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Association Between Depression, Anxiety, and Stress and Sleep Quality Among University Students from Saudi Arabia: A Cross-Sectional Study

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Introduction: Inadequate sleep is linked to increased mental distress, and mental disorders often impair sleep quality, suggesting a bidirectional relationship. University students are particularly vulnerable to mental health issues due to academic pressures and related personal experiences. This study assesses sleep quality among university students in Jazan, Saudi Arabia, and its association with depression, anxiety, and stress levels.

Methods: A cross-sectional study was conducted among university students in online settings. The questionnaire collected demographic data, assessed anxiety, depression, and stress using the DASS-21, and measured sleep quality with the Pittsburgh Sleep Quality Index (PSQI). Statistical significance was tested using either Chi-squared tests or Fisher's exact tests and followed up by logistic regression to calculate the odds of poor sleep quality among the students according to the levels of depression, anxiety, and stress.

Results: Of 508 participating students, 74% reported poor sleep quality. A statistically significant association was found between poor sleep quality and the presence of anxiety, depression, and stress (all $P<0.001$). Abnormal stress levels were associated with higher odds of poor sleep 4.68 [2.8–7.7], followed by higher odds of poor sleep quality among students with anxiety 3.62 [2.38–5.52] and higher odds of poor sleep quality among students with depression 3.31 [2.1–4.99]. All seven PSQI components were significantly associated with depression, anxiety, and stress ($P<0.05$), except for sleep duration and stress, as well as sleep duration and depression, which had a marginally significant association ($P=0.065$). Depression showed a higher association with subjective sleep quality, daytime dysfunction, and sleep disturbances compared to stress and anxiety.

Conclusion: The majority of university students in this study experienced poor sleep quality, which was significantly associated with higher levels of depression, anxiety, and stress. The study highlights the critical importance of addressing poor mental health in university students and its strong correlation with sleep quality.

Keywords: sleep quality, depression, anxiety, stress, Jazan, Saudi Arabia

Introduction

Mental wellbeing is an important component of health and is often associated with how individuals learn, work, and contribute to their communities. An individual's mental wellbeing is affected by multiple factors, such as coping skills, substance use, genetics, and socioeconomic determinants.[1] Furthermore, according to the American College of Lifestyle Medicine, stress management, avoidance of risky substances, social connections, and restorative sleep are important components of a healthy lifestyle, in addition to good nutrition and physical activity.[2]

Current evidence indicates that sleep quality is correlated with mental wellbeing, and inadequate sleep is associated with increased risk of mental distress.[3] Additionally, mental disorders influence sleep quality, and individuals suffering from stress,[4,5] anxiety,[6] and depression[7] are at higher risk of sleep disturbances and poor sleep quality. This suggests that

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the association between mental wellbeing and sleep quality is bidirectional, meaning that mental health can affect sleep quality and that poor sleep quality is a risk factor for mental disorders.[8,9] While the general association between mental health and sleep quality is well-established, further context-specific research is needed to fully understand the magnitude and contextual determinants of this association among university students in the Middle Eastern region.

One contextual factor that may impact mental wellbeing and sleep quality is education environment. The current evidence suggests that students are at higher risk of mental health problems if they have a negative educational environment and personal experiences relating to it, such as exposure to bullying and substance abuse.[10] The prevalence of depression, anxiety, and stress among university students was reported to be high, and some students required access to relevant supportive services.[11] Furthermore, academic performance also correlates with mental health, as impaired mental health has been indicated to impact academic performance.[12,13]

It was found that the impacts of an education environment on the mental wellbeing of students could be buffered by personal characteristics and lifestyle factors. Personality traits, coping strategies, and self-esteem levels were found to be internal characteristics that could alter mental wellbeing among university students.[14–16] Additionally, lifestyle choices and social support also act as buffers for students' mental wellbeing, as exercise, good sleep, and social support were reported to reduce the risk of developing depression, anxiety, and stress.[17–20] This highlights the importance of addressing lifestyle factors, including sleep hygiene, among university students and their association with overall mental wellbeing.

Recent studies indicate that poor sleep quality is prevalent among university students and is highly associated with mental wellbeing.[21–24] This emphasizes the importance of assessing sleep quality among university students and how it correlates with levels of depression, anxiety, and stress. Ajeebi et al reported in a previous investigation conducted to assess chorontype distribution among university students from Jazan, Saudi Arabia that only 27.4% were morning type and the remaining were either evening type or neither type.[25] Ajeebi et al concluded that the university students exhibited certain lifestyle practices that can disturb sleeping chronotype such as dietary habits, caffeine consumption, and smoking and Khat chewing.

