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Daytime sleepiness reflects depression, anxiety, and stress among students at the University of Ghana Medical School

Alice TAYLOR [1], Delali ED-BANSAH [2*], Thomas A TAGOE [1, 2]

[1] Department of Physiology, University of Ghana Medical School, University of Ghana, Accra, Ghana, [2] GhScientific, Accra, Ghana

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Abstract

Background: Due to high academic demands, many medical students reportedly sleep fewer hours than they would desire. However, the impact of their sleep habits on their mental health is unclear.

Objective: This study aimed to determine the level of sleep deprivation among University of Ghana Medical School students and assess the relationship between sleep deprivation and depression, anxiety, and stress.

Methods: This cross-sectional study recruited 112 medical students from the University of Ghana Medical School. A series of self-administered questionnaires were used to obtain data from participants. Sleep was assessed using the sleep deprivation index (SDI) and the Epworth sleepiness scale (ESS), whereas mental health status was assessed using the Depression Anxiety Stress Scale (DASS).

Results: Males (43.8%, n = 49) and females (56.2%, n = 63) from both preclinical (39.3%, n = 44) and clinical (61.7%, n = 68) years participated in this study. Self-reported sleep duration was 5.6 ± 0.12 hours on weekdays and 7.2 ± 0.13 hours on weekends, resulting in an SDI of 1.56 ± 0.12 hours. Regarding daytime sleepiness, 53.8% of the participants were classified as normal, 31.3% as excessive, and 15.1% as severe on the ESS. When compared to students with normal daytime sleepiness, students with severe daytime sleepiness scored significantly higher on measures of depression (3.4 ± 0.4 versus 6.9 ± 0.6), anxiety (3.9 ± 0.5 versus 8.0 ± 0.8) and stress (2.7 ± 0.5 versus 6.9 ± 0.9). The evidence indicated a weak positive correlation between daytime somnolence, as measured by the DASS, and depression, anxiety, and stress ($r^2 = 0.199$, $p < 0.0001$). However, there was no correlation between these mental health conditions and sleep deprivation ($r^2 = 0.020$, $p = 0.1$). Further analysis revealed that daytime sleepiness significantly predicted depression, anxiety, and stress, as measured by the DASS.

Conclusion: Our findings showed that sleep deprivation among medical students could lead to daytime sleepiness and an increased risk of developing depression, anxiety, and stress. Furthermore, daytime sleepiness was predictive of the mental health status of the study participants.

Keywords: Daytime somnolence; mental health; sleep deprivation

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INTRODUCTION

The quality and quantity of sleep have an impact on the general health and well-being of any individual. For young adults between 18 months and 5 years of age as well as adults between 26 and 64 years of age, the National Sleep Foundation recommends a sleep duration of 7 to 9 hours. It is also advised that adults do not sleep less than 6 hours or more than 10 hours, while young adults should not sleep more than 11 hours [1]. These recommendations are based on the fact that sleep is important for cognition, alertness, vigilance, sustenance of attention, and control of emotions [2]. Some short-term effects of inadequate sleep include sleepiness, irritability, reduced alertness, poor motor skills, and attention problems. In addition, long-term effects include obesity, type 2 diabetes, hypertension, and mental health disorders [2-6]. Sleep deprivation in adults of all ages is defined as getting less than seven to nine hours of sleep [1]. Acute

* *Corresponding author*
Email: delali2214@gmail.com

sleep deprivation lasts for only a few days, and it becomes chronic when an individual continually sleeps less than the number of hours required to operate efficiently [7,8]. Due to the demanding nature of many university courses, sleep deprivation is common among students [9,10]. Poor sleep quality is associated with high failure rates and poor academic performance [11]. In addition, having poor quality of sleep is linked with lower memory retention, decreased ability to learn, and poorer academic performance. This can result in having to spend more time studying to improve academic performance, which in turn can lead to less time for sleep [12]. The use of alcohol, caffeine, stimulants, and technology among students also contributes to their poor sleep habits and prevents them from achieving the right quality and quantity of sleep [13].

