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To cite this article: Sohaila Cheema , Patrick Maisonneuve , Amit Abraham , Karima Chaabna , Abdallah Tom , Hania Ibrahim , Tasnim Mushannen , Wajiha Yousuf , Albert B. Lowenfels & Ravinder Mamtani (2021): Factors associated with perceived stress in Middle Eastern university students, Journal of American College Health, DOI: [10.1080/07448481.2020.1865979](https://doi.org/10.1080/07448481.2020.1865979)

To link to this article: <https://doi.org/10.1080/07448481.2020.1865979>



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Published online: 12 Feb 2021.



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Factors associated with perceived stress in Middle Eastern university students

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ABSTRACT

Objective: University students face high levels of stress-related factors, such as an unfamiliar environment, challenging workload, and uncertainty about their ability to succeed. **Participants:** A total of 370 students in Qatar who consented to participate between February 2017 and February 2018. **Methods:** This cross-sectional study assessed perceived stress [using a validated 4-point perceived stress scale (PSS-4)], as well as diet, exercise, body mass index, sleep, and life satisfaction. **Results:** Among students aged 18–39 (mean = 20.1 ± 3.0 years), PSS-4 scores varied between 0 and 16 (mean = 7.4 ± 3.4). Elevated stress was significantly associated with female sex, country of origin, residing off-campus, eating when bored, lack of self-discipline, disturbed sleep, and low levels of life satisfaction. Furthermore, students with PSS-4 scores above the median level were 2.3 times likelier to report difficulty concentrating on academic work. **Conclusion:** Elevated stress levels are present in university students in Qatar. Strengthening coping skills may improve health and academic performance.

ARTICLE HISTORY

Received 21 May 2020
Revised 29 October 2020
Accepted 13 December 2020

KEYWORDS

Mental health; Middle East; risk factors; stress; university students

Introduction



In this study, the underlying theory to explain stress is based on the following concepts: (1) although life is stressful for all individuals, response to stress shows person-specific differences; (2) change, such as attending university after high school is a major stressor; (3) college and university students face unique circumstances that can lead to increased stress. These include factors such as living independently for the first time,^{1,2} academic pressure,^{3,4} making new friends,^{5,6} and the high financial cost associated with advanced education.^{3,7}

Adjusting to these various pressures can be challenging for many students, leading to anxiety and increased stress levels, impacting health and academic performance. This may be detrimental not only in the short term, but also in the long term, as obtaining a university-level degree is often viewed as a measure of success in life.⁸


Education City, founded in 1997 by the Qatar Foundation,⁹ is a unique educational experiment, bringing together several prestigious international institutions to offer advanced training options in multiple educational fields for students in the Middle East. Although most students who matriculate at Education City are from Middle Eastern

countries, the student body (estimated $N = 2741$) comprises students from 44 different countries spread throughout six continents.

The initial hypothesis motivating this study is that demographic and lifestyle variables might alter measured levels of stress in students enrolled at this international university-level educational institution. These variables include physical activity, sleep quality, class-related variables such as ability to understand and focus on course material, general satisfaction with life, smoking, self-perceived body image, age, country of origin, and place of domicile. Several factors have been previously associated with stress including sleep, exercise, diet, smoking, and gender.^{10–15} Therefore, based on these existing reports, we anticipate higher stress levels in women and smokers, and a beneficial effect of exercise. Based on the inconclusive findings of a systematic review, we were unsure whether there would be an association between measured stress and diet.¹⁶ We also hypothesized that poor quality or a lack of sleep, inability to understand or focus in class, poor life satisfaction and tobacco use would correlate with higher stress levels. The hypothesis includes several other variables without *a priori* hypotheses such as country of origin and housing status, because of the

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 Supplemental data for this article can be accessed online at <https://doi.org/10.1080/07448481.2020.1865979>

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unique character of the students in the sample. The literature on age as a correlate of stress levels is unclear, so it was difficult to hypothesize the direction of the relationship between age and stress.^{17–19}

In the Middle East, stress levels and predictors linked to stress are less well-known and many existing reports apply only to nursing or medical students. The study aim is to measure stress levels among students studying in many different disciplines within Education City and to look for associations between stress and potential predictor variables in this diverse student population.