In addition to the identified disturbance of the chronotype among the university students, it can be postulated that quality of sleep can be affected. Additionally, disturbance of quality of sleep might be associated with negative impact on mental well-being of the students. Nonetheless, evidence concerning the magnitude of the association between quality of sleep and mental health among university students in the southwest of Saudi Arabia is currently limited. The current study assesses sleep quality in a sample of university students from Jazan, in the southwest of Saudi Arabia, and examines the association between levels of depression, anxiety, and stress with sleep quality.

Methods

Study Context

The current investigation utilized a cross-sectional design to recruit a sample of university students. The targeted sample was from Jazan University in the southwest of Saudi Arabia. The students were invited to participate in the study during February and March of 2023. The study setting was online. Approval to conduct the study was secured from the Standing Committee of Scientific Research at Jazan University (approval number: REC-44/04/365, dated November 14, 2022). Additionally, the study has been implemented while adhering to the principles of the Declaration of Helsinki. Participation in the study was voluntary, and students had the right to reject participation and to withdraw at any stage of the study.

Data Collection Tool

The data for the analysis was collected via a questionnaire comprised of three main components. The first component asked the students about their demographic data, including their age, gender, college, year of study, social status, diagnosis with a chronic disease, smoking and khat chewing habits, and latest GPA. The second component assessed levels of anxiety, depression, and stress using the DASS-21 questionnaire. The validity and reliability of the questionnaire were assessed with reference to Antony et al, revealing internal consistencies between 0.87 and 0.94 for

depression, anxiety, and stress.[26] Additionally, the validity of the DASS-21 questionnaire was tested by comparing the performance of the questionnaire to similar tools measuring depression and anxiety, such as the Beck Depression Inventory and Beck Anxiety Inventory, resulting in positive correlations between 0.51 and 0.85.[27] The third component measured quality of sleep via the Pittsburgh Sleep Quality Index (PSQI). The questionnaire included seven main components measuring subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medications, and daytime dysfunction. The validity and reliability of the PSQI were tested by Buysse et al, and it was concluded that a cut-off score of 5 could distinguish between good and poor sleep quality, with a sensitivity of 89% and a specificity of 85% respectively.[28] To meet the language preference of the target population, the Arabic versions of the scales were used.[27,29]

Data Collection Process

Identification and recruitment of students were conducted within online settings. To secure an adequate sample, the assessment tool was converted to an online format using Google Forms. The online questionnaire was accompanied by a study information sheet that included the study's objectives and assessment methods and enabled the participants to provide electronic informed consent. Those who refused to participate were directed elsewhere.

Convenient, non-random sampling was performed to recruit the study's sample. The generated web link was shared on social media platforms, mainly WhatsApp, to recruit students who met the inclusion criteria. Participants were also encouraged to share the generated web link with their colleagues. Students who were registered with the university at the time of the study were included in the study. Additionally, those who were not students or were university alumni at the time of the recruitment were excluded from the study.

The sample size estimation was performed using Epi Info's StatCal function for surveys to determine the prevalence of depression, anxiety, and stress of 50% with a 95% confidence interval and 5% margin of error. The resulting sample size was increased by 30% to 500 as a procedure to account for cases not meeting the inclusion criteria. Additionally, the estimated sample size was sufficiently powered to detect an association between abnormal mental health and poor sleep quality of a moderate effect size (odds ratio = 1.5) with a significance level of 5% and statistical power of 95%.

Data Analysis

Data analysis was conducted using the Statistical Package for the Social Sciences software (version 25). Descriptive analysis involved the calculation of frequencies and proportions to determine binary and categorical variables. Additionally, it also involved using means and standard deviations to summarize continuous variables. An evaluation of the presence of depression, anxiety, and stress was performed in line with the standardized scoring system described elsewhere.[26] Scoring of the PSQI was also performed according to the standardized scoring system described elsewhere.[28]

A comparison was performed to compare demographic sample characteristics with quality of sleep. Additionally, the sleep quality scores for both the seven PSQI components and the global PSQI were examined according to the presence of depression, anxiety, and stress. For the purpose of conducting cross-tabulation to compare the distributions, age was dichotomized, with the mean age of 22 being the cut-off point. Additionally, the global PSQI was dichotomized based on a score of 5, where scores higher than 5 indicated poor sleep quality and scores lower than 5 indicated good sleep quality. Finally, depression, anxiety, and stress were dichotomized into normal and abnormal levels based on cut-off scores of 9, 7, and 14, respectively. Statistical significance was tested using either Chi-squared tests or Fisher's exact tests. This was followed up by logistic regression to calculate the odds of poor sleep quality among the students according to the levels of depression, anxiety, and stress. Crude odds ratios (OR) and odds ratios adjusted for measured demographic characteristics were estimated to provide assessment of effect sizes and adjustments for confounders. A P value ≤ 0.05 was considered statically significant.