In general, medical students tend to experience even less sleep than students in other areas of study [14,15]. This is due to high academic demands and clinical rotations, nighttime shifts, and the high learning volume required for their training. Many sleep-deprived medical students experience daytime sleepiness [15]. The rising occurrence of insufficient sleep and its consequential impacts have a detrimental effect on the mental well-being of medical students, leading to heightened levels of depression, anxiety, and stress [15]. According to a large study involving over 200,000 participants, individuals who slept less than an average of 6 hours per night were approximately 2.5 times more prone to experiencing frequent mental distress. Frequent mental distress was defined as self-reporting a mental state as "not good" for more than 14 days in a month. In comparison, participants who averaged more than 6 hours of sleep per night had a lower likelihood of experiencing such distress [16]. Medical students can therefore be considered a representative population However, in Ghana, data are scarce regarding daytime sleepiness and its implications for medical students. Conducting studies that elucidate the factors influencing the connection between sleep and mental health among students, particularly those in medical schools, can provide valuable insights for university practices and public health policies. The purpose of this study was, therefore, to determine the level of sleep deprivation among University of Ghana Medical School students and assess its relationship with markers of mental health status.

MATERIALS AND METHODS

Study design and sites

The study employed a cross-sectional design and included the student population of the University of Ghana Medical School as participants. The University of Ghana Medical School is the largest medical school in Ghana. The study included students who were enrolled in the Graduate Entry Medical Programme from level 200 up to their final year. A simple random sampling technique was used to select students from each class to participate in the study. Information about the study was shared with each year group via their class "WhatsApp" page, and interested students were provided with the electronic link to the questionnaire. Study participation was voluntary, and students were assured of confidentiality. No incentives or rewards were provided for participation in this study. To be included in the study, medical students had to meet two criteria: they had to be $\leq$ 18 years old and studying at levels 200, 300, 400, 500, or 600 (including the final year) of the program. Additionally, they had to voluntarily agree to participate in the study after the researchers explained the aim of the study to them. Students who were ill or diagnosed with conditions that had chronic implications on sleep were excluded from the study.

Sample size and sampling technique

For participant recruitment, the study employed the convenience sampling method, resulting in a total of 112 students included in the survey. The sample size was determined using Cochran's formula, considering a 10% non-response rate. The study ensured equal participation opportunities for medical students of various levels by providing information to all, and only those who expressed interest took part. The sample size was calculated as $n_o = \frac{Z^2\,(P)(1-P)}{E^2}$, where n_o is the sample size, z is the selected critical value of desired confidence level (1.96), *p* is the estimated proportion of the population which has the attribute in question, and E is the desired level of precision defined as the margin of error. This study assumed a confidence level of 95%, a *p* of 0.5 and an error allowance of 10%. Thus $n_o = \frac{1.96^2\,(.5)(1-.5)}{(.1)^2} = 96$. Factoring in an unresponsive rate of 10%, the final desired sample size was given by sample size $= \frac{100\%}{100\%-10\%} \times 96 = 107$. The minimum sample required was 107. Overall, a total of 112 participants responded to the questionnaire.

Ethics

This study was reviewed and approved by the Community Health Department Review Committee of the University of Ghana Medical School before the start of the study. Informed consent was obtained from each participant after providing a detailed explanation of the study. Participants were assured of the confidentiality of their data, and each participant was assigned a study number based on the order of completion of the study questionnaire.

Procedure

A study questionnaire was created electronically using Google Forms (Google LLC, California, USA), and participants required an internet connection to complete and submit the forms online. Each participant completed the questionnaire on their phone or laptop. After the study had been explained to each participant, they received an electronic link to the study, which led them to the consent page. They could only access the questions after they had read and indicated on the page that they had agreed to participate in the study. Participants progressed to fill out the questionnaire, and all the questionnaires were completed on the same day. Ample time was given to complete the questionnaire. The average time needed to complete the questionnaire was approximately 15 minutes. After a participant completed the questionnaire, the responses were automatically saved on a Microsoft Excel spreadsheet (Microsoft Corporation, Washington, USA). Demographic data included name initials, age range, University level, and sex of each participant. Three assessment instruments were included in the electronic questionnaire. The Sleep Deprivation Index (SDI), which assesses sleep deprivation, was calculated as the difference between the average hours of sleep on weekends and weekdays [10]. The following questions were used to determine the SDI: What was the average sleep time for a participant on weekdays over the last two weeks? And what was the average sleep time for a participant on weekends over the last two weeks, if no one woke them up? The validated Epworth Sleepiness Scale (ESS) was used to assess daytime sleepiness [16]. This questionnaire asked participants to rate their likelihood of dozing or falling asleep in eight common situations of daily living. Each situation was scored on a scale of 0 to 3, with 0 being "never" and 3 being "almost always". The final score was calculated by adding up the scores for each item and ranged from 0 to 24. Scores > 10 were considered excessive daytime sleepiness, and those > 15 were considered severe sleepiness [16]. The third assessment tool was the Depression Anxiety Stress Scale (DASS), a 21-item questionnaire [17]. Each component consisted of 7 sub-questions. The responses were measured on a Likert scale ranging from 0 “did not apply at all” to 3 “applied most or all of the time”. This scale is acceptably consistent across different ages and multiple populations, including healthy adults [17].

