

Food Selection Under Stress Among Undergraduate Students in Riyadh, Saudi Arabia

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Background: University students might experience numerous sources of stress in their daily lives. Previous research has found that stress affects food selection patterns, but the effect might vary by country and sex. No previous study conducted in Saudi Arabia has assessed the association between stress and dietary habits among university students. Thus, this study aimed to examine the association between perceived stress and food selection patterns among undergraduate students by sex at King Saud University (KSU).

Methods: A cross-sectional study of 400 students attending the College of Applied Medical Sciences in Riyadh, Saudi Arabia, was conducted. The self-administered questionnaire that was used consisted of three sections: sociodemographic, food frequency questionnaire, and Cohen's Perceived Stress Scale.

Results: Approximately (59.0%) of the participants reported suffering from some level of stress, with more females (64.5%) experiencing stress than males (54.0%). The univariate analysis showed that under stress, more females (68.0%) reported eating more than usual than males (49.0%), while the percentage of respondents that reported eating less than usual was higher for females (23.0%) than that for males (31.0%). The McNemar test indicated that under stress, there was an increased preference for salty flavors, which was not associated with sex. Significantly more females (82.0%) than males (64.5%) reported preferring sweets under stress. More males reported preferring bitter and savory flavors than females. Under stress, females preferred homemade food, while males preferred takeout foods. More females (68.0%) reported losing control and overeating than males (49.0%). A logistic regression showed that for female students, perceived stress was associated with frequent consumption of sweets, cake/cookies, snacks and beverages and less frequent consumption of fruits and vegetables. For males, the consumption of fast food and meat was significantly positively associated with perceived stress.

Conclusion: Perceived stress led to unhealthy changes in eating patterns in both sexes, as evidenced by reports of an increased preference for sweets, snacks and cake/cookies among females and an increased preference for fast food and meat among males. These results may be potentially important targets for interventions for stress-related food consumption.

Keywords: stress, food intake, undergraduate students, sex, Riyadh

Introduction

University entrance can be a stressful experience in view of the major life changes involved in the transition to college. University students are challenged by many stressors in their day to day lives. New social relationships, peer competition, the need to achieve high grades, and lack of time management are some of the factors that can cause or aggravate students stress. Stress causes biological and psychological changes that can alter food preferences and consumption.^{1,2} Individual

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changes in eating behavior in response to stress are not universal. Studies have shown that food selection patterns among stressed individuals can vary by country of residence,^{3–7} culture,⁸ sex,^{4,9,10} or a combination of these factors.

The eating behaviors of males and females vary in response to stress. In several studies, females have shown vulnerability to increased food consumption under stress compared to males, who tend to eat less.^{1,11–14} In contrast, other studies have found no change in eating behavior.¹⁵ Perhaps this is because it has also been shown that specific food preferences vary by sex. For example, Oliver and Wardle¹⁶ reported that stressed females were more likely to eat snack foods such as sweets and less likely to eat fruits and vegetables. In a survey study on comfort food preferences, males reported preferring warm, hearty, meal-related foods (steak, casseroles and soup) under stress, while females preferred snack foods (ice cream and chocolate).¹⁷ Moreover, in an experimental study, women were more likely to eat sweet foods than men during a stressful video about industrial accidents. In fact, compared to controls, women ate 202% more sweet foods when stressed, and men ate 61.0% more sweet foods when stressed.¹¹ These findings might be confounded by the fact that more women report eating fruits and vegetables, avoiding high-fat foods, and dieting than men during times of nonstress.^{18,19}

The nutritional value and sensory properties of food are other factors that have an impact on the stress eating relationship. The general trend is that during times of stress, people reduce their intake of healthy, low-fat foods and increase their intake of unhealthy, high fat foods.¹ Zellner et al¹ reported that when people are under stress, foods that are normally avoided are chosen as people lose control of self-imposed rules. Findings on specific food preferences when a person is stressed are mixed. Sweet foods,¹⁵ high fat foods, high protein foods,²⁰ and sweet or bland foods¹¹ have all been preferred in stress-induced eating studies. Consistently, however, there has been an inclination towards “snack” foods as opposed to meal-type foods. Oliver and Wardle¹⁶ found that 73.0% of those who increase their food consumption under stress turn to snack foods, such as chocolate biscuits. This relationship seems to be sex dependent.¹⁷

Changes in eating behavior and food preference have been widely explored in experimental settings^{21–24} but much less commonly in survey studies, especially among college students. Very little is known about the

relationships between dietary habits and stress in the Gulf region countries. Although patchy research on food habits has been conducted in Saudi Arabia,^{25,26} Oman,²⁷ and Kuwait,¹⁰ to the best of our knowledge, no study has explicitly considered the association between food habits and stress in Saudi Arabia. This study was carried out to assess the associations between stress levels and food consumption frequency among students at the College of Applied Medical Sciences of King Saud University. The results of this study may contribute to the improvement of the quality of life of University students.