Results

A total of 508 students participated in the current study. The distribution of scores for quality of sleep among the sample according to the measured demographic characteristics is displayed in Table 1. In summary, 377 students (74%) suffered

Table 1 Distribution of Global Pittsburgh Sleep Quality Index Scores According to the Demographic Variables Among the 508 University Students from Jazan, Saudi Arabia

Variables	**Global Pittsburgh Sleep Quality Index Score**		**Total**	**P value****
	5 or less	More than 5		
Age *				0.102
Less than 22	51 [22.1%]	180 [77.9%]	231 [100%]	
22 or more	79 [28.7%]	196 [71.3%]	275 [100%]	
Gender				0.104
Male	78 [28.9%]	192 [71.1%]	270 [100%]	
Female	53 [22.3%]	185 [77.7%]	238 [100%]	
Specialty*				0.452
Health specialty	89 [26.6%]	245 [73.4%]	334 [100%]	
Non-health specialty	40 [23.4%]	131 [76.6%]	171 [100%]	
Year of study*				0.534
Less than 4th year	58 [23.8%]	186 [76.2%]	244 [100%]	
4th year or more	66 [26.5%]	183 [73.5%]	249 [100%]	
Smoking*				0.028
Never	112 [27.9%]	290 [72.1%]	402 [100%]	
Current	8 [15.4%]	44 [84.6%]	52 [100%]	
Previous	5 [13.2%]	33 [86.8%]	38 [100%]	
Khat chewing*				0.830
Never	117 [25.9%]	335 [74.1%]	452 [100%]	
Current	2 [16.7%]	10 [83.3%]	12 [100%]	
Previous	6 [21.4%]	22 [78.6%]	28 [100%]	
GPA*				0.335
Good/pass	35 [26.7%]	96 [73.3%]	131 [100%]	
Very good	46 [28.4%]	116 [71.6%]	162 [100%]	
Excellent	44 [21.9%]	157 [78.1%]	201 [100%]	
Social status				0.855
Single	121 [26.0%]	345 [74.0%]	466 [100%]	
Married/ Divorced widowed	10 [23.8%]	32 [76.2%]	42 [100%]	
Diagnosis with a chronic disease				0.762
None	113 [25.5%]	330 [74.5%]	443 [100%]	
Yes	18 [27.7%]	47 [72.3%]	65 [100%]	

Notes: *Two missing cases for age, three missing cases for specialty, 15 missing cases for year of study, 16 missing cases for smoking and khat chewing, and 14 missing cases for GPA. **Chi-squared tests were performed to determine the significance of all associations, except for khat chewing, which was determined using Fisher's exact test.

from poor sleep quality. The distribution of quality of sleep among the sample was not statistically significant in relation to the measured sample characteristics except for smoking. Higher rates of poor sleep quality were detected for current and previous smokers than for those who had never smoked (P=0.028).

Table 2 displays the distribution of quality of sleep scores according to the presence of anxiety, depression, and stress. It is clear that poor sleep quality is more frequent in students with anxiety, depression, or stress (P<0.05). Stress appears to be more associated with poor sleep quality than depression and anxiety, as 89% of those with abnormal levels of stress suffered poor sleep quality.

Table 3 and Figure 1 present the distribution of the seven components of sleep according to the presence of anxiety, depression, and stress. Students with abnormal levels of anxiety, depression, and stress scored higher for all components, indicating positive correlation among the measured components. Nonetheless, the extent to which sleep quality components worsened varied according to mental health status.

All seven components were statistically significant in their association with depression, anxiety, and stress in the study sample (P<0.05), excluding the association between sleep duration and stress. Additionally, the association between sleep duration and depression was marginally significant (P=0.065). Observing the distributions, depression appears to have a higher association with subjective sleep quality in comparison to stress and anxiety. Similarly, daytime dysfunction and sleep disturbances were frequently present in those with abnormal anxiety or depression levels in comparison to other sleep quality components. Although the global PQSI score suggests that stress had a higher impact on sleep quality among this sample, the assessment of each component suggests that depression has a higher impact on certain sleep quality components.