Table 1: Demographics of study participants

Variables	Frequency (%)
Age categories	
18–23	52 (46.4)
23–27	42 (37.5)
28–32	16 (14.3)
Above 32	2 (1.8)
Sex	
Males	49 (43.8)
Females	63 (56.2)
Medical School level	
200	33 (29.5)
300	11 (9.8)
400	17 (15.2)
500	7 (6.2)
600	44 (39.3)

%, percentage

Table 2: Differences in ESS, SDI, and DASS based on sex and training level

	ESS	SDI	DASS
Gender			
Male (n = 49)	10.49 ± 0.6	1.39 ± 0.26	7.33 ± 1.43
Female (n = 63)	10.44 ± 0.59	1.7 ± 0.2	14.95 ± 1.47
p value	0.71	0.29	0.1
Training level			
Preclinical (n = 44)	9.51 ± 0.65	2.13 ± 0.25	15.61 ± 1.71
Clinical (n = 68)	10.92 ± 0.56	1.19 ± 0.2	12.06 ± 1.3
p value	0.09	0.006*	0.1

*, significant difference (Mann–Whitney U); ESS, Epworth Sleepiness Scale; DASS, Depression, Anxiety, Stress Scale; SDI, Sleep Deprivation Index

Data analysis

The data were analysed using Statistical Package for Social Sciences, version 25.0 (IBM, New York, USA) and Microsoft Excel Software (Microsoft Corporation, Washington, USA). Data were summarised and presented as tables and graphs. Data for continuous variables were expressed as means and standard deviations if they were normally distributed, as determined by the Kolmogorov–Smirnov test. Otherwise, they are expressed as medians and ranges or interquartile ranges. The data from categorical variables were expressed as frequencies and percentages. The Mann-Whitney U test was used to compare differences between groups. Categorical variables were compared using the Chi-square test. One-way analysis of variance was used to compare differences between multiple groups. Tukey's test was used for the post hoc analysis. Binary and ordinal logistic regression analysis was used to assess the predictors of DASS and ESS, respectively. Spearman's rank-order correlation was used to assess the correlation between DASS and ESS or SDI. Statistical significance was set at $p < 0.05$.

RESULTS

A total of 112 students from the University of Ghana Medical School participated in this study. The participants were selected from two groups of medical students: preclinical (levels 200 and 300) and clinical (levels 400 and higher). The distribution of participants was balanced, with 43.8% male (n = 49) and 56.2% female (n = 63). The full demographic representation of study participants is shown in Table 1. Figure 1 presents the distribution of self-reported sleep hours on weekdays (Figure 1A) and weekends (Figure 1B). The discrepancies between these two measurements (Figure 1C) were quantified as a sleep deprivation index. The number of hours for self-reported sleep was 5.61 ± 0.12 hours during weekdays and 7.21 ± 0.13 hours during weekends. This resulted in a sleep deprivation index of 1.56 ± 0.12 hours. Figure 1D displays the levels of daytime somnolence, assessed using the ESS. The results indicate that 53.58% were categorized as normal, 31.25% as excessive, and 15.12% as severe. There were no significant differences between the sexes based on either the ESS ($p = 0.71$) or SDI ($p = 0.29$) scores (Table 2). In our study population, DASS shared a positive correlation with ESS ($r^2 = 0.199$), which was absent between DASS and SDI ($r^2 = 0.020$; Figure 2A). The ESS categories of the participