., Adjepong, M., Zan, M. C. H., et al., "Gender differences in the relationships between perceived stress, eating behaviors, sleep, dietary risk, and body mass index", *Nutrients*, 14(5). 1045. 2022.
- [23] Anversa, R. G., Muthmainah, M., Skettriene, D., et al., "A review of sex differences in the mechanisms and drivers of overeating", *Frontiers in neuroendocrinology*, 63, 100941. 2021
- [24] "Deanship of admission and registration in King Abdulaziz University", 2019. <https://www.kau.edu.sa/Content-0-EN-2384>. (Accessed November 25, 2021).
- [25] Raosoft, "Sample size calculator", 2004. <http://www.raosoft.com/samplesize.html>. (Accessed November 25, 2021).
- [26] Gan, W.Y., Chin, P.Q. and Law, L.S., "Determination of risk factors for night eating syndrome among public university students in Malaysia", *Malaysian journal of medicine and health sciences*, 15 (1). 25-32. 2019.
- [27] Abdulla, N.K., Obaid, R.R., Qureshi, M.N., et al., "Relationship between hedonic hunger and subjectively assessed sleep quality and perceived stress among university students: A cross-sectional study", *Heliyon*, 9 (4). e14987. 2023.
- [28] Branca, F., Nikogosian, H., Lobstein, T. and World Health Organization, "Regional office for Europe. The challenge of obesity in the WHO European region and the strategies for response summary". https://www.euro.who.int/_data/assets/pdf_file/0008/98243/E89858.pdf. (Accessed December 25, 2021).
- [29] Allison, K.C., Lundgren, J.D., O'Reardon, J.P., et al., "The Night Eating Questionnaire (NEQ): Psychometric properties of a measure of severity of the night eating syndrome", *Eating behaviors*, 9 (1). 62-72. 2008.
- [30] Peker, M., Oztora, S., Caylan, A. and Dagdeviren, H.N., "Internal reliability of Turkish version of 'night eating questionnaire'", in: General Adult Population, *Eurasian Journal of Family Medicine*, 5 (3). 109-112. 2016.
- [31] Almadi, T., Cathers, I., Hamdan Mansour, A.M.H. and Chow, C.M., "An Arabic version of the perceived stress scale: Translation and validation study", *International journal of nursing studies*, 49 (1). 84-89. 2012.
- [32] Chaaya, M., Osman, H., Naassan, G. and Mahfoud, Z., "Validation of the Arabic version of the Cohen perceived stress scale (PSS-10) among pregnant and postpartum women", *BMC psychiatry*, 10 (1). 111. 2010.
- [33] de Lauzon, B., Romon, M., Deschamps, V., et al., "The three-factor eating questionnaire-R18 is able to distinguish among different eating patterns in a general population", *Journal of nutrition*, 134 (9). 2372-2380. 2004.
- [34] Mansouri, M., Hasani-Ranjbar, S., Yaghubi, H., et al., "Breakfast consumption pattern and its association with overweight and obesity among university students: A population-based study", *Eating and weight disorders*, 25 (2). 379-387. 2020.
- [35] Hoertel, H.A., Will, M.J. and Leidy, H.J., "A Randomized Crossover, Pilot Study Examining the Effects of a Normal Protein vs. high Protein Breakfast on Food Cravings and Reward Signals in Overweight/Obese 'Breakfast Skipping', Late-Adolescent Girls", *Nutrition journal*, 13 (1). 80. 2014.
- [36] Gwin, J.A. and Leidy, H.J., "A review of the evidence surrounding the effects of breakfast consumption on mechanisms of weight management", *Advances in nutrition*, 9 (6). 717-725. 2018.
- [37] Aljefree, N.M., Shatwan, I.M. and Almoraie, N.M., "Impact of the intake of snacks and lifestyle behaviors on obesity among university students living in Jeddah, Saudi Arabia", *Healthcare*, 10 (2). 400. 2022.
- [38] Iyer, S. and Shriram, V., "Prevalence of eating disorders and its associated risk factors in students of a medical college hospital in South India", *Cureus*, 13 (1). e12926. 2021.
- [39] de Matos, A.P., Rodrigues, P.R.M., Fonseca, L.B., Ferreira, M.G. and Muraro, A.P., "Prevalence of disordered eating behaviors and associated factors in Brazilian university students", *Nutrition and health*, 27 (2). 231-241. 2021.
- [40] Choi, J., "Impact of stress levels on eating behaviors among college students," *Nutrients*, 12 (5), 1241. 2020.
- [41] Maillet, M.A. and Grouzet, F.M.E., "Understanding changes in eating behavior during the transition to university from a self-determination theory perspective: A systematic review", *Journal of American college health: J of ACH*, 71 (2). 422-439. 2023.
- [42] Papier, K., Ahmed, F., Lee, P. and Wiseman, J., "Stress and dietary behaviour among first-year university students in Australia: Sex differences", *Nutrition*, 31 (2). 324-330. 2015.
- [43] Lisnyj, K.T., Gillani, N., Pearl, D.L., McWhirter, J.E. and Papadopoulos, A., "Factors associated with stress impacting academic success among post-secondary students: A systematic review", *Journal of American college health: J of ACH*, 71 (3). 851-861. 2023.
- [44] Restrepo, J.E., Bedoya Cardona, E.Y., Cuartas Montoya, G.P., Cassaretto Bardales, M.M. and Vilela Alemán, Y.P., "Academic stress and adaptation to university life: Mediation of cognitive-emotional regulation and social support", *Anales de psicología*, 39 (1). 62-71. 2023.
- [45] Vesnaver, E. and Keller, H.H., "Social influences and eating behavior in later life: A review", *Journal of nutrition in gerontology and geriatrics*, 30 (1). 2-23. 2011.
- [46] Taheri, S., Lin, L., Austin, D., et al., "Short sleep duration is associated with reduced leptin, elevated ghrelin, and increased body mass index," *PLoS Medicine*, 1 (3), e62. 2004.
- [47] Chaput, J.P., Després, J.P., Bouchard, C., et al., "Short sleep duration is associated with reduced leptin levels and increased adiposity: results from the Quebec Family Study," *Obesity*, 15 (1), 253-261. 2007.
- [48] Gomes, S., Ramalhet, C., Ferreira, I., Bicho, M. and Valente, A., "Sleep patterns, eating behavior and the risk of noncommunicable diseases", *Nutrients*, 15 (11). 2462. 2023.

- [49] Liu, S., Wang, X., Zheng, Q., Gao, L. and Sun, Q., "Sleep deprivation and central appetite regulation", *Nutrients*, 14 (24), 5196. 2022.
- [50] Akdevelioglu, Y., Sahin, T.O. and Yesildemir, O., "Sleep quality and its relationship with night eating syndrome, the risk of diabetes, and nutritional status among university students", *Progress in nutrition*, 22 (1), 304-315. 2020.
- [51] Cassidy, S., Harvey, L. and Smyth, S., "Examining the relationship between obstructive sleep apnoea and eating behaviours and attitudes: A systematic review", *Appetite*, 181, 106390. 2023.
- [52] Amaral, A.P., Soares, M.J., Pinto, A.M., et al., "Sleep difficulties in college students: The role of stress, affect and cognitive processes", *Psychiatry research*, 260, 331-337. 2018.



© The Author(s) 2026. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<http://creativecommons.org/licenses/by/4.0/>).