Table 4 illustrates the findings of the univariate and multivariate logistic regression to estimate the odds of poor sleep quality as measured via PSQI according to the presence of abnormal levels of anxiety, depression, and stress. Abnormal stress levels were associated with higher odds of poor sleep 4.68 [2.8–7.7], followed by higher odds of poor sleep quality among students with anxiety 3.62 [2.38–5.52] and higher odds of poor sleep quality among students with depression 3.31 [2.1–4.99]. The associates remained statistically significant (p values <0.001) upon adjusting for the effect of age, gender, specialty, year of study, smoking, khat chewing, GPA, social status, and diagnosis with a chronic disease. This indicates the potential strong association between mental health and sleep quality among the university students despite the variation of other demographic and health characteristics.

Table 2 Distribution of Global Pittsburgh Sleep Quality Index Scores According to the Presence of Anxiety, Depression, and Stress Among the 508 University Students from Jazan, Saudi Arabia

Variables	**Global Pittsburgh Sleep Quality Index Score**		**Total**	
	5 or less	More than 5		
Anxiety				<0.001
Normal	88 [39.3%]	136 [60.7%]	224 [100%]	
Abnormal	43 [15.1%]	241 [84.9%]	284 [100%]	
Depression				<0.001
Normal	81 [39.5%]	124 [60.5%]	205 [100%]	
Abnormal	50 [16.5%]	253 [83.5%]	303 [100%]	
Stress				<0.001
Normal	110 [35.6%]	199 [64.4%]	309 [100%]	
Abnormal	21 [10.6%]	178 [89.4%]	199 [100%]	

Table 3 Distribution of Pittsburgh Sleep Quality Index Components According to the Presence of Anxiety, Depression, and Stress Among the 508 University Students from Jazan, Saudi Arabia

Pittsburgh Sleep Quality Index Components	Anxiety		Depression		Stress	
	Normal	Abnormal	Normal	Abnormal	Normal	Abnormal
Component 1: Subjective Sleep Quality						
Very good	**55 [59.1%]**	**38 [40.9%]**	**52 [56.5%]**	**40 [43.5%]**	**75 [81.5%]**	**17 [18.5%]**
Fairly good	**120 [50.2%]**	**119 [49.8%]**	**112 [46.9%]**	**127 [53.1%]**	**163 [68.2%]**	**76 [31.8%]**
Fairly bad	**43 [30.5%]**	**98 [69.5%]**	**53 [37.6%]**	**88 [62.4%]**	**62 [44.0%]**	**79 [56.0%]**
Very bad	**10 [19.2%]**	**42 [80.8%]**	**15 [28.8%]**	**37 [71.2%]**	**22 [42.3%]**	**30 [57.7%]**
Total	**228 [43.4%]**	**297 [56.6%]**	**222 [42.3%]**	**303 [57.7%]**	**322 [61.3%]**	**203 [38.7%]**
Component 2: Sleep latency Final Score						
None	**51 [57.3%]**	**38 [42.7%]**	**40 [44.9%]**	**49 [55.1%]**	**69 [77.5%]**	**20 [22.5%]**
Low	**93 [50.3%]**	**92 [49.7%]**	**89 [48.1%]**	**96 [51.9%]**	**131 [70.8%]**	**54 [29.2%]**
Moderate	**51 [32.7%]**	**105 [67.3%]**	**53 [34.0%]**	**103 [66.0%]**	**77 [49.4%]**	**79 [50.6%]**
High	**32 [36.0%]**	**57 [64.0%]**	**30 [33.7%]**	**59 [66.3%]**	**43 [48.3%]**	**46 [51.7%]**
Total	**227 [43.7%]**	**292 [56.3%]**	**212 [40.8%]**	**307 [59.2%]**	**320 [61.7%]**	**199 [38.3%]**
Component 3: Sleep duration						
>7 hours	67 [40.6%]	98 [59.4%]	71 [43.3%]	93 [56.7%]	**104 [63.4%]**	**60 [36.6%]**
6-7 hours	88 [47.8%]	96 [52.2%]	82 [44.6%]	102 [55.4%]	**120 [65.2%]**	**64 [34.8%]**
5-6 hours	39 [44.3%]	49 [55.7%]	27 [30.7%]	61 [69.3%]	**55 [62.5%]**	**33 [37.5%]**
<5 hours	32 [40.5%]	47 [59.5%]	24 [30.4%]	55 [**69**.6%]	**43 [54.4%]**	**36 [45.6%]**
Total	226 [43.8%]	290 [56.2%]	204 [39.5%]	311 [60.5%]	**322 [62.4%]**	**194 [37.6%]**
Component 4: Habitual sleep efficiency						
>85%	**151 [49.2%]**	**156 [50.8%]**	**136 [44.4%]**	**170 [55.6%]**	**213 [69.6%]**	**93 [30.4%]**
75-84%	**17 [36.2%]**	**30 [63.8%]**	**12 [25.5%]**	**35 [74.5%]**	**27 [57.4%]**	**20 [42.6%]**
65-74%	**7 [38.9%]**	**11 [61.1%]**	**3 [16.7%]**	**15 [83.3%]**	**8 [44.4%]**	**10 [55.6%]**
<65%	**50 [35.2%]**	**92 [64.8%]**	**37 [26.1%]**	**105 [73.9%]**	**69 [48.6%]**	**73 [51.4%]**
Total	**225 [43.8%]**	**289 [56.2%]**	**188 [36.6%]**	**325 [63.4%]**	**317 [61.8%]**	**196 [38.2%]**
Component 5: Sleep disturbances						
None	**40 [85.1%]**	**7 [14.9%]**	**35 [74.5%]**	**12 [25.5%]**	**40 [85.1%]**	**7 [14.9%]**
Low	**163 [51.7%]**	**152 [48.3%]**	**138 [43.9%]**	**176 [56.1%]**	**215 [68.5%]**	**99 [31.5%]**
Moderate	**23 [16.3%]**	**118 [83.7%]**	**28 [19.9%]**	**113 [80.1%]**	**46 [32.6%]**	**95 [67.4%]**
High	**2 [9.1%]**	**20 [90.9%]**	**3 [13.6%]**	**19 [86.4%]**	**7 [31.8%]**	**15 [68.2%]**
Total	**228 [43.4%]**	**297 [56.6%]**	**204 [38.9%]**	**320 [61.1%]**	**308 [58.8%]**	**216 [41.2%]**