Materials and methods

To measure stress levels, we used a validated instrument, the Perceived Stress Scale (PSS), first described by Cohen in 1983. The original instrument had 14 questions. We used a shortened version with only four questions (PSS-4) that had a reliable predictive value and its brevity increases the response rate.²⁰ The calculated PSS-4 score is based on four questions that asked whether students “felt unable to control important things in life”, “felt confident about ability to handle personal problems”, “felt things are going her/his way” and “felt difficulties piling up so high that she/he could not overcome them” (See [Supplementary Table 1](#)).

Sampling strategy

The sample included all students aged 18 or older who consented to participate (convenience, non-probability sampling), were not pregnant, able to understand English, and who were attending classes in various fields of study at universities in Education City between February 2017 and February 2018. With the total number of Education City students estimated to be 2741, we calculated that a sample of 338 (12% of the total population) would have provided a representative sample of the student population using a margin of error of 5% and 95% confidence interval levels. As per the protocol, a total of 370 students have been recruited to account for attrition and incomplete responses.

Students in Education City completed a 50-item, self-administered English language questionnaire. In addition to the questions about stress, the questionnaire also asked about demographics, diet, exercise, and smoking. Sleep habits and quality were determined with questions from the Pittsburgh Sleep Quality Index.²¹ Trained Weill Cornell Medicine- Qatar (WCM-Q) students supervised by the Institute for Population Health, WCM-Q staff performed the subject recruitment. Recruited students were briefed about study aims, were not compensated, and were informed that their decision to participate would have no effect on their academic standing. Recruited students gave consent for collecting height and weight data. Participation was voluntary and the response rate was 96%. All study procedures involving human participants were in accordance with the Qatari and US policies for the protection of human participants. WCM-Q’s Institutional Review Board (IRB) approved the study.

Statistical analysis

The PSS-4 score consists of four items on a 5-point Likert scale ranging from 0 (*never*) to 4 (*very often*). It was calculated by totaling points obtained from the four validated questions and dichotomized using its median value in the total sample. Reliability of the PSS-4 was assessed using the Cronbach’s alpha coefficient.

Other items from the questionnaire, such as dietary food intake, eating frequency and physical activity frequency, were categorized as low or high using the median value for each variable. For questions with multiple response levels, such as feelings about healthy food statements or sleep quality responses were regrouped to create two groups, i.e. merging responses “very bad” with “fairly bad” and “fairly good” with “very good”.

Students scored their overall satisfaction with life (“how satisfied are you with life as a whole these days?”) on a 0 “not at all satisfied” to 10 “completely satisfied” scale and then grouped into quartiles.

We measured associations between PSS-4 using the continuous scale (0–16) and categorical variables using the Student *t*-test with box and whisker plots. Unconditional logistic regression was used to assess the association between students’ responses to the 50-item questionnaire, and its derived variables, and the dichotomized PSS-4 score. Factors associated with PSS-4 score in the univariate analysis were considered for inclusion in a multivariable model; those not retaining statistically significant association ($p > .10$) were subsequently eliminated using a backward selection technique. Models were fitted on all participants with missing values represented by dummy-variables (missing-indicator method).

Data analysis was performed using the SAS software (version 9.4, Cary NC, USA). All tests were two-sided and p -values $< .05$ were considered statistically significant.

Results

Students’ characteristics

[Table 1](#) lists the distribution of the PSS-4 scale stratified by the main demographic characteristics of the 370 students in our sample. The mean age (\pm standard deviation) of all students was 20.1 ± 3.0 with a range from 18 to 39: 268 students (72.4%) were between 18 and 20 years and 228 (62%) students were women. In the sample, students originated from 44 different countries: 163 students (44.1%) were from Qatar, 147 (39.7%) were from other countries within the Eastern Mediterranean Region (EMR), Africa or Asia, and 42 students (11.4%) originated from other regions (mostly USA and Europe). Of students matriculating at Education City, the largest proportion registered at engineering schools ($n = 87$, 23.5%) or business and computer schools ($n = 80$, 21.6%). One hundred and twenty-five students (34%), the largest group, were first-year students with gradually declining numbers in subsequent years. Most students ($n = 277$, 74.9%) resided off-campus either at home or in private lodging, while 93 (25.1%) lived on the Education City campus.