Methods

A cross-sectional study design was used to collect data from undergraduate students studying at the College of Applied Medical Sciences (CAMS) in Riyadh, Saudi Arabia (SA). The selection of the college was based on its diverse academic programs and students, and it is the largest college in Saudi Arabia. Due to the absence of previous studies on stress among undergraduate students in colleges of allied medical sciences, we carried out a pilot survey of 30 male students and 30 female students using the PSS-10 stress scale. We found stress to be present in 47.0% of males and 59.0% of females. If we assume the power to be set at 95% and 95% confidence intervals, the sample size would need to be 383. Including the 5% increment to compensate for potential nonresponse, the final required sample size was estimated to be 400 students. Since there are two separate colleges, one for males and the other for females, with an equal number of students, we selected 200 random students from each college. None of the students in the sample were found to perform any kind of treatment related to a weight loss goal or dieting.

All students who participated in the study were informed about the nature objectives of the study, and the questionnaire used was explained by well-trained students who acted as research assistants. The students were informed that participation in the study was voluntary and that they had the choice to remain anonymous. Further, a written informed consent was obtained from each participant after explaining the purpose of the study. Approval for conducting the study was obtained from the Research and Ethics Committee of the CAMS, King Saud University.

The questionnaire consisted of three parts: demographic information, Cohen's Perceived Stress Scale (PSS-10) questionnaire,²⁸ and a dietary intake questionnaire. The

demographic information mainly included variables pertaining to the demographic profile and personal factors of the participants, which mainly included age, sex, body weight, family income, living situation, credit hours, and level of study.

Stress Assessment

Stress was assessed using the PSS-10 questionnaire, which is a reliable and valid assessment instrument for the study of stress in college students.²⁹ Cohen³⁰ reported an alpha reliability of 0.78. The PSS has been used in various clinical circumstances, settings and cultures and has been translated into 17 languages, including Arabic.³¹ The score ranges from 0 to 40 and serves as an outcome variable. The answers were graded on a 5-point Likert scale: never = 0, almost never = 1, sometimes = 2, fairly often = 3, or very often = 4. The positively framed questions, including questions 4, 5, 7, and 8, were reverse scored: never = 4 to very often = 0.

The scores were summed across all scale items, with higher scores indicating higher perceived stress. According to the table for the PSS published by Cohen, a score of 14.2 with an (SD = 6.2) was reported as the average for the 18 to 29-year age group. A cut-off score of 14 for the PSS was chosen, below which students were considered to have a nonsignificant level of stress. A low stress level was determined if scores ranged from 0–13. Scores ranging from 14–26 were considered to correspond to moderate stress, and scores ranging from 27–40 indicated high stress. In this study, the internal consistency (Cronbach's alpha) for the total scale was 0.83. In other related studies, Cronbach's alpha of the PSS was 0.85 in Germany, 0.81 in Poland, 0.80 in Bulgaria,³² 0.76 in Finland,⁵ 0.47 in Egypt,⁶ and 0.68 in Oman.²⁷ BMI was calculated from self-reported weight and height.

Assessment of Dietary Intake

Self-reported dietary intake for the participants was assessed using a 7-day food frequency questionnaire (FFQ) comprising variables that measured the consumption of sweets (desserts, chocolate, candy), snacks (potato chips, ice cream/milk shakes, cakes, and muffins), fast food (hamburgers, pizza, French fries and chicken nuggets), fresh fruits, vegetables, meat and chicken, beverages (fruit juice, tea, coffee, soft drinks, flavored milk, and energy drinks), fish/seafood, dairy/dairy products (yogurt, milk and cheese), and cereal/cereal products. The instrument was created to include food groups that are important

when studying dietary habits, which is in line with other research studies.^{33,34} The introductory question "How often do you eat the following foods?" asked participants about the frequency of their usual consumption of each food item separately. Food frequency intake responses ranged from never to several times per day. The FFQ was focused on the frequency of selected food items only, and information on the portion size was not included. The consumption frequency of each group of food in the previous week was divided into five categories: 5 = "several times a day", 4 = "daily", 3 = "several times a week", 2 = "1–4 times a month", and 1 = "never". No formal test of validity was undertaken, but the questionnaire was very similar to other food frequency questionnaires that had been validated.

