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# The Prevalence and Risk Factors For Poor Sleep Quality Amongst Medical Students: A Cross Sectional Study

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**Abstract: Introduction:** Undergraduate medical students have consistently been shown to have high prevalence of mental health disorders in comparison to their peers from non-medical backgrounds and sleep quality is a critical aspect for maintaining mental wellbeing. The aim of this study is to compile prevalence on poor sleep quality and analyze its potential risk factors. **Methodology:** A cross sectional study was conducted at the Aga Khan University. Undergraduate medical students asked to fill out a self-reported questionnaire that was sent via email which included the 14-point Perceived Stress Scale (PSS), Pittsburgh Sleep Quality Index (PSQI) and Epworth Sleepiness Scale (ESS). 302 students responded and the data was analyzed using chi square and logistic regression to determine their association with Sex, BMI, Year of Study and Academic Score. **Results:** The mean age of study participants was 21.58 + 1.41 years and majority were males (58%). The mean PSQI, ESS and PSS scores were 6.35 + 3.28, 7.72 + 4.58 and 28.38 + 7.81 respectively. 11.3% of participants reported poor sleep quality, which was significantly associated with female sex and academic performance. 28.5% of students had excessive daytime sleepiness, which was significantly associated with female sex and academic year (first year). "Stress" and "Overthinking/Anxiety" were the two most common self-reported reasons for Poor Sleep Quality. 85.4% of students were stressed with an average PSS score of 28.38 $\pm$ 7.81. **Conclusion**: This study therefore shows a high prevalence of stress with moderate sleep disturbance prevalence, which was associated with female sex and academic performance.

**Keywords:** Sleep Disorders, Psychological Stress, Medical Education

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## Introduction

Sleep plays a crucial role in regulating a vast variety of cognitive and physiological functions [1]. Both anecdotal and empirical evidence strongly suggest that poor sleep quality has profound negative consequences on an individual's mental and physical wellbeing [2]. Poor sleep quality has become an increasing concern over the past decades, due to both an increase in knowledge regarding its significance as a symptom of overarching sleep disorders, as well as its high prevalence reported in recent literature [3].

Sleep disturbances and poor sleep quality are particularly common amongst medical students. Given the rigorous workload associated with medical school, students often sacrifice time dedicated to non-academic activities such as sleep and leisure to keep up with their academic commitments [4]. Various studies have reported a high prevalence of poor sleep quality and excessive daytime sleepiness – an easily identifiable and noticeable by-product of sleep disturbances – amongst medical students across the world [5-8].

Poor sleep quality is by no means a benign entity and has often been shown to have important ramifications. Of particular significance in the context of medical students is its detrimental effect on neurocognition, learning and memory – all of which result in reduced academic and exam performance [9]. Interestingly, imposed sleep deprivation – as is common among medical students who reduce their sleep to make time for studies and clinical activities on purpose – may be as detrimental to neurocognitive, and thus academic, performance as naturalistic poor sleep quality due to external factors [10].

Perhaps more insidiously, poor sleep quality shares a close and bidirectional association with increased stress. In a subject who is not consciously perceiving acute stress, sleep deprivation leads to impaired cortisol and Corticotropin Releasing Hormone modulation and thus impaired feedback to the Hypothalamic-Pituitary-Adrenal Axis and a physiological stress response [11]. Therefore, with the well-known association of stress with deleterious mental health issues, it is not surprising that poor sleep quality has also been linked to an increased risk of depression and burnout [12].

It is therefore imperative to be able to determine the characteristics of sleep quality amongst medical students in Pakistan and to empirically identify demographics and groups at high-risk for poor sleep quality and its associated sequelae. This study was conducted with the aim to generate contextual data on the prevalence of poor sleep quality among medical students in Pakistan and analyze and identify potential risk factors for poor sleep quality.