Table 1. Distribution of the Perceived Stress Scale (PSS-4) by main student demographic characteristics.

| Students' characteristics | Participants N (%) | PSS-4 (0-7) | PSS-4 (8-16) | Odds Ratio (95% CI) | P-value |
|-------------------------------------|-----------------------|----------------|--------------|-------------------------------|---------|
| ALL | 370 (100) | 190 | 172 | | |
| Age | | | | | |
| 18 years old | 110 (29.7) | 59 | 50 | 1.00 | |
| 19 years old | 83 (22.4) | 35 | 47 | 1.59 (0.89–2.82) | 0.12 |
| 20 years old | 75 (20.3) | 40 | 32 | 0.94 (0.52–1.72) | 0.85 |
| 21–24 years old | 76 (20.5) | 41 | 33 | 0.95 (0.53–1.72) | 0.86 |
| ≥25 years old | 23 (6.2) | 15 | 7 | 0.55 (0.21–1.46) | 0.22 |
| Sex | | | | | |
| Male | 141 (38.1) | 90 | 50 | 1.00 | |
| Female | 228 (61.6) | 99 | 122 | 2.24 (1.45–3.47) | 0.0003 |
| Country of origin | | | | | |
| Qatar | 163 (44.1) | 91 | 68 | 1.00 | |
| Other EMR country, Asia, Africa | 147 (39.7) | 65 | 80 | 1.65 (1.05–2.59) | 0.03 |
| Europe, America, Oceania | 42 (11.4) | 26 | 15 | 0.77 (0.38–1.57) | 0.47 |
| Field of study at University | | | | | |
| Fine arts | 48 (13.0) | 23 | 23 | 1.16 (0.66–2.02) [†] | 0.61 |
| Medicine | 41 (11.1) | 20 | 20 | 1.16 (0.64–2.09) [†] | 0.63 |
| Engineering | 87 (23.5) | 45 | 39 | 1.00 (0.64–1.56) [†] | 0.99 |
| Business / computer studies | 80 (21.6) | 43 | 37 | 0.99 (0.63–1.57) [†] | 0.98 |
| Foreign service | 38 (10.3) | 20 | 18 | 1.04 (0.57–1.90) [†] | 0.90 |
| Journalism | 31 (8.4) | 13 | 18 | 1.60 (0.82–3.11) [†] | 0.17 |
| Archeology | 14 (3.8) | 9 | 4 | 0.51 (0.18–1.47) [†] | 0.21 |
| Academic Bridge Program | 31 (8.4) | 17 | 13 | 0.88 (0.45–1.73) [†] | 0.72 |
| Education program | | | | | |
| Pre-university | 31 (8.4) | 17 | 13 | 0.87 (0.39–1.95) | 0.74 |
| Undergraduate, first year | 125 (33.8) | 65 | 57 | 1.00 | |
| Undergraduate, sophomore | 88 (23.8) | 34 | 53 | 1.78 (1.02–3.11) | 0.04 |
| Undergraduate, junior | 62 (16.8) | 35 | 25 | 0.82 (0.44–1.52) | 0.52 |
| Undergraduate, senior | 36 (9.7) | 21 | 15 | 0.82 (0.38–1.73) | 0.59 |
| Post-graduate | 27 (7.3) | 17 | 9 | 0.60 (0.25–1.46) | 0.26 |
| Place of residence | | | | | |
| On-campus | 93 (25.1) | 58 | 34 | 1.00 | |
| Off campus | 277 (74.9) | 132 | 138 | 1.78 (1.10–2.90) | 0.02 |

*PSS score is missing for eight participants; age for three; sex for one; nationality for 18; education program for 1.

[†]Odds Ratio calculated using the population average as reference category.

Other countries from the WHO Eastern Mediterranean region (EMR) include: Afghanistan ($n = 1$); Bahrain ($n = 2$); Egypt ($n = 25$); Islamic Republic of Iran ($n = 1$), Iraq ($n = 1$), Jordan ($n = 15$), Kuwait ($n = 2$), Lebanon ($n = 7$), Morocco ($n = 1$), Occupied Palestinian territory ($n = 5$), Oman ($n = 1$), Pakistan ($n = 32$), Saudi Arabia ($n = 3$), Sudan ($n = 9$), Syrian Arab Republic ($n = 2$), Tunisia ($n = 3$), Yemen ($n = 1$).

PSS-4 score construction

PSS-4 score was calculated based on responses to four questions asking whether students “felt unable to control important things in life”, “felt confident about ability to handle personal problems”, “felt things are going her/his way”, and “felt difficulties piling up so high that she/he could not overcome them” (Supplementary Table 1). Responses for each of these four items were scored with values ranging from 0 to 4 and summed. High scores indicated more stress. The internal consistency of the scale was 0.73 (Cronbach’s alpha).