Statistical Analysis

The results from the univariate analyses are presented as the mean and standard deviation and absolute (n) and relative (%) frequencies. The amount of food eaten under stress was assessed using the following response options: much more than usual, more than usual, the same as usual, less than usual, or much less than usual. The binomial test and the McNemar chi-square test were used to analyze food flavor, food type, food preparation and the loss of control overeating when stressed and not stressed for both sexes. Logistic regression was also used to assess the associations between stress and dietary behaviors for male and female students separately. The food categories were treated as outcome (dependent) variables, and stress was treated as the independent variable. The intake levels in each food category were divided into two groups using the median intakes as cutoffs in both sex groups.⁴ The independent variable (perceived stress) was categorized into three levels: not stressed (treated as the reference category), moderate stress, and high stress. Previous studies have found that stress is associated with various sociodemographic factors.^{35,36} Therefore, the data were adjusted for potential confounders, including age, marital status, family income, living situation, and body mass index (BMI) using the logistic regression model. The results of the regression analyses are presented as odds ratios that are adjusted for confounding variables. A P value < 0.05 was considered statistically significant. The statistical analysis was performed using Statistical Package for the Social Sciences (SPSS) version 21.0 computer software (SPSS Inc., Chicago, SPSS for Windows).

Results

The characteristics of the study sample are shown in Table 1. Of the participants, 50.0% (200) were male and 50.0% (200) were female. The mean (SD) age of the participants was 21.5 (SD=2.8) years for males and 21.2 \pm 3 years for females. Most of the students were single (89.3%), and only 10.7% were married. However, a significantly higher proportion of males (95.5%) were single compared to the females (83.0%). Regarding family income, approximately 51.0% of the students came from a family with an income between 5000 and 10,000 SR, and approximately one-third of the students came from families with incomes less than 5000 SR. Most of the students (81.3%) were living at home with family, especially females (95.5%), with 18.7% of students living off campus and the rest living on campus (10.0%); living apart from family was more common among males than among females. Approximately (10.0%) of males and (12.5%) of females were fourth year students, while the rest were equally distributed between the other years. At the time of the study, the majority of the students (63.5%) indicated that they were taking 17 to 20 credit hours that semester. The prevalence rates of overweight and obesity were (39.0%) for males and (31.0%) for females, whereas (56.0%) of males and (62.5%) of females were considered of a normal weight. Approximately (59.0%) of all participants were found to suffer from some level of stress, with relatively more females (64.5%) than males (54.0%) exhibiting some level of stress ($Z = 2.137$, $p = 0.032$). Approximately 28% of female students suffered from mild stress, and (37.0%) experienced high stress. Among males, (32.0%) were suffering from mild stress and (22.0%) were experiencing high stress.

Table 2 presents the amount of food eaten under stress for males and females. Most participants reported that they altered their eating behavior in response to stress (83.0%). Females (68.0%) were more likely than males (49.0%) to report eating more ($Z = 4.83$, $p < 0.001$), while the percentage that reported eating less was (23.0%) for females and 31% for males ($Z = 1.80$, $p = 0.072$). Males (20.0%) were significantly more likely to report no change compared to females (9.0%) ($Z = 2.87$, $p < 0.004$).

Table 3 shows the preference for food flavor by sex. The McNemar chi-square test indicated that there was a significant change in preference for sweet-flavored foods when stressed compared to when not stressed for both males and females ($p < 0.001$). Significantly more