(*Continued*)

Table 3 (Continued).

Pittsburgh Sleep Quality Index Components	Anxiety		Depression		Stress	
	Normal	Abnormal	Normal	Abnormal	Normal	Abnormal
Component 6: Use of sleeping medications						
None	**200 [47.6%]**	**220 [52.4%]**	**178 [42.5%]**	**241 [57.5%]**	**267 [63.6%]**	**153 [36.4%]**
Less than once a week	**17 [32.7%]**	**35 [67.3%]**	**19 [36.5%]**	**33 [63.5%]**	**32 [61.5%]**	**20 [38.5%]**
Once or twice a week	**7 [23.3%]**	**23 [76.7%]**	**7 [23.3%]**	**23 [76.7%]**	**14 [46.7%]**	**16 [53.3%]**
Three or more times a week	**4 [17.4%]**	**19 [82.6%]**	**4 [17.4%]**	**19 [82.6%]**	**5 [21.7%]**	**18 [78.3%]**
Total	**224 [42.7%]**	**278 [52.9%]**	**204 [38.9%]**	**320 [61.1%]**	**313 [59.7%]**	**211 [40.3%]**
Component 7: Daytime dysfunction						
None	**31 [63.3%]**	**18 [36.7%]**	**32 [66.7%]**	**16 [33.3%]**	**42 [87.5%]**	**6 [12.5%]**
Low	**151 [51.9%]**	**140 [48.1%]**	**144 [49.5%]**	**147 [50.5%]**	**201 [69.1%]**	**90 [30.9%]**
Moderate	**41 [28.7%]**	**102 [71.3%]**	**41 [28.7%]**	**102 [71.3%]**	**67 [46.9%]**	**76 [53.1%]**
High	**5 [11.9%]**	**37 [88.1%]**	**5 [11.9%]**	**37 [88.1%]**	**7 [16.7%]**	**35 [83.3%]**
Total	**228 [43.4%]**	**297 [56.6%]**	**222 [42.3%]**	**303 [57.7%]**	**317 [60.4%]**	**208 [39.6%]**

Notes: Bold indicates a statistically significant value (P<0.05) for the Chi-squared test.