Overall, the mean PSS-4 value for all students was 7.4 ± 3.1 . Students were divided into two similar-sized groups based on the median value of PSS-4 score. The first group contained 190 students with a PSS-4 score between 0 and 7 and the second group had 172 students with PSS-4 score between 8 and 16. The PSS-4 scores for all students approximated a normal distribution (Figure 1).

Demographic and other factors associated with perceived stress level

With respect to demographic factors, female students had significantly higher stress levels than male students: 7.9 ± 3.1 versus 6.7 ± 3.0 (t -value = 3.67; $p = .0003$) (Tables 1, 3,

Supplemental Table 5 and Figure 2). Also, students from other EMR countries, Asia or Africa ($p = .03$) were more likely to have elevated stress scores than Qatari students; second-year students had elevated stress levels compared to other students ($p = .03$); students living off-campus ($p = .02$) were more likely to have an elevated PSS-4 score than students living on-campus (Table 1). Neither age nor particular field of study was associated with PSS-4 score.

Table 2 describes the univariate association ($p < .10$) between PSS-4 stress levels and other variables included in the survey. Among diet-related items, elevated PSS-4 score is significantly associated with low fresh fruit juice intake ($p = .04$) and high soft drink intake ($p = .04$). Students who feel that it is not important to eat healthily ($p = .05$) or that they are too busy to eat healthy foods ($p = .005$) have somewhat higher PSS-4 scores. Students with elevated PSS-4 scores also eat dinner less regularly ($p = .02$), eat more when bored ($p = .0009$), or when angry ($p = .001$).

Diminished physical activity was also associated with elevated PSS-4 scores. Students listed diminished self-discipline ($p = .02$), self-conscious sociocultural norms ($p = .01$), excessive heat levels ($p = .01$), and no exercise buddy ($p = .03$) as barriers to exercise.

PSS-4 scores were significantly related to sleep quality, including difficulty falling asleep ($p = .002$), short sleep duration ($p = .02$), and perceived bad sleep quality ($p < .0001$).

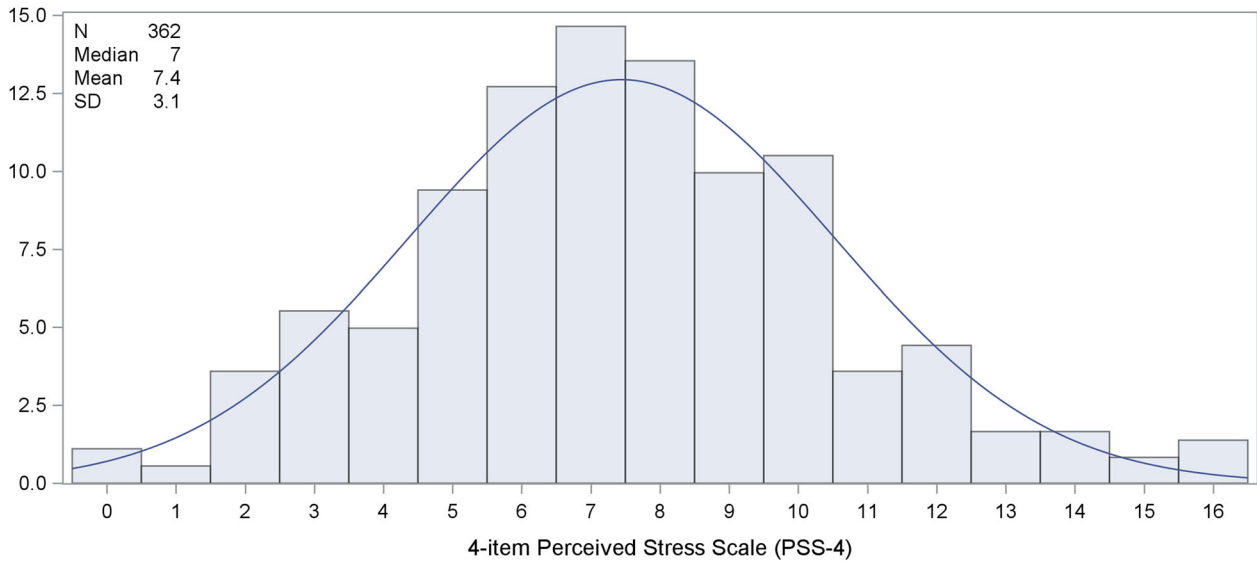


Figure 1. Distribution of the 4-point perceived stress scale.

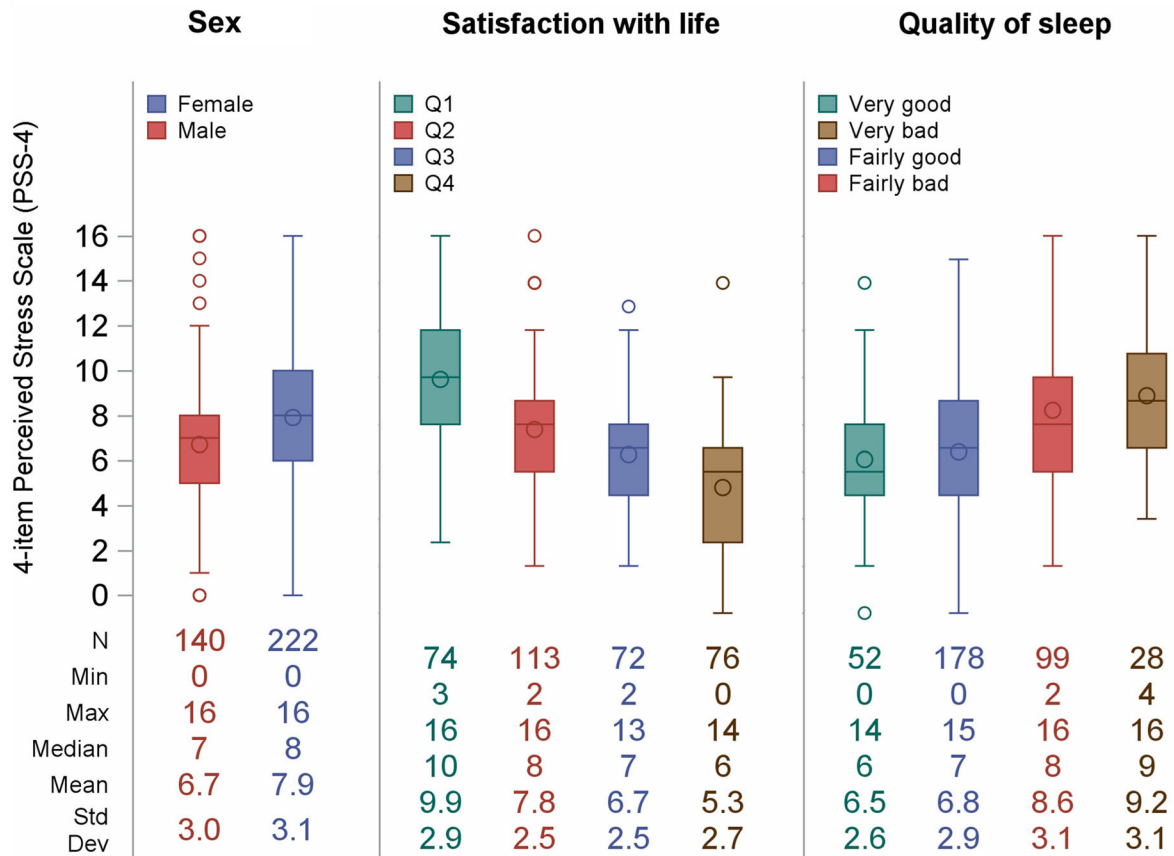


Figure 2. Distribution of the 4-point perceived stress score by sex, quality of sleep and satisfaction with life.

PSS-4 score increased steadily across deteriorating sleep categories: with mean values steadily increasing from 6.5 ± 2.6 to 9.2 ± 3.1 , across the various groups (Figure 2). Sleep symptoms associated with elevated PSS-4 scores included difficulty sleeping within 30 min ($p = .0008$), waking up in the middle of the night or early morning ($p = .007$), bad dreams ($p = .01$), and pain ($p = .006$).

Especially important for a student population, elevated PSS-4 scores were significantly associated with trouble concentrating ($p < .0001$) or staying awake ($p = .02$) during class. As might be expected, satisfaction with life was negatively associated with increased perceived stress ($p < .0001$), with mean PSS-4 scores decreasing from 9.9 ± 2.9 to 5.3 ± 2.7 when satisfaction with life increased (Figure 2).