Table 1 Characteristics of the Study Population

Characteristics	Sex		Total (n = 400)
	Male (n = 200)	Female (n = 200)	
	n (%)		
Age			
18–20 years	84 (42.0)	87 (43.5)	171 (42.8)
21+ years	116 (58.0)	113 (56.5)	229 (57.2)
Marital status			
Single	191 (95.5)	166 (83.0)	357 (87.8)
Married	9 (4.5)	34 (17.0)	43 (12.2)
Family income (SR)			
< 5000	63 (31.5)	67 (33.5)	130 (32.5)
5000 – 10,000	99 (49.5)	103 (51.5)	202 (50.5)
> 10,000	38 (19.0)	30 (15.0)	68 (17.0)
Living situation			
On-campus accommodation	37 (18.5)	3 (1.5)	40 (10.0)
Off-campus accommodation	29 (14.5)	6 (3.0)	35 (8.7)
At home with family	134 (67.0)	191 (95.5)	325 (81.3)
College credit hours			
9–12	7 (3.5)	4 (2.0)	11 (2.8)
13–16	54 (27.0)	41 (20.5)	95 (23.7)
17–20	116 (58.0)	138 (69.0)	254 (63.5)
> 20	23 (11.5)	17 (8.5)	40 (10.0)
Level of study			
1st year	68 (34.0)	63 (31.5)	131 (32.8)
2nd year	57 (28.5)	55 (27.5)	112 (28.0)
3rd year	56 (28.5)	57 (28.5)	113 (28.2)
4th year	19 (9.5)	25 (12.5)	44 (11.0)
Body mass index (BMI)			
< 18.5	10 (5.0)	13 (6.5)	23 (5.8)
18.5–25	112 (56.0)	125 (62.5)	237 (59.2)
25–30	64 (32.0)	43 (21.5)	107 (26.8)
> 30	14 (7.0)	19 (9.5)	33 (8.2)
Stress level			
Not stressed	92 (46.0)	71 (35.5)	163 (40.8)
Moderate	64 (32.0)	55 (27.5)	119 (29.8)
High	44 (22.0)	74 (37.0)	118 (29.5)

Abbreviations: SR, Saudi Riyal (1\$ = 3.75 SR).

females (82.0%) than males (64.5%) ($Z = 5.05$; $p < 0.001$) reported that they preferred sweets under stress. Participants of both sexes indicated that they significantly preferred salty flavors when stressed compared to when

Table 2 Amount of Food Eaten Under Stress

Food Amount	All n (%)	Female n (%)	Male n (%)
Much less than usual	25 (06.25)	10 (05.0)	15 (07.5)
Less than usual	83 (20.75)	36 (18.0)	47 (23.5)
Same amount as usual	68 (17.00)	18 (9.0)	40 (20.0)
More than usual	197 (49.25)	116 (58.0)	91 (45.5)
Much more than usual	27 (6.75)	20 (10.0)	7 (03.5)

not stressed ($p < 0.001$). No significant difference was observed for the change in flavor preferences between males (74.5%) and females (71.5%) ($Z = 1.63$; $p = 0.499$). The binomial test showed that the participants, both males and females, reported to prefer bitter flavors significantly less when stressed. Males (16.5%) reported preferring bitter-flavored foods significantly more than females did (4.0%) ($Z = 2.81$, $p < 0.001$). Participants reported preferring savory flavors less when stressed

compared to when not stressed ($p = 0.002$ for males and $p = 0.005$ for females). The results showed that males preferred savory flavors more (47.5%) than females did (37.5%) ($Z = 2.03$; $p = 0.043$).

Table 4 depicts the preferences for food type and food preparation and loss of control eating by sex. The McNemar test indicated that there was a significant change in preferences related to food type and food preparation and the loss of control eating when stressed compared to when not stressed for both sexes. Females (78.0%) reported preferring snack-type food options significantly more than males (20.5%) did when stressed ($Z = 10.5$; $p < 0.001$). Males (79.5%) reported preferring meal-type foods significantly more than females (22.0%) did when stressed ($Z = 10.5$, $p < 0.001$). Females reported preferring home-made food significantly (72.0%) more than males (27.5%) when stressed, while males (72.5%) preferred take-out

Table 3 Preferences by Sex for Food Flavor (Sweet, Salty, Bitter, Savory), Food Type and Food Preparation When Stressed Compared to When Not Stressed

