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The prevalence and association of stress with sleep quality among medical students

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ABSTRACT

Introduction: Medical students tend to reduce their sleep, in an effort to adjust and cope with their workload and stressful environment. This study estimated the prevalence of and the relationship between poor sleep quality and stress among medical students.
Methods: This cross-sectional study was conducted using a stratified random sample of male and female medical students in King Saud bin Abdulaziz University for Health Sciences in Riyadh, Saudi Arabia. A self-administered questionnaire was distributed to assess sleep quality using the Pittsburgh Sleep Quality Index, and the stress level by using the Kessler Psychological Distress Scale.
Results: A high prevalence of poor sleep quality (76%) and stress (53%) were found, with a statistically significant association ($p < 0.001$). Logistic regression indicated that students who are not suffering from stress are less likely to have poor sleep quality (OR = 0.28, $p < 0.001$), and the risk of having poor sleep quality is almost four times higher in students whose cumulative grade point average (GPA) is less than 4.25 (OR = 3.83, $p = 0.01$).
Conclusion: The study documents a statistically significant association between stress and poor sleep quality. A recommendation for the management of medical college is to establish academic counseling centers focusing in promoting good sleep hygiene and strengthening students' study skills and coping with their stressful environment.

1. Introduction

A high prevalence of stress is one of the most important issues reported among medical students globally. It is defined as the "wear and tear" the body experiences as it adjusts to pressure or a threating situation [1]. Many factors can contribute to medical school being a very stressful environment. Some of those factors include: extensive curricula, numerous academic requirements, frequent, difficult and various types of examinations [2,3]. High proportions of stress have been reported among medical students in different countries, for example in Pakistan (60%), Thailand (61%), Malaysia (42%), and the United States (57%) [2,4–6]. Locally, the prevalence of stress among medical students is reported as 63% at King Saud University [7], and 53% at King Faisal University [8].

Although some studies have found that some level of stress has good effects on the physiological functioning and can facilitate the learning process (favorable stress), it is well documented that high levels of stress has negative effects on the physical and mental health of medical students (distress or unfavorable stress) [1]. Specifically, high levels of stress can affect cognitive functioning, level of concentration and academic performance [9].

Medical students may not consider sleep as a top priority in the context of their academic requirements as they reduce their sleeping time to have extra hours for studying and workload. Consequently, they develop poor sleeping habits especially in the weeks preceding an examination [10]. It is reported that 51% and 59% of medical students had a poor sleep quality in the United States [11] and Lithuania [12], respectively. Few studies have been done to investigate sleep-related problems in Saudi medical students [13,14] reporting that more than a third (37%) of the medical students at King Saud University have abnormal sleep habits [13].

Since sleep plays a significant role in the cognitive processes as well as physical and mental health [15,16], sleep deprivation can affect the academic performance of medial students [10]. Many

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studies in the United States, Australia, India and other countries have found that students with a poor sleep quality have poor marks on their examinations and were more depressed than their colleagues [17–19]. However, there are no recent studies investigating the association of stress with sleep quality. Two studies, conducted in 1989 and 1997, concluded that sleep disturbance could be either a cause, symptom or comorbidity with stress or with a psychiatric disorder [20,21]. Another study indicated that stress causes many sleep difficulties, such as restless sleep, mid-sleep awakening and waking up too early [22].

From a Saudi perspective, it is important to have a better understanding of medical students' mental and physical health and to identify their additional needs not yet met through medical school counseling centers. Therefore, the objectives of this study were to determine the prevalence of and the association between poor sleep quality and self-perceived stress among medical students in a College of Medicine in Saudi Arabia.

2. Material and methods

2.1. Study design and setting

This cross-sectional study was conducted from April to May 2016 at the College of Medicine at King Saud bin Abdulaziz University for Health Sciences (KSAU-HS) in Riyadh, Saudi Arabia. At KSAU-HS, students are required to spend two years in the Pre-Professional Program at the College of Science and Health Profession (COSHP) before they enroll in the College of Medicine. Most of the KSAU-HS students are undergraduates, and their average age at the beginning of medical school is 20 years old. The College of Medicine at KSAUHS offers a four-year problem-based learning (PBL) program, divided into two phases namely a pre-clinical (the first two years) and the clinical phase (the last two years). The cumulative grade point average (GPA) in KSAU-HS is out of five and can be described as a grade (e.g. GPAs 4.75 and above are considered as A+ Excellent).