Discussion

The current study measured sleep quality among university students from Saudi Arabia and evaluated the association between sleep quality and depression, anxiety, and stress. The findings indicate that the majority of the sample suffered from poor sleep quality (74%). Lower sleep quality was found in participants with abnormal levels of depression, anxiety, and stress. Poor sleep quality was more frequently reported among students with abnormal stress levels compared to depression and anxiety. Univariate analysis showed abnormal stress had the highest odds of poor sleep (OR=4.68), followed by anxiety (OR=3.62) and depression (OR=3.31), and these strong associations remained statistically significant ($p<0.001$) after adjusting for demographic and health characteristics. However, when assessing the associations between depression, anxiety, and stress and the components of the PSQI, the frequency of poor sleep quality varied depending on the presence of these mental health conditions. All seven components of sleep quality were statistically significant with regard to their correlations with depression, anxiety, and stress, excluding the relationship between sleep duration, anxiety, and depression.

The findings of the study can be compared to similar local or international investigations. In a similar cross-sectional study conducted by Sayed et al, which recruited a sample of 347 university medical students and used the PSQI to measure sleep quality, it was concluded that 46.6% of participants experienced moderate sleep quality.[30] Additionally, it was concluded that gender and marital status were associated with sleep quality, though these were not measured in the current study. The main differences between the study conducted by Sayed et al and the current study are the different cut-off points for sleep quality and the study sample, which was restricted to medical students in Sayed et al's study, whereas the current analysis involved students from different specialties.

In a similar study conducted by Almojali et al, with a sample of 756 medical students from Riyadh, Saudi Arabia, it was concluded that 76% of the students suffered poor sleep quality, which is similar to the findings of the current analysis.[31] Additionally, Almojali et al found that students suffering from stress were more likely to suffer from low sleep quality, which is consistent with the findings of the current study. Similarly, in another study conducted in Abha, Saudi Arabia, involving a sample of 514 students, it was also concluded that 88% of the students suffered poor sleep quality and that sleep quality was not associated with demographic factors, similar to the findings of the current study.[32]

Similarly, international studies also indicate a positive correlation between the presence of depression, anxiety, and stress and poor sleep quality. A study conducted in Iran involving a sample of 471 freshman university students noted that risk of poor sleep quality was higher for those with depression or anxiety compared to for those without these conditions.[33] A Turkish study involving a sample of 704 university students also reported similar findings, indicating positive correlations between depression, anxiety, and stress and poor sleep quality.[34] In a Croatian study that involved a sample of 386 medical students, it was similarly concluded that depression, anxiety, and stress were correlated with poor sleep quality.[21]

The current study assessed the association between depression, anxiety, and stress and the seven components of the PSQI. It was noted that the associations varied according to each measured component. Nonetheless, studies that assess sleep quality components and mental health are limited. In a study that assessed the association between the seven components of sleep quality and the presence of depression, stress, and anxiety among a sample of 1552 participants from Portugal, Spain, and Brazil, it was concluded that all components were associated with the measured mental conditions except for subjective sleep quality.[35] This is similar to the findings of the current study, except that all seven components were associated with depression, anxiety or stress, although sleep duration was only associated with the latter.

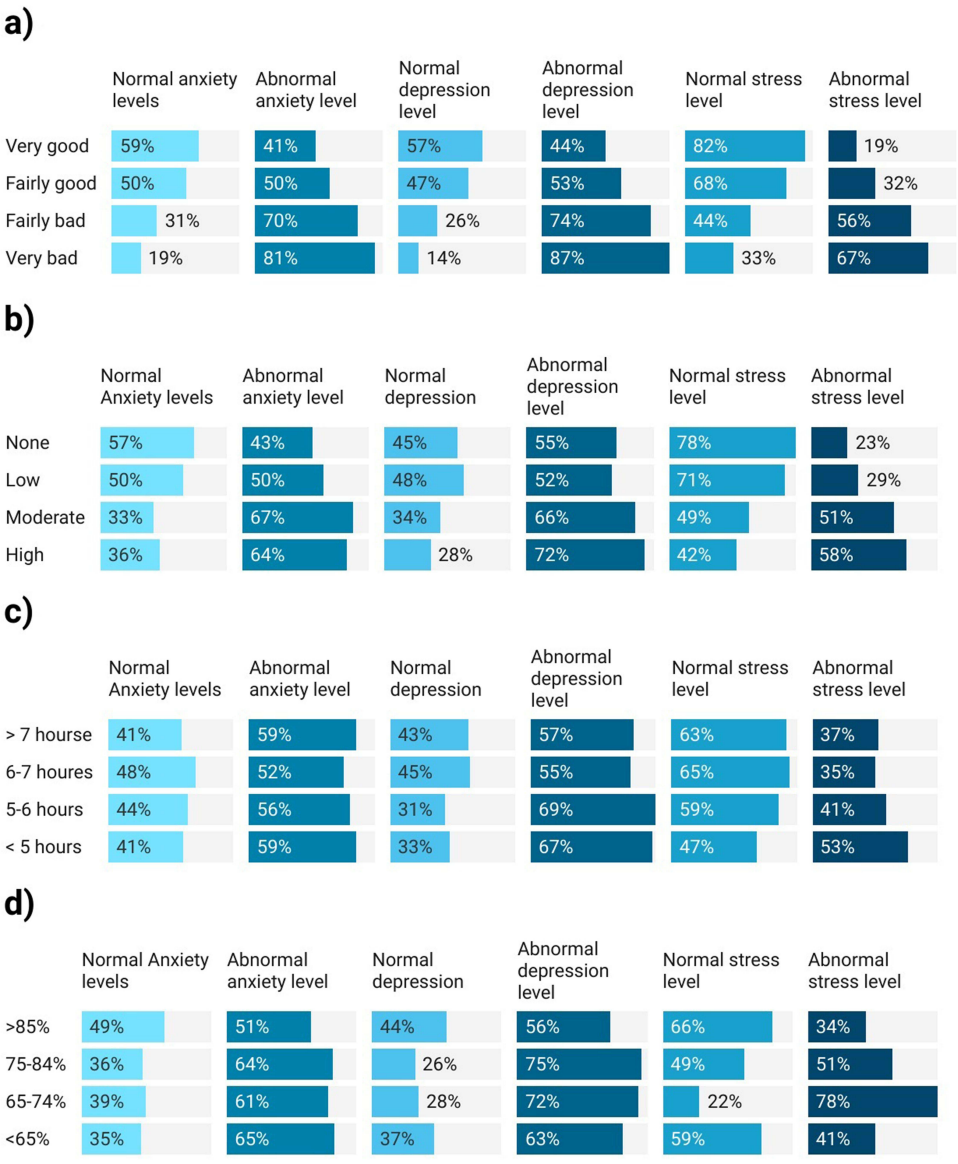

Figure 1 Continued.

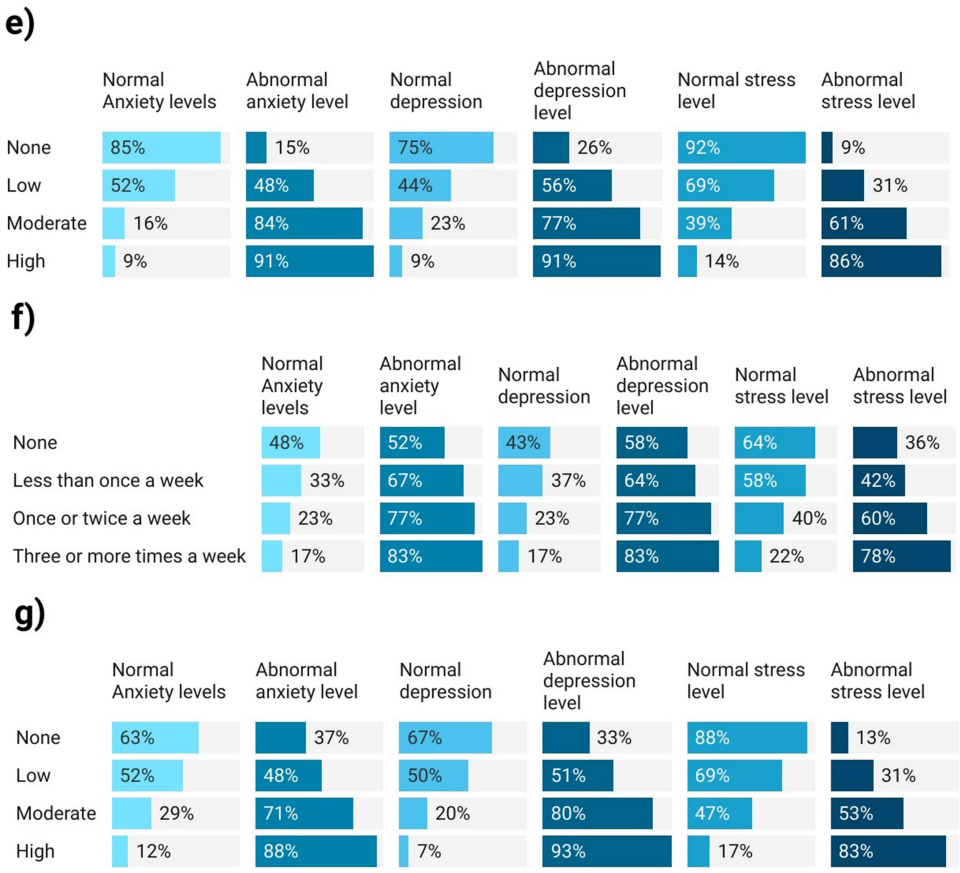

Figure 1 Distribution of Pittsburgh Sleep Quality Index components according to the presence of anxiety, depression, and stress among the 508 university students from Jazan, Saudi Arabia ((**a**) Subjective Sleep Quality, (**b**) Sleep Latency, (**c**) Sleep Duration, (**d**) Habitual Sleep Efficiency, (**e**) Sleep Disturbances, (**f**) Use of Sleeping Medications, (**g**) Daytime Dysfunction).

In a Chinese study that assessed the association between sleep pattern and duration and depression among a sample of 8775 adolescents, it was concluded that depression was associated with shorter periods of sleep.[36] This is similar to the findings of the current study, with students having shorter periods of sleep among those suffering from abnormal levels of

Table 4 Odds Ratios of Poor Sleep Quality Measured via Pittsburgh Sleep Quality Index According to the Presence of Anxiety, Depression, and Stress Among the 508 University Students from Jazan, Saudi Arabia

Variables	ORs for Poor Sleep Quality			
	Crude ORs [95% CI]	P value	Adjusted OR* [95% CI]	P value
Anxiety				
Normal	Reference			
Abnormal	3.62 [2.38–5.52]	<0.001	3.23 [2.00–5.23]	<0.001
Depression				
Normal	Reference			
Abnormal	3.31 [2.1–4.99]	<0.001	2.79 [1.76–4.41]	<0.001

(*Continued*)

Table 4 (Continued).

Variables	ORs for Poor Sleep Quality			
	Crude ORs [95% CI]	P value	Adjusted OR* [95% CI]	P value
Stress				
Normal	Reference			
Abnormal	4.68 [2.8–7.7]	<0.001	4.41 [2.48–7.81]	<0.001

Notes: *Adjusted for age, gender, specialty, year of study, smoking, khat chewing, GPA, social status, and diagnosis with a chronic disease.
Abbreviations: OR, Odds ratios; CI, Confidence intervals.

depression. However, the association detected in the current study exhibited marginal statistical significance (P=0.065), which can be partially explained by the smaller sample size of the current study in comparison to the Chinese study.

The findings of the current study, which illustrate a strong association between mental health and sleep quality among university students, have multiple clinical and public health implications. The presence of abnormal levels of depression, anxiety, and stress among the students suggests the presence of contextual factors influencing mental well-being of the university students. This necessitates the provision of supporting services within the university campus, such as better access to mental healthcare services and the provision of courses or workshops for stress management. Additionally, students can be offered access to sleep medicine clinics within the university healthcare services, which can then apply targeted interventions to improve sleep hygiene. Finally, a policy of faculty-targeted programs can be implemented to increase awareness among the university faculty about the importance of detecting signs of psychological distress and the possible association with impaired sleep quality.

The current study has several strengths and limitations. Its main strength lies in its recruitment of a sample of university students with varying levels of anxiety, depression, and stress to measure associations with sleep quality. Additionally, the assessment of these associations with sleep quality components provided further evidence of how mental health might be related to each sleep quality component. Its main limitation is the nature of the assessment tool used, which may have resulted in measurement bias. Nonetheless, the assessment was performed using validated tools with strong reliability. Since the sample was limited to university students, the generalizability is limited, meaning the study is less applicable to the general population and people of older ages. Additionally, selection bias might have been incurred by targeting students who have access to the internet and the WhatsApp application, potentially excluding those with no internet access or those without the application. Finally, the cross-sectional design inherently limits the ability to establish causality between sleep quality and mental health. This necessitates the use of future longitudinal research to provide stronger evidence for causal inference.

Conclusion

The findings of the current study revealed that the majority of the sample suffered from poor sleep quality. Lower sleep quality was associated with abnormal levels of depression, anxiety, and stress. All seven components of quality of sleep were statistically significant in their association with depression, anxiety, and stress, except for the association between sleep duration, anxiety, and depression. This study indicates the importance of addressing mental health issues in university students and how they correlate with sleep quality. Additionally, the findings suggest the need to conduct future longitudinal research to investigate specific mechanisms related to sleep quality and its contribution to the severity of mental health outcomes.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically

reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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