Prefer When Normal		Male n (%)			Female n (%)		
		Prefer When Stressed					
		No	Yes	Total	No	Yes	Total
Sweet	No	38 (19)	89 (44.5)	127 (41.5)	25 (12.5)	107 (53.5)	132 (66.0)
	Yes	33 (16.5)	40 (20)	73(58.5)	11(5.5)	57(28.5)	68 (34.0)
Total		71 (35.5)	129 (64.5)	200	36 (18)	164 (82.0)	200
McNemar test		$\chi^2 = 55.15$; p < 0.001			$\chi^2 = 76.48$; p = < 0.001		
		No	Yes	Total	No	Yes	Total
Salty	No	37 (18.5)	59 (29.5)	96 (48)	33 (16.5)	53 (26.5)	86 (43.0)
	Yes	14 (7)	90 (45)	104 (52)	24 (17.0)	90 (50.0)	114 (57.0)
Total		51 (25.5)	149 (74.5)	200	57 (28.5)	143 (71.5)	200
McNemar test		$\chi^2 = 26.52$; p < 0.001			$\chi^2 = 25.50$; p < 0.001		
		No	Yes	Total	No	Yes	Total
Bitter	No	160 (80.0)	23 (11.5)	183 (91.5)	178 (89)	0	178 (89.0)
	Yes	7 (3.5)	10 (5.0)	17 (8.5)	14 (7.5)	8 (4.0)	22 (11.0)
Total		167 (83.5)	33 (16.5)	200	192 (96)	8 (4.0)	200
Binomial test		P = 0.021			P = 0.013		
		No	Yes	Total	No	Yes	Total
Savory	No	45 (22.5)	13 (6.5)	58 (29)	76 (38)	15 (7.5)	73 (36.5)
	Yes	60 (30)	82 (41)	142 (71)	49 (24.5)	60 (30.0)	127 (63.5)
Total		105 (52.5)	95 (47.5)	200	125 (62.5)	75 (37.5)	200
McNemar test		$\chi^2 = 9.26$; p = 0.002			$\chi^2 = 7.89$; p = 0.005		

Table 4 Food Type Preferences and Loss of Control Eating According Stress Status and Sex

		Food Type Preference When Stressed					
		Male n (%)			Female n (%)		
		Meal-Type	Snack-Type	Total	Meal-Type	Snack-Type	Total
Food type preference when not stressed	Snack-type	66 (33.0)	25 (12.5)	91 (35.5)	4 (2.0)	91 (45.3)	95 (47.5)
	Meal-type	93 (46.5)	16 (8.0)	109 (54.5)	40 (20.0)	65 (32.7)	105 (52.5)
Total		159 (79.5)	41 (20.5)	200	44 (22.0)	156 (78.0)	200
McNemar test		$\chi^2 = 38.04$; p < 0.001			$\chi^2 = 19.85$; p < 0.001		
		Food Preparation Preference When Stressed					
		Male			Female		
		Homemade	Take-Out	Total	Homemade	Take-Out	Total
Food preparation preference when not stressed	Homemade	31 (15.5)	72 (36)	103 (51.5)	132 (66.0)	34 (17.0)	166 (83.0)
	Take-out	24 (12.0)	73 (36.5)	97 (48.5)	12 (6.0)	22 (11.0)	34 (17.0)
Total		55 (27.5)	145 (72.5)	200	144 (72.0)	56 (28.0)	200
McNemar test		$\chi^2 = 24$; p < 0.001			$\chi^2 = 13.44$; p < 0.001		
		Loss of Control Eating When Stressed					
		Male			Female		
		Yes	No	Total	Yes	No	Total
Loss of control eating when not stressed	Yes	14 (7.0)	31 (15.5)	45 (22.5)	35 (25.7)	16 (25.0)	51 (35.5)
	No	84 (42.0)	71 (35.5)	155 (77.5)	101 (74.2)	48 (75.0)	149 (64.5)
Total		98 (49.0)	102 (51.0)	200	136 (68.0)	64 (32.0)	200
McNemar test		$\chi^2 = 24.42$; p < 0.001			$\chi^2 = 26.91$; p < 0.001		

food significantly more than females (28.0%) did when stressed. Both male and female participants reported loss of control eating significantly more when stressed compared to when they were not stressed ($p < 0.001$). Additionally, females (68.0%) reported loss of control eating significantly more than males (49%) ($Z = 3.86$; $p < 0.001$).

Table 5 displays the logistic regression analysis between stress and the selection of various food groups by sex while controlling for potential confounding factors. Female students who experienced moderate to high levels of stress were more likely to eat more sweets and snacks and drink more beverages than the unstressed students. However, the stressed female students were less likely to consume fruits, vegetables, meat, chicken, fish and sea food. Male students who experienced moderate to high

levels of stress were more likely to consume more fast food, meat, chicken, fish and sea food than unstressed students. However, the stressed male students were less likely to consume fruits and vegetables.