2.2. Subjects and sample size

The participants of this study were medical students in KSAU-HS. During the 2015–2016 academic year, there were 756 medical students (512 males and 244 females) registered in the College of Medicine. There were 290 first year students, 180s year, 152 third year, and 134 fourth-year medical students. Students in each academic year were divided into two groups based on their gender, which gave a total of eight groups for the four academic years.

To obtain a confidence interval (CI) of 95% and a 5% margin of error, a sample size of 255 participants was required. An additional 20% was added to the sample size to ensure an adequate percentage response rate and to compensate excluded students, resulting in a sample of 306 participants. Students who refused to take part in the study, or did not complete the questionnaire were excluded from the study.

2.3. Data collection and sampling technique

This study was approved by the Institutional Review Board of King Abdullah International Medical Research Center (KAIMRC), which is affiliated with KSAU-HS. The Students Affairs Department provided the student name list for each group. To obtain an unbiased sample size that represents the whole population, participants were selected from the eight lists through stratified random sampling using Microsoft Excel 2016. Examinations dates were obtained from the Student Affairs Department for each academic year, and a week was assigned for each group, at least two weeks prior to any examination to collect the data under the same circumstances for each group. Participants were informed that they were selected randomly, their participation was voluntary, and their responses were confidential. The study's objectives and information about the instruments were explained to the participants, and an informed consent was obtained from each participant. The questionnaires were distributed at the beginning of the day, and completed during breaks between lectures. Locked boxes were put outside each lecture hall and the participants were requested to deposit their completed questionnaire in the boxes to maintain confidentiality. After collecting the data, each questionnaire was given a serial number and no personal identifiers were used.

2.4. Outcome measures

The questionnaire consisted of three sections: the first section focused on demographic and lifestyle related information, the second section was the Kessler Psychological Distress Scale (K10), and the third section the Pittsburgh Sleep Quality Index (PSQI). Demographics and lifestyle variables included age, gender, academic year, current GPA, residence, having a physician among first-degree family members, and frequency of caffeine consumption (including coffee, tea and energy drinks).

The Kessler Psychological Distress Scale (K10), developed by Kessler, is a widely used instrument in many epidemiological studies to assess the severity of stress that students have experienced during the last four weeks [23]. It is a self-administered questionnaire consisting of ten questions about emotional states, each with a five-point Likert scale ranging from 'none of the time' to 'all of the time' and was scored from 1 to 5, respectively. The lowest score that could be achieved is 10 and the highest possible score 50. The scores were classified as follows: 20–24 are classified as mild stress, 25–29 as moderate stress and 30–50 as severe stress. The questionnaire can differentiate between cases and non-cases, is valid for use in general-purpose health surveys, and have good psychometric properties with a Cronbach's alpha of 0.89 [95% confidence interval (CI) 0.88–0.90] [23].

The last section contained the Pittsburgh Sleep Quality Index (PSQI), which was used to measure the quality and patterns of sleep over the last month [24]. The PSQI is the gold standard questionnaire for assessing subjective sleep quality and has been validated in both clinical and non-clinical populations [25,26]. The questions are framed in a 4-point Likert scale (0–3) and analyze seven factors including subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medications, and daytime dysfunction. The scores from each component are added to give a sum score, also called a global score (range 0–21). Combined, these numerical scores provide the clinician with an efficient overall summary of a patient's quality of sleep and sleep health.

2.5. Statistical analysis

Data were entered in Microsoft Excel 2016 and analyzed using IBM Statistical Package for the Social Sciences (SPSS) version 22. Categorical variables were presented by frequency and percentages, and continuous variables by mean and standard deviation. The association between sleep quality and stress as well as the demographic variables was examined using the Pearson's Chi-square test. Forward stepwise binary logistic regression was used to determine the predictors of sleep quality, and to calculate the odds ratio (OR) and 95% confidence intervals (95% CI). Sleep quality was used as a dependent variable and stress level and demographic variables as independent variables. A test with a p-value < 0.05 was considered as statistically significant.

3. Results

3.1. Baseline characteristics

Of 306 students, 263 (86%) completed and returned the questionnaire. The average age of the participants was 21.9 ± 1.4 year. Most of the participants were undergraduates (89%, n = 234). The majority of the participants were male (68.8%, n = 181). All participants were of Saudi background, and their characteristics are shown in Table 1.

3.2. Stress

The prevalence of all levels of stress among the students was 53.2% (n = 140). Mild stress was experienced by 61 students (23.2%), moderate stress by 35 students (13.3%), and severe stress by 44 students (16.7%). The mean Kessler Psychological Distress Scale (K10) score of the participant was 21.9 ± 7.3 (max = 50). As shown in Table 2, no significant association was found between stress and sex (p = 0.25), academic year (p = 0.72), GPA (p = 0.39), consumption of coffee (p = 0.24), tea (p = 0.92) or energy drinks (p = 0.37).