## Methods

This cross-sectional study was conducted between December 2019 till December 2020 at the Aga Khan University (AKU). AKU is a private medical college situated in the city of Karachi, Pakistan. Students from all 05 years studying at AKU participated in the study via voluntary response sampling. Students who did not voluntarily participate were excluded. Prior consent was obtained from the students. A simple questionnaire was filled out (described in detail below). Institutional Review Board approval was obtained from the AKU Ethical Review Committee for the purpose of conducting this study (ERC Approval # 2019-1565-5643).

A minimum sample size of 218 was calculated using the online Open-Epi software [95% confidence level and absolute precision of 5%].

An open invitation to participate was sent out disseminated via internal institutional email groups to recruit subjects to fill out a self-reported questionnaire on Google Docs link. The questionnaire consisted of an informed consent, one section on the participants' demographic information and three sections with validated questionnaires for assessing their stress, sleep quality and daytime sleepiness:

2.1 Demographics: Data was recorded on the participants' age, gender, BMI (weight/[height]$^2$), year of study and academic performance in each rotation or module.

2.2 14-item Perceived Stress Scale (PSS-14): The PSS-14 (Cohen, Kamarck & Mermelstein (1983)) instrument was used to measure perceived stress. It is a five-point scale (1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree). The questions in this scale ask about your feelings and thoughts during the last month. The scale consists of 7 positive and 7 negative items giving a score ranging from 0 to 56 with higher scores indicating higher levels of stress [13].

2.3 Pittsburgh Sleep Quality Index (PSQI): This questionnaire determines sleep quality and disturbances during the preceding month. It has 19 items and seven clinically different components of sleep ("subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbance, use of sleeping medication and daytime dysfunction"). Among these questions, one question also asks self-reported reasons for trouble sleeping. The scale provides scores ranging from 0 to 21 with scores greater than 5 considered as poor sleepers [14].

2.4 Epworth Sleepiness Scale (ESS): This questionnaire was used to evaluate excessive daytime sleepiness. It consists of an eight-items with a score range from 0 to 24. A score ranging from 0 to 10 was defined as normal, while a score of 11–24 was abnormal and indicative of excessive daytime somnolence [15].

2.5 Statistical Analysis: Statistical analyses was done via the IBM Statistical Package for the Social Sciences (IBM SPSS version 21; IBM Corp Inc., Armonk, NY). The categorical demographic data for Sex, BMI, Year of Study and Average Academic Score were expressed as percentage frequencies, whereas the continuous data for the validated PSS-14, PSQI and ESS scores were expressed in terms of their mean scores + standard deviation. Pearson Chi-Squared and Multinomial Logistic regression analysis was performed to investigate the association between the PSS-14, PSQI and ESS scores and the previously described categorical variables. A p-value of <0.05 was considered significant.

**Table 1:** Demographics of study population

| Variable | Frequency (n) | Frequency % |
|---|---|---|
| Gender | | |
| Male | 178 | 58.9 |
| Female | 124 | 41.1 |
| BMI (kg/m$^2$) | | |
| Underweight (<18.5) | 26 | 8.6 |
| Normal (18.5 - 25) | 220 | 72.8 |
| Overweight (25 - 30) | 42 | 13.9 |
| Obese (>30) | 14 | 4.6 |
| Year of Study | | |
| First Year | 48 | 15.9 |
| Second Year | 46 | 15.2 |
| Third Year | 50 | 16.6 |
| Fourth Year | 38 | 12.6 |
| Fifth Year | 120 | 39.7 |
| Average Academic Score | | |
| <55 | 0 | 0 |
| 55 – 59 | 2 | 0.7 |
| 60 – 69 | 38 | 12.6 |
| 70 – 79 | 204 | 67.5 |
| 80 – 100 | 58 | 19.2 |

60 subjects (19.9%) self-reported reasons for poor sleep quality, which are presented in Table 2.