Discussion

Our findings showed that approximately (59.0%) of the undergraduate students at the CAMS suffered from some level of stress, with significantly more female students (64.5%) suffering from a higher level of stress compared to male students (54.0%). This sex difference may be due to the structures of Saudi Arabian society, considering the role of tradition, culture and religion in the social structure of the country. Conservative social norms and cultural restrictions influence the contexts in which women can be involved. Women require permission from their male guardian and

Table 5 Logistic Regression for Consumption of Various Foods Associated with Stress Levels by Sex

Food category	Female Adjusted OR (95% CI)				
	Stress Level				
	Normal	Moderate	p-value	High	p- value
Sweets	1	1.87 (1.03–3.32)	0.017	3.06 (1.86–4.91)	0.001
Snacks	1	1.74 (1.03–3.45)	0.041	2.66 (1.47–3.54)	0.013
Cake/cookies	1	1.43 (1.12–3.84)	0.032	2.73 (1.39–4.12)	0.002
Fast food	1	0.94 (0.67–2.04)	0.182	0.90 (0.62–2.27)	0.261
Beverages	1	1.59 (1.17–3.09)	0.024	1.97 (1.09–3.08)	0.037
Fruits	1	0.52 (0.25–0.86)	0.041	0.38 (0.21–0.88)	0.025
Vegetables	1	0.64 (0.41–0.93)	0.037	0.49 (0.29–0.87)	0.038
Meat & chicken	1	0.58 (0.28–0.96)	0.022	0.41 (0.30–0.86)	0.016
Fish & seafood	1	0.57 (0.23–0.87)	0.047	0.34 (0.19–0.96)	0.008
Dairy & dairy products	1	1.06 (0.91–3.86)	0.176	1.08 (0.84–3.72)	0.211
Cereal/cereal products	1	0.91 (0.76–2.08)	0.183	1.02 (0.72–0.84)	0.188

Food Category	Male Adjusted OR (95% CI)				
	Stress Level				
	Normal	Moderate	p-value	High	p- value
Sweets	1	0.98 (0.75–2.10)	0.601	1.07 (0.96–2.81)	0.533
Snacks	1	1.08 (0.85–3.05)	0.136	0.97 (0.63–2.76)	0.116
Fast food	1	1.78 (1.22–3.49)	0.027	2.87 (1.45–4.67)	0.007
Beverages	1	1.04 (0.78–2.02)	0.536	0.89 (0.59–1.52)	0.623
Fruits	1	0.62 (0.42–0.94)	0.031	0.49 (0.38–0.91)	0.012
Vegetables	1	0.71 (0.44–0.92)	0.373	0.83 (0.58–0.91)	0.147
Meat & chicken	1	1.57 (1.08–3.14)	0.042	2.31 (1.07–3.79)	0.024
Fish & seafood	1	1.32 (1.09–3.75)	0.041	1.88 (1.13–4.02)	0.034
Dairy/ dairy products	1	1.18 (1.07–2.42)	0.048	1.12 (0.92–3.08)	0.231
Cereal/cereal products	1	0.81 (0.57–0.93)	0.046	1.10 (0.83–3.51)	0.205

Abbreviations: OR, odds ratio; CI, confidence interval.

company of close male relatives. Culturally, Saudi males are not as strictly supervised as females. Previous studies among university students in Saudi Arabia and other Arab countries with similar cultures have shown the same pattern. For example, in Kuwait,¹⁰ (40.0%) of people were stressed, with more females (44.0%) than males (40.9%) experiencing stress. In Jordan,³⁷ (70.0%) of people were stressed, including (73.0%) of females and (63.0%) of males. In Saudi Arabia,³⁸ stress was (71.9%) of people were stressed, including (77.0%) of females and (64.0%) of males. The prevalence of stress found in this study was higher than the prevalence of stress observed in similar studies conducted in Malaysia³⁹ (36.0%), Turkey (27.0%),³⁵ the USA⁴⁰ (38.0%) and Hong Kong⁴¹ (43.0%) but was lower than the prevalence of stress in Australia⁴² (83.9%) and Iran⁴³ (61.3%).