3.3. Sleep quality

The prevalence of poor sleep quality (PSQI score $\geq$ 5) among the students was 76% (n = 200), and the mean PSQI score was 7.11 ± 3.84 (maximum = 21). Of the seven components of the PSQI, the mean scores of subjective sleep quality, sleep latency, sleep duration, and daytime dysfunction were above 1, making them the highest contributing subscales to the global PSQI score. However, habitual sleep efficiency, sleep disturbances and the use of sleep medications had mean scores below 1. Table 1 shows that 36.6% of the students (n = 97) reported going to bed at 12 a.m. while 33.1% (n = 87) reported getting up at 7 a.m. However, the majority (73.4%, n = 193) had a sleep duration of less than seven hours per night with a mean of 5.8 ± 1.3 h of actual sleep (ranged from 2 to 10 h). Most of them (74.5%, n = 196) took less than 30 min to fall asleep (mean 32 ± 33 min, range 1–210 min). Of note, only 32.3% (n = 84) of the students specifically stated that their sleep quality was fairly bad or very bad with the majority (67.7%, n = 176) rating their sleep quality as fairly good or very good.

Table 1
Demographics and characteristics of the participants (N = 263).

Characteristics	Level	n	%
Sex	Male	181	68.8
	Female	82	31.2
Academic year	1st year	99	37.6
	2nd year	61	23.2
	3rd year	56	21.3
	4th year	47	17.9
Current GPA[†] (out of 5)	<4.25	59	23.1
	4.25–4.49	48	18.8
	4.50–4.74	67	26.3
	4.75–5.00	81	31.8
Living with family	No	20	7.6
	Yes	243	92.4
Physician among family members	No	184	70
	Yes	79	30
Time of going to bed	Before 00:00	60	22.8
	00:00–00:59	97	36.9
	01:00–01:59	46	17.5
	02:00–02:59	41	15.6
	After 3:00	19	7.2
Time of getting up in the morning	Before 6:00	42	16
	6:00–6:59	58	22.1
	7:00–7:59	87	33.1
	8:00–8:59	59	22.4
	After 9:00	17	6.5
Hours of actual sleep at night	<7 h	193	73.4
	$\geq$7 h	70	26.6

[†] Current Grade Point Average.

3.4. Factors associated with sleep quality

There was a statistically significant association between sleep quality and stress (p < 0.001). The association of sleep quality and the study variables of the participants are shown in Table 3. It shows that there is a statistically significant association between sleep quality and current GPA (p = 0.03). Additionally, having a physician among family members was significantly associated with poor sleep quality (p = 0.03).

Forward stepwise binary logistic regression was done to identify the predictors of sleep quality (the dependent variable) as shown in Table 4. It shows that students who are not suffering from stress are less likely to have poor sleep quality (OR = 0.28, 95% CI 0.15–0.53). Also, the risk of having poor sleep quality is almost four times higher in students who have a low GPA (<4.25) (OR = 3.83, 95% CI 1.48–9.93). Finally, being a medical student of a physician parent, sister or brother was a borderline predictor of poor sleep quality (OR = 2.11, 95% CI 0.99–4.50).

4. Discussion

The current study provided evidence of a high prevalence of psychological stress (53%) and a high and perhaps even alarming prevalence of poor sleep quality (76%). The prevalence of stress in this study is comparable with other studies conducted in different countries such as Pakistan (60%) [2] Thailand (61%) [4], and United States (57%) [6], but it is higher than what was reported in a study in Malaysia (42%) [5]. The prevalence of poor sleep quality in this study is higher than reported in current literature, with the prevalence of poor sleep quality ranging between 30% and 59% [11–13,27]. This variation could be either due to the different instruments used to measure stress and sleep quality in these studies, or due to different underlying causes.

Recently, the Saudi Commission for Health Specialties (SCHS) developed new admission requirements for postgraduate training programs. To gain acceptance, medical students, besides their academic workload, are required to publish research, present in conferences, participate in workshops and organize social/community activities [28]. Additionally, the lack of sufficient residency positions in Saudi Arabia creates a stressful and competitive environment among Saudi medical students to be accepted in their chosen residency program. This may explain the difference between the reported prevalence of poor sleep quality in the present study (76%) and in the previous local studies (30% in King Abdulaziz University [27] and 37% in King Saud University [13]) that were done before the new SCHS admission requirements. It supports the hypothesis that medical students are reducing their sleeping hours to work on the multiple academic requirements. The significant proportions of stress and poor sleep quality among Saudi medical students are a cause for concern as it may have a negative impact on their quality of life, emotional and physical health, and the learning process, which in turn may have negative consequences on the quality of patient care in the future.