**Table 2:** Subject Self-Reported Reasons for Poor Sleep Quality

| Reasons for Poor Sleep Quality | Frequency (n) | Frequency (%) |
|---|---|---|
| Stress | 19 | 31.7 |
| Overthinking/Anxiety | 16 | 26.7 |
| Uncomfortable/Restlessness | 12 | 20.0 |
| Daytime Naps | 5 | 8.3 |
| Family & Leisure | 5 | 8.3 |
| Doing work or studies | 3 | 5.0 |

## Results

Out of total 500 undergraduate students, 302 responded (60.4%). The mean age was 21.58 $\pm$ 1.41 years Demographic features are summarized in Table 1. Mean PSQI, ESS and PSS score were 6.35 $\pm$ 3.28, 7.72 $\pm$ 4.58 and 28.38 $\pm$ 7.81 respectively.

A statistically significant association was seen among poor sleep quality and female sex (p=0.009), with more females suffering from poor sleep quality than males. There was significant

association between the age and poor sleep quality and excessive daytime sleepiness with the most students amongst 18-21.9 age group. There is also a significant association between Average academic score and poor sleep quality. Most students with sleep disturbance had an average academic score between 70 -79 whereas only 4 students scored between 80 -100. Apart from this, no significant association ($p>0.05$) was found between poor sleep quality and BMI or year of study (Table 3).

**Table 3:** Associated factors for stress and sleep disturbance

| Variable | Poor Sleep Quality (PSQI >5) N(%) {P value} | Excessive Daytime Sleepiness (ESS>10) N (%) {P value} | Perceived Stress (PSS > 28) N(%) {P value} |
|---|---|---|---|
| Age(years) | | | |
| 18 - 21.9 | 26(17.8) | 60(41.1) | 130(89) |
| 22 – 25 | 8(5.3) | 26(17.3) | 122(81) |
| >25 | 0(0) | 0(0) | 6(100) |
| p-value | {0.001} | {0.000} | {0.101} |
| Sex | | | |
| Male | 10 (5.6) | 36 (20.2) | 148(83.1) |
| Female | 24 (19.4) | 50 (40.3) | 110(88.7) |
| p-value | {0.009} | {0.007} | {0.34} |
| BMI | | | |
| Underweight (<18.5) | 2 (7.7) | 12 (46.2)$^{\wedge x}$ | 20 (76.2)$^{\#}$ |
| Normal$^{\wedge}$ (18.5 - 25) | 26 (11.8) | 50 (22.7)$^{\#}$ | 188 (85.5) |
| Overweight$^{\#}$ (25 - 30) | 4 (9.5) | 20 (47.6)$^{x}$ | 38 (90.5) |
| Obese$^{x}$ (>30) | 2 (14.3) | 4 (28.6) | 12 (85.7) |
| p-value | {0.955} | {0.056} | {0.756} |
| Year of Study | | | |
| First Year | 8 (16.67) | 34 (70.8) | 42 (87.5) |
| Second Year | 10 (21.7) | 12 (26.1) | 38 (82.6) |
| Third Year | 8 (16) | 12 (24) | 46 (92) |
| Fourth Year | 4 (21) | 8 (21.1) | 36 (94.7) |
| Fifth Year | 4 (3.3) | 20 (16.7) | 96 (80) |
| p-value | {0.108} | {0.000} | {0.428} |
| Average Academic Score | | | |
| <55 | 0 (0) | 0 (0) | 0 (0) |
| 55 - 59 | 2 (100) | 2 (100) | 2 (100) |
| 60 - 69 | 4 (10.5) | 8 (21.1) | 34 (89.5) |
| 70 - 79 | 24 (11.7) $^{*}$ | 60 (29.4) | 172 (84.3) |
| 80 – 100 | 4 (6.9) | 16 (27.6) | 50 (86.2) |
| p-value | {0.037} | {0.379} | {0.911} |
| $^{x}$= Obese, ^= Normal BMI and $^{\#}$ = overweight, p<0.05 is considered significant | | | |

Moreover, our analysis revealed certain factors associated with excessive daytime sleepiness as well. Female sex was statistically significantly associated with excessive daytime sleepiness with more females suffering from daytime dozing off than males. In addition, there was a significant association between year of study and excessive daytime sleepiness – most students with daytime

snoozing belonged to their 1st year of their medical education. There was no significant association between daytime sleepiness and BMI or average academic score. Perceived stress was not found to be associated with sex, BMI, academic year of study or academic score.
Logistic regression analysis was also conducted to ascertain the association of various factors on the likelihood of sleep disturbance and stress. It showed that sex ($p=0.000$) and academic score between 80-100 ($p=0.041$) were associated with poor sleep quality. Females ($p<0.05$)and year of study ($p=0.000$) were associated with daytime sleepiness. However, no significant difference was found between perceived stress and any of the other variables.