The results from this study showed that most of the students altered their eating behavior (increased or decreased consumption) in response to stress. The

percentage that reported eating more when stressed (56.0%) was lower than the percentages reported by Weinstein et al¹⁴ (57.0%) and Kandiah et al⁹ (62.0%) and was very close to the percentage reported by Willenbring et al⁴⁴ (48.0%) but was higher than those reported by Oliver and Wardle¹⁶ (42.0%) and Stone and Brawnell⁴⁵ (28.0%). The percentage that reported eating less when stressed (27.0%) was below those reported by Oliver and Wardle (38.0%)¹⁶ and Kandiah et al⁹ (38.0%). These differences in results may be mainly due to the methods used in those studies. For example, in the Stone and Brownell⁴⁵ study, participants rated their stress daily and recorded whether they had eaten more, the same as, or less than usual over a period of 84 days. Additionally, in Stallman's study,⁴² he sampled from two universities, and the data were collected using both web-based questionnaires and face-to-face interviews. Of the two universities included in his study, one had a very low response rate,

which may have created a response bias. In the present study, we sampled from one university and estimated consumption patterns based on the memories of the respondents. We collected data using a self-administered questionnaire. The study also provided preliminary evidence that females may be more prone to alter certain eating patterns in response to stress. This was shown by results that indicated that females were more likely than males to report adjusting their food consumption in response to stress, as approximately (69.0%) of females reported that they increased their food intake and approximately (23.0%) reported that they decreased their food intake when stressed. Males reported a (44.0%) increase in food intake and an approximate (31.0%) decrease in food intake.

Stress was associated with reported increased preferences for salty flavors, but these results contradicted the results of the study by Grunberg and Straub,¹¹ in which the participants choose sweet or bland foods over salty foods during stressful moments. This change in flavor preference was not associated with sex (males 74.5%, females 76.5%). The effect may be a product of sympatho-adrenal medullary activity (increased renal sodium excretion may cause a sodium deficiency and increase the appetite for sodium).⁴⁶ Respondents also preferred bitter and savory foods less when stressed than when they were not stressed. This decreased preference for bitter foods may be a possible reflection of stress driving flavor preference to more palatable foods.^{16,47} In addition, reports of both bitter and savory flavor preferences appeared to be influenced by sex. When stressed, males reported preferring bitter (males 11.5%, females 4.0%) and savory (males 47.5%, females 37.5%) flavors more than females did.

According to this study, sex influences preferences for the method of food preparation. Male students reported a preference for take-out food (68.0%), while female students (72.0%) reported preparing their own food when stressed. Previous research has shown that the reason participants choose the food they consume when stressed is convenience and taste.^{13,16} During stress, time and energy are not plentiful; and thus, convenient foods are preferable to foods that require more time and energy to prepare. For females, going out to a restaurant may be too time consuming during stressful moments when time is limited. This is because conservative social norms and cultural restrictions influence the context in which females can go out. Thus, females prefer to prepare their own food rather than ordering in or having someone else prepare

their food; this difference may also be because stress is more frequently experienced when at home and alone. The majority of female students were living at home with their parents (95.5%). As another explanation, female participants may prefer to prepare their own food because they are seeking specific flavors, tastes or nutritional components that are depleted during stress or that encourage positive effects. Males are not strictly supervised, and they can freely go out. This might explain the clear sex differences in food preparation behavior when stressed.

During stressful moments, more females (78.0%) than males (20.5%) tended to prefer snack-related foods (e.g., sweets, chocolate, ice cream, cookies), while males tended to prefer meal-related foods (e.g., meat, fish). This corresponds well with the results of Wansink et al,¹⁷ which demonstrated that a higher percentage of females preferred candy and chocolate (69.0% female, 58.0% male), but a lower percentage of females preferred meal-related foods such as meat and sea food (52.0% female, 77.0% male). Oliver and Wardle,¹⁶ however, did not find a sex difference in snacking behavior under stress. Snacks may be preferred during stress because of their typical high fat and sugar content⁴⁸ and because they are easy to prepare. Snacking during stress may be beneficial as a coping mechanism, as energy-rich snacks in the afternoon have been shown to increase attention and memory.⁴⁸ When stressed, 69.5% of females preferred small and bite-sized food compared to only 21.0% of males. Oliver and Wardle¹⁶ explained that the preference for small and bite-sized foods may validate a preference for snack-type foods because they are more easily digested while gut activity is suppressed and may additionally indicate the ability to eat while completing a secondary activity (such as studying) or engaging in a distraction (such as watching TV).

The relationship between stress and food selection patterns by sex was examined using logistic regression after adjusting for socioeconomic variables. The results revealed that both males and females were more likely to consume unhealthy foods under stress compared to when they were not stressed. The consumption of unhealthy foods was higher among female students. Stressed females were 3.06, 2.66, and 1.97 times more likely to consume sweets, snacks and beverages, respectively, compared to unstressed students. The preference for unhealthy food is evident in the literature.^{1,9,11,49} Females tend to be more health-conscious and tend to go on more diets than males;⁵⁰ thus, they are more susceptible to the lack of restraint involved in stress eating. Therefore, females

tend to allow themselves to consume these unhealthy high-calorie foods when the inhibition they usually show is reduced by stress.¹ Moreover, sex dimorphisms in the functioning of the hypothalamic-pituitary-adrenal (HPA) axis have been documented; when the HPA is activated, glucocorticoid (GC) output is thought to be higher among females than among males.⁵¹ For male students, consumption of fast food, meat, fish and sea food was more common when stressed. Stressed males were 2.87, 2.31, and 1.88 times more likely to consume fast food, meat, fish and sea food, respectively, compared to unstressed students. Similar results were reported among university/college students from the USA,⁵² Bangladesh,⁵³ Lebanon⁵⁴ and Italy.⁵⁵ Females and males also ate fewer fruits and vegetables when stressed. Stressed females were 51.0% and 54.0% less likely to consume fruits and vegetables, respectively, compared to unstressed students, while stressed males were 38.0% and 34.0% less likely to consume fruits and vegetables, respectively, compared to unstressed students. Similar results were reported among university students in the USA,⁵² Bangladesh,⁵³ China,⁵⁶ and Greece.⁵⁷ Similarly, the consumption of cereal/cereal products and dairy/dairy products was more common among male students. This finding was in accordance with the results of other studies.^{4,58}

Findings on specific food preferences when a person is stressed are mixed. Two reasons might account for specific food preference during stress. When under stress, foods that one normally avoids are chosen as people lose control of self-imposed rules, which is a further confirmation of the role of disinhibition in stress eating.^{1,16} Kandiah 2006⁹ speculated that the food composition (high fat/energy content) rather than aesthetic properties (taste) could have more influence on why certain foods are chosen over others during stressful times. Keren 2015⁴ attributed the preference of these foods to the quick availability and palatability of these foods. The second reason that an individual chooses the foods they do during stress is the influence of the hormone cortisol on the metabolism. Not only has cortisol been shown to regulate energy balance through glucogenesis and lipolysis, but cortisol also influences macronutrient selection (increased appetite for carbohydrates and for fat) in rodents.^{24,59}

This study had some limitations. The study was cross-sectional, and we could not reach a conclusion on the direction of the association between food selection and stress on the basis of our results. We used an FFQ and, as a prior investigation explained, FFQs can lead to

underestimating dietary consumption.⁶⁰ We examined the relationship between food selection and stress in one university and one college in Riyadh due to the difficulty in securing permission from other universities. We recommend that this relationship be further examined among different universities.

Nevertheless, this study was the first to examine the association between food selection and stress among undergraduate university students in Saudi Arabia by sex while controlling for other confounding variables. Additionally, the response rate was high. All students responded fully to the questionnaires. We measured a wide range of eating behavior variables, providing a comprehensive assessment of the correlation between stress and food selection among college students. We did not compare overeaters to undereaters, which would help to elucidate the association between stress and eating habits.

In conclusion, the results support the notion that both males and females perceive that stress leads to unhealthy changes in eating patterns. The present investigation also provides preliminary evidence suggesting that females perceived themselves to be more susceptible than males to stress-related changes in food consumption, especially unhealthy changes. Females were more likely to consume sweets, snacks and beverages and fewer fruits and vegetables, while males were more likely to consume meat and fast foods. Given that women are at increased risk for disordered eating,⁶¹ it would be sensible to continue to explore the unique susceptibility to unhealthy changes in stress-eating patterns, such as consuming sweets and snacks, among females to further elucidate how and why sex impacts some stress eating behaviors.

Data Sharing Statement

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

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Author contributions

All authors contributed to data analysis, drafting and revising the article, gave final approval of the version to be

published, and agree to be accountable for all aspects of the work.

Disclosure

The authors declare that they have no competing interests.

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