The present study demonstrates a significant association between stress and sleep quality among medical students. It shows that a high level of stress is a major predictor and contributor to poor sleep quality. Our results revealed that the prevalence of poor sleep quality among stressed students is 86%, whereas 64% of non-stressed students were poor sleepers. This is similar to the findings of a recent study conducted in a private medical school in Pakistan,

Table 2
The association between stress and the study variables.

Characteristics	Level	Well (n = 123)		Stressed (n = 140)		p-value
		n	%	n	%	
Sleep quality	Good	44	69.8	19	30.2	<0.001*
	Poor	79	39.5	121	60.5	
Sex	Male	89	49.2	92	50.8	0.25
	Female	34	41.5	48	58.5	
Academic year	1st year	42	42.4	57	57.6	0.72
	2nd year	29	47.5	32	52.5	
	3rd year	28	50	28	50	
	4th year	24	51.1	23	48.9	
Current GPA† (out of 5)	<4.25	28	47.5	31	52.5	0.76
	4.25–4.49	23	47.9	25	52.1	
	4.50–4.74	28	41.8	39	58.2	
	4.75–5.00	41	50.6	40	49.4	
Physician among family members	Yes	30	38	49	62	0.06
	No	93	50.5	91	49.5	
Coffee consumption	Never	20	48.8	21	51.2	0.53
	Weekly	62	43.7	80	56.3	
	Daily	41	51.2	39	48.8	
Tea consumption	Never	22	55	18	45	0.52
	Weekly	57	45.6	68	54.4	
	Daily	44	44.9	54	55.1	
Drinking energy drinks	Never	107	48.2	115	51.8	0.26
	Yes	15	38.5	24	61.5	

P values were calculated using the Pearson's chi-square test.
* Significant p value (<0.05).
† Current Grade Point Average.

Table 3
The association between sleep quality and the study variables.

Characteristics	Level	Poor Sleep Quality (n = 200)		Good Sleep Quality (n = 63)		P-value
		n	%	n	%	
Stress	Negative	79	64.2	44	35.8	<0.001*
	Positive	121	86.4	19	13.6	
Sex	Male	134	74.0	47	26.0	0.26
	Female	66	80.5	16	19.5	
Academic year	1st year	79	79.8	20	20.2	0.72
	2nd year	45	73.8	16	26.2	
	3rd year	42	75.0	14	25.0	
	4th year	34	72.3	13	27.7	
Current GPA† (out of 5)	<4.25	52	88.1	7	11.9	0.03*
	4.25–4.49	35	72.9	13	27.1	
	4.50–4.74	52	77.6	15	22.4	
	4.75–5.00	54	66.7	27	33.3	
Physician among family members	Yes	67	84.8	12	15.2	0.03*
	No	133	72.3	51	27.7	
Coffee consumption	Never	29	70.7	12	29.3	0.51
	Weekly	107	75.4	35	24.6	
	Daily	64	80.0	16	20.0	
Tea consumption	Never	30	75.0	10	25.0	0.96
	Weekly	96	76.8	29	23.2	
	Daily	74	75.5	24	24.5	
Drinking energy drinks	Never	165	74.3	57	25.7	0.08
	Yes	34	87.2	5	12.8	

P values were calculated using the Pearson's chi-square test.
* Significant p value (<0.05).
† Current Grade Point Average.

where a strong association between poor sleep and academic stressors was found [2]. Physiologically, many studies have found that sleep and stress are closely linked to the hypothalamo-pituitary-adrenal (HPA) axis, which may explain the close relationship between these two factors [29–32]. Acute stress is accompanied by a decrease in slow wave and rapid eye movement (REM), and sleep deprivation, as a stressor, have pronounced effects on sleep architecture and circadian rhythms [32]. These characteristic changes of the sleep electroencephalogram also occurred in patients with affective disorders such as depression [33].

Generally, due to the multiple demands of the academic environment, medical students tend to reduce their sleeping hours to extend the time available to study. They may not consider sleep as a top priority compared to studying and other academic requirements. Consequently, they become sleep deprived and stressed especially in the weeks preceding an examination [10]. This is supported by the participants' answers of the PSQI question 5j "How often have you had trouble sleeping because of other reason(s), please describe," where the most frequent response was related to stress. Answers such as "start reviewing at night", "overthinking

Table 4
The predictors of sleep quality.