**Discussion**

Our cross-sectional study had 2 main findings. Firstly, it demonstrated an extremely high prevalence of psychological stress (85.4%), a moderate prevalence of excessive daytime sleepiness (eds) (28.5%) and a moderate prevalence of poor sleep quality (PSQ) (11.3%) in our study demographic. Secondly, there were statistically significant associations between PSQ and EDS with female sex; PSQ and poor academic performance; and EDS and students in their first year of study.
There exists remarkable fluctuation in the findings of current literature on the prevalence of PSQ and EDS. While studies in Columbia, Brazil, and Pakistan, which also utilized the Epworth scale, reported a high prevalence of eds – 49.8%, 46.5% and 44.9% respectively [7, 16, 17] – others, such as a study from Indonesia as well as our own results demonstrate a much lower prevalence of eds(24.3%) [18]. A similar situation exists for poor sleep quality, wherein findings on the prevalence of PSQ exhibit marked variation from 37.6% to 75.4% [7, 17, 18].
We propose 2 potential explanations for the discrepancies in prevalence of sleep disturbances in our study versus the literature. The first is a primarily methodological inconsistency – different studies use different metrics to classify the scores from the Epworth scale. Marta *et al*. [18] and our own study used a single set benchmark of ESS$\geq$11 to classify eds; Machado Duque *et al*. [16] used a stratified classification of ESS 7-9 for moderate daytime sleepiness and ESS>10 for eds; Rique *et al*. And Perotta *et al*. [17] used stratified classifications for interpreting ESS scores as mild (ESS>10), moderate or severe eds (ESS>15). This technical discrepancy alone is likely to account for some part of the inconsistency in current findings – data which may count as eds and be included in the prevalence estimates for one study may be excluded from another study due to the arbitrary benchmarks used. The second possible reason is the lack of temporal standardization of these studies. Stress and PSQ are unlikely to be constant all year-round – certain time periods such as closer to exams are likely more stressful and may result in more PSQ. As most studies, including our own, did not account for this when collecting data, the lack of consistency of results is likely a product of the fact that the subjects were at different phases of their academic years and thus had varying degrees of PSQ. The only study we identified that accounted for exam dates when collecting data demonstrated a very high prevalence of PSQ (76%), thus further reinforcing our reasoning [6]. Apart from this, the moderate prevalence of PSQ and EDS in our study could also be inter-related as the more a person experiences PSQ, the more they sleep in the daytime leading to EDS.
Our finding of a high prevalence of psychological stress amongst medical students corresponds well with global literature. Findings from across the world report the same, with studies from Morocco (86.4%) and Pakistan (45.2%), both reporting a high prevalence of academic and psychological stress among medical students [5, 19]. It is therefore unfortunately unsurprising that – given that stress often predisposes to mental health issues – the prevalence of stress, depression and anxiety in medical students is significantly higher than that of the general population (approximately 27.2%) [20].
Our results suggest that poor sleep quality plays a role in this worrying epidemic. Given that sleep quality is dependent on a variety of factors and causes, it is difficult to establish definitive

etiologies for such a multi-faceted issue. However, our results identified three variables that were associated with poor sleep quality and excessive daytime sleepiness to a level of statistical significance: female sex, first year of study and academic performance. Studies have already reported a higher prevalence of sleep disorders in female medical students than in males [21]. Review article of sex-related in differences in insomniac tendencies revealed that it 1.5 times more common in females than males, confirming that our results are in-line with an overarching global trend [22]. The reason for these sexual differences may be due to the fact that men complain about sleep quality, whereas females seem to concentrate more on single symptom. Moreover, there is more in HPA axis reactivity to stressors or awakening in females and other physiologic factors such as changes in sleep quality at different phases of the menstrual cycle may also account for these differences in sleep quality.