Table 2. Factors associated with elevated perceived stress at univariate analysis.

| Factor | Participants N (%) | PSS-4 (0–7) | PSS-4 (8–16) | Odds Ratio (95% CI) | p-value |
|--|-----------------------|----------------|-----------------|------------------------|---------|
| DIET | | | | | |
| Low fresh fruit juice intake (below median) | 176 (47.6) | 81 | 93 | 1.57 (1.03–2.38) | .04 |
| High soft drinks intake (above median) | 459 (49.0) | 74 | 85 | 1.55 (1.02–2.35) | .04 |
| Feeling about healthy food statements | | | | | |
| It is not important for me to eat healthy [†] | 69 (18.6) | 28 | 39 | 1.70 (0.99–2.90) | .05 |
| I am too busy to eat healthy foods [‡] | 181 (48.9) | 80 | 97 | 1.84 (1.21–2.79) | .005 |
| Eating habits frequency | | | | | |
| Eat dinner (below median) | 134 (36.2) | 58 | 73 | 1.67 (1.08–2.58) | .02 |
| Eat when bored (above median) | 148 (40.0) | 61 | 86 | 2.07 (1.35–3.17) | .0009 |
| Eat when stressed (above median) | 217 (58.7) | 97 | 114 | 1.85 (1.20–2.84) | .005 |
| Eat when angry (above median) | 105 (28.4) | 40 | 63 | 2.14 (1.34–3.41) | .001 |
| PHYSICAL ACTIVITY | | | | | |
| Sitting during weekday (above median) | 122 (33.0) | 54 | 66 | 1.80 (1.06–3.07) | .03 |
| Barriers for not exercising regularly | | | | | |
| Lack of self-discipline | 115 (31.1) | 48 | 64 | 1.73 (1.10–2.71) | .02 |
| Self-conscious/sociocultural norms | 20 (5.4) | 4 | 15 | 4.40 (1.43–13.5) | .01 |
| Environmental conditions | 37 (10.0) | 11 | 24 | 2.61 (1.24–5.50) | .01 |
| Lack of an exercise buddy | 74 (20.0) | 30 | 43 | 1.76 (1.04–2.96) | .03 |
| SLEEPING | | | | | |
| Fall asleep after 20 min | 144 (38.9) | 59 | 81 | 1.96 (1.27–3.02) | .002 |
| No more than 6 hours of actual sleep | 180 (48.6) | 82 | 96 | 1.62 (1.07–2.46) | .02 |
| Bad overall quality of sleep [†] | 127 (34.3) | 44 | 83 | 2.99 (1.90–4.70) | <.0001 |
| Reasons for trouble sleeping | | | | | |
| Cannot sleep within 30 min | 119 (32.2) | 45 | 70 | 2.18 (1.38–3.43) | .0008 |
| Wake up in middle of night or early morning | 154 (41.6) | 67 | 86 | 1.80 (1.18–2.76) | .007 |
| Have bad dreams | 71 (19.2) | 27 | 43 | 1.98 (1.16–3.38) | .01 |
| Have pain | 61 (16.5) | 21 | 38 | 2.25 (1.26–4.02) | .006 |
| SCHOOLING | | | | | |
| Trouble concentrating during class | 216 (58.4) | 88 | 126 | 3.08 (1.98–4.80) | <.0001 |
| Trouble staying awake during class | 174 (47.0) | 78 | 93 | 1.62 (1.06–2.45) | .02 |
| OVERALL SATISFACTION WITH LIFE | | | | | |
| Good | 151 (40.8) | 105 | 42 | 1.00 | |
| Average | 81 (21.9) | 41 | 38 | 2.32 (1.31–4.09) | .0004 |
| Poor | 111 (30.0) | 28 | 81 | 7.23 (4.14–12.7) | <.0001 |

[†]Agree or strongly agree vs neutral, disagree or strongly disagree.

[‡]Very bad or fairly bad vs fairly good or very good.

Supplementary Table 2 lists variables in the 50-item questionnaire not associated with perceived stress levels. In particular, no association was found with dietary items such as fruits, vegetables, starchy foods, eggs or meat, milk and dairy products, fast food, snacks, energy drink, or protein shake intake, or with eating breakfast, lunch, or snacking between meals. PSS-4 score was not associated with body mass index, intention to lose weight, moderate physical activity or walking, or time spent watching television or watching on a computer. Invoked symptoms for trouble sleeping such as breathing problems, coughing or snoring, or feeling too cold or too hot were not associated with perceived stress levels. PSS-4 levels were not significantly related to smoking either cigarettes or water pipes (hookah), although students with elevated PSS-4 scores were more likely to have tried smoking cigarettes and not like it ($p = .02$).

Supplemental Tables 3 and 4 presents results of the PSS-4 scale by main demographic characteristics stratified by country of origin. Results are similar to the main analysis, but because of smaller samples for comparison, fewer associations remain significant.

Multivariable analysis

At multivariable analysis, eight independent factors remained significantly associated with elevated PSS-4 score. Female students (OR = 1.84; 95% CI 1.07–3.17), students

from other EMR countries, Asia or Africa (OR = 2.60; 95% CI 1.40–4.80), and students residing off-campus (OR = 2.13; 95% CI 1.09–4.18) had higher PSS-4 scores than male students, students from Qatar or living on the Education City campus, respectively. Other factors independently associated with increased PSS-4 score are: eating when bored (OR = 2.12; 95% CI 1.27–3.55), lack of self-discipline (OR = 1.93; 95% CI 1.11–1.36), difficulty falling asleep (OR = 2.21; 95% CI 1.28–3.81), trouble concentrating during class (OR = 2.32; 95% CI 1.38–3.92), and poor quality of life (OR = 6.35; 95% CI 3.37–12.0) (Table 3).

Discussion

This report focuses on stress levels in students from 44 countries attending Education City, Doha, Qatar. The stress measure relied upon a widely used scoring system, the PSS-4, a validated questionnaire, in use since 1983.²⁰ Although Education City is located in Qatar, more than half the responders were citizens of other countries (Table 1).

Many variables initially hypothesized to be related to stress levels were found to be significant in univariate analyses (Table 2). In multivariable analyses, sex, country of origin, place of residence while at school, and certain variables relating to eating, exercise, sleeping, and satisfaction with life remained significant (Table 3). These are the main

Table 3. Factors associated with elevated perceived stress at multivariable analysis.

| Factor | Strata | OR (95% CI) | <i>p</i> -value |
|---|--|------------------|-----------------|
| Sex | Female vs male | 1.84 (1.07–3.17) | .03 |
| Country of origin | Other EMR country, Asia or Africa vs Qatar | 2.60 (1.40–4.80) | .002 |
| | Europe, America, Oceania vs Qatar | 0.81 (0.32–2.00) | .64 |
| Place of residence | Off-campus vs on-campus | 2.13 (1.09–4.18) | .03 |
| Eat when bored | Above median vs below median | 2.12 (1.27–3.55) | .004 |
| Do not exercise for lack of self-discipline | Yes vs no | 1.93 (1.11–3.36) | .02 |
| Trouble sleeping because | Cannot sleep within 30 min vs sleep | 2.21 (1.28–3.81) | .005 |
| Trouble concentrating during class | Yes vs no | 2.32 (1.38–3.92) | .002 |
| Overall satisfaction with life | Average vs good | 1.87 (0.99–3.51) | .05 |
| | Poor vs good | 6.35 (3.37–12.0) | <.0001 |

variables that can help school officials and health staff identify and manage stress in university students.

In the sample, female students constituted 62% of the total, and were twice at risk of elevated stress than male students ($p = .009$). Cohen's²⁰ original study and other studies from non-EMR countries^{22–24} have reported higher stress levels in women than in men. Two studies based on data from dental students in EMR countries also reported higher stress levels in women compared to men.^{25,26} One explanation for higher stress levels in women could be that women have different coping skills and are more likely to be affected by anxiety and mood disorders than men.²⁷

Our results also indicate that students living off-campus had higher stress levels than those who live in Education City dormitories. This may be explained by on-campus students having more interaction and more support from friends, peers, and faculty members, and access to on-campus recreational facilities. This results in a higher sense of belonging and community and, at the same time, serving as an effective coping strategy for stress.²⁸

Students who listed barriers to regular exercise had higher PSS-4 scores in univariate and multivariable analysis. Some but not all previous studies have noted that exercise, particularly vigorous exercise, which can release endorphins, can help reduce anxiety.^{29,30}

Stress levels as measured on the PSS-4 scale varied within the sample of students. In this study, in addition to sex, the main reasons for the heterogeneous response to stress include country of origin, place of residence, diet, exercise, and sleep-related factors, as well as the ability to concentrate and general life satisfaction (Tables 2 and 3). These factors could lead to increased stress levels in many students and explain why stress has been listed as the most reported health impediment to academic performance in a survey of more than 80,000 US college students.³¹ In a large sample of American college students, stress has also been associated with both mental and physical health.³²

In this study, the mean stress level was considerably higher than the mean of 5.43 ± 2.96 obtained using the same PSS-4 scale in a large sample of European adults.²⁴ One explanation for the difference could be that stress levels tend to decrease with age.²³ Another possible explanation is that there may be geographic variations in perceived stress levels based on cultural differences.²⁴

International students comprise one quarter of all students living on their own in a new culture and environment. Consequently, they may be exposed to higher levels of stress

due to acculturation, or the need to adjust to the host culture.³³ There may also be differential parental or familial expectations on students from different cultures, which may impact perceived stress levels.³⁴ Additionally, Asian or African cultures are typically collectivist in nature and rely more on familial support which may be lacking in the campus environment,³⁵ compared to their European counterparts. This may account for elevated stress levels in this sample.

With the exception of the role of finance, the study confirms many of the concepts often postulated to be linked to stress and also strengthens findings originally identified in other global regions. A new finding unique to this study is that place of residence (on- or off-campus) contributes to stress levels. This has implications for international students studying in other countries.

This study has several strengths. There are now several other Middle Eastern countries hosting satellite schools based in the United States, England, Canada, or other countries. The study findings should be applicable to these schools, helpful to school administrators, and to the students enrolled in these international universities.

The instrument used to measure stress levels has been validated in many different reports, including other Middle Eastern students. Students attending several different universities had similar stress levels, suggesting the findings from this report can be generalized across different study areas.

Furthermore, the study results may help school officials identify students who are likely to have elevated stress levels. These include female students, international students from non-Western regions, and students living off-campus. Such students should be encouraged to exercise, to practice appropriate sleep hygiene, and to seek ways to share experiences and concerns with other students. Additionally, a meta-analysis demonstrated the effectiveness of cognitive, behavioral, and mindfulness interventions in reducing stress in university students.³⁶ Positive impacts of cognitive restructuring, relaxation, and meditation on students were consistently reported across countries and different educational programs.³⁶ The effectiveness of these interventions is supported by other meta-analyses of studies in mixed populations.^{37,38}

The study's weaknesses include utilizing the PSS-4 scale rather than the more comprehensive PSS-14 instrument to measure stress. The rationale was that the PSS-4 instrument has been recommended as a way to increase the response rate for surveys with lengthy questionnaires. Satisfaction with life was also assessed using a single Likert scale.

Another weakness is that the study was cross-sectional. Different results might have been obtained if the study was repeated, or if it had been performed at a different time during the year. Also, some students may have had unique stressful events, such as an important examination or an impending deadline for a paper. We did not collect information on financial stressors relating to tuition, and to the high living expenses in Qatar. Furthermore, we did not collect information on academic performance, therefore stress levels cannot be correlated with educational achievement. Education City is a unique educational environment in the Middle East, so it is uncertain if the results can be generalized to other students attending universities in other regions. Finally, except for the relationship with sex, we cannot be certain about causality and can only state that there is an association between stress and several other variables.

Conclusions

After multivariable adjustment, we found that being female and from an EMR country other than Qatar, Asia or Africa, living on-campus, eating when bored, not exercising for lack of self-discipline, having trouble sleeping and concentrating during class, and having low overall satisfaction with life were all related to higher levels of self-reported stress in university students attending Education City in Qatar. Awareness of these factors can help educators and student health providers to identify students needing support to manage stress. Stress-reduction and self-compassion interventions, self-support systems, mentorship and buddy programs; and well-being campaigns can be implemented on-campus, while counseling and mental health services should be designed and made easily accessible in the university setting. Such programs provide students with appropriate tools and support to effectively cope with academic stress.

Future research should explore reliable ways to identify, monitor, and manage stress in university students. These pathways should be pursued along with the overall goal of stress prevention in this vulnerable population. Recognition and stress prevention will be especially relevant following the severe disruption in higher education caused by the SARS CoV-2 virus pandemic.

Acknowledgments

The authors would like to thank Hekmat Alrouh and Aida Nasir (both former employees at the Institute for Population Health, Weill Cornell Medicine-Qatar) for their assistance with data collection and data entry.

Conflict of interest disclosure

The authors have no conflicts of interest to report.

Funding

This work was funded by the Institute for Population Health, Weill Cornell Medicine-Qatar and Qatar Foundation through the Weill Cornell Medicine-Qatar Biomedical Research Program.

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Data availability statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to ethical restrictions; they contain information that could compromise the privacy of research participants.

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