Characteristics	Level	Poor Sleep Quality		
		Sig.	OR	CI 95%
Stress	Negative	<0.001*	0.28	(0.15, 0.53)
	Positive‡		1	
Current GPA†	<4.25	0.01*	3.88	(1.48, 9.93)
	4.25–4.49	0.76	1.14	(0.49, 2.65)
	4.50–4.74	0.25	1.58	(0.72, 3.46)
	4.75–5.00‡		1	
Physician among family members	Yes	0.05	2.11	(0.99, 4.50)
	No‡		1	

* Significant p value (<0.05).
† Current Grade Point Average.
‡ Reference group.

about my future", "working on my research project" and "anxiety from exams" accounted for 47% of the responses, followed by using a mobile and browsing social networks (16%), excess noise (11%) and taking naps during evening or afternoon time (8%). The outcome is a vicious cycle, where students are trying to deal with their multiple academic requirements and stressors by reducing their sleeping time, resulting in sleep deprivation and poor sleep quality that increase their stress level. This cycle requires appropriate interventions that focus on promoting good sleep hygiene and providing medical students with alternative skills (e.g. time management skills) to cope with their stressful and competitive environment.

Consistent with previous studies [10,14], the current results show a significant association between sleep quality and cumulative GPA. The study revealed that the GPA is a significant predictor of sleep quality, where most of the students, whose GPA is less than 4.25 (out of 5) are poor sleepers. Although it is well documented that poor sleep quality is associated with lack of concentration, impaired memory function, and lower academic performance, sleep-deprived students are usually not aware that sleep loss can negatively influence examination preparation and performance, and impair their ability to complete cognitive tasks [14,15]. Moreover, they believe they will score better in examinations and inaccurately reported higher levels of estimated performance [34]. Therefore, it is imperative to implement appropriate interventions to raise students' awareness about the importance of good sleep quality and the negative consequences of sleep deprivation.

An interesting finding in our analysis is that the prevalence of poor sleep quality is higher among medical students who have one or more physicians among their family members. Initially, this appears paradoxical and not supporting our hypothesis that being a medical student of a physician parent, sister or brother is considered an advantage, due to improved guidance about the medical school environment and time management. However, the result could be due to high parenteral expectations, which has been reported in some studies as one of the most frequent and severe stressors among medical students whose parents are medical doctors [2,3].

In this study, no significant association was found between sex and sleep quality nor stress. This result is consistent with many previous studies, where no significant association between sex and stress levels nor sleep quality has been found [2,8,11,12,14,35]. In contrast, a few studies did report that being a female medical student was a significant predictor of a high stress level [7,36] and sleep disorder [13]. However, the design of the present study limits detailed analysis of gender differences. Further studies are needed to investigate these differences.

In addition, no significant association was found between sleep quality and the frequency of caffeine consumption. This unexpected result was reported in a few previous studies, where no significant relationship between the use of caffeinated beverages with sleep quality was found [11,14,27]. Nevertheless, many studies found a strong association between caffeine with sleep quality and excessive daytime sleepiness [16,37–39]. Caffeine intake was not sufficiently assessed in the current study. Further studies are needed to assess the relationship between the amount, type, and drinking time of caffeinated beverages with sleep quality.

Though the current study reports several important and significant findings, there are some limitations inherent in its cross-sectional design, including not being able to establish a cause-effect relationship between sleep quality and stress and the possibility of recall bias due to the use of self-administered questionnaires. In addition, the study sample represents a single medical school and the results are not necessarily generalizable to the Saudi medical student population. Future studies involving multiple Saudi medical schools are encouraged to estimate the exact prevalence of stress and poor sleep quality in Saudi Arabia, and to determine whether poor sleep quality increases the level of stress, or it is a consequence of a high level of stress.

5. Conclusion

This study documents a high prevalence of stress and poor sleep quality in a sample of Saudi medical school students. It demonstrates a strong association between sleep quality and stress, current GPA, and being a medical student of a physician parent, sister or brother. It reports two important predictor factors of poor sleep quality which are stress and having a low GPA. Based on these findings, medical students urgently need to be educated about sleep hygiene and the negative consequences of poor sleep quality. A recommendation for the management of medical colleges in Saudi Arabia is to establish academic counseling centers that focus on improving students' study skills and coping with their stressful environment.

Disclosure statement

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of this article.

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