Furthermore, we believe that the significant relationship between eds and students in their first year of study is best explained by the justification that first year students have not yet adjusted and acclimatized to the drastically more rigorous lifestyle in medical school; both in terms of academics as well as the added stressors of being in an entirely new physical environment. Also, first year students have an easier schedule as opposed to their counter parts in clinical years which might allow them to take afternoon naps. An in-depth study on the perceptions of stress and sleep quality of first year students specifically would likely shed more light on this.

As for the relationship between poor sleep quality and poor academic performance, several studies on medical students have reported a strong correlation between sleep patterns and high academic GPA [6, 21] – although a few studies found no such association [23]. Notably, Almojali *et al*. Established that the risk of poor sleep quality amongst students with a low GPA is almost four times higher (or=3.83, p=0.01). It is well documented that PSQ impairs decision making, innovation and declarative memory [24], therefore it is not surprising that it would also be associated with poor academic performance. However, cross sectional studies, such as ours and most of the existing literature, cannot infer a causal relationship between the two.

Respondents in our study were also asked to self-report what they believed the reasons for their poor sleep quality were. The two most common themes were responses either some form of psychological stress due to academic performance (31.6%) or to anxiety and overthinking (26.7%) - this concurs with findings from Almoljali *et al* and reiterates the significant relationship between academic stress and poor sleep quality [6]. It is particularly interesting to note, that time dedicated to studies and work commitments was the least common reason for lost sleep. Instead, paradoxically, the perception and stress of that workload often seemed to be the primary reason for their poor sleep quality. This suggests that the relationship between PSQ and academic performance is bidirectional – PSQ may lead to poor academic performance as described above, but poor academic performance may also be a risk factor for PSQ. Furthermore, students mentioned to feel burned out, which was similar to another study from Pakistan where 18.2 respondents claimed to be burned out, most of which were from private medical colleges[25]. This burnout may lead to excessive stress and anxiety about the future which leads to poor sleep quality.

Our study has some important limitations worth consideration. Firstly, the population under study was restricted to students from a single private medical university, therefore the results of our study may not be generalizable to medical students across Pakistan especially those in the public sector. The second limitation is, as discussed earlier, that we did not account for the changes in the subjects' academic schedules throughout the year, thus introducing a possible confounder, wherein students may have been in different stages of stress (near exams or during difficult rotations) or rest (after exams or during vacation). Lastly, possible variables such as diet on time, breakfast, exercise routine, marital status and ethnicity were not included in our study which limits the scope of our study.

## Conclusion

In conclusion, this study provides empirical, contextual analysis on the patterns of sleep disturbance and stress amongst medical students. The high prevalence of these entities merit further study and immediate intervention. Counselling and wellness programs at our medical institution and others should be made aware of the high prevalence of sleep disorders and begin appropriate screening for them. The risk factors we have identified for PSQ, and EDS should be considered during such screening. Early intervention for high-risk groups and those displaying signs of sleep disturbance is imperative to prevent progression to more severe sleep disorders. We recommend further study into this important field of research as well, both with the initiation of new, larger-scale cross-sectional studies spanning multiple institutions, as well as repeated, systematic review and analysis of existing literature to account for methodological discrepancies such as the ones we highlighted above.

## ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Institutional Review Board approval was obtained from the AKU Ethical Review Committee for the purpose of conducting this study (ERC Approval # 2019-1565-5643).

## HUMAN AND ANIMAL RIGHTS

No animals were used in this study. The study on humans was conducted in accordance with the ethical rules of the Helsinki Declaration and Good Clinical Practice.

## CONSENT FOR PUBLICATION

Not applicable.

## AVAILABILITY OF DATA AND MATERIALS

None.

## FUNDING

None.

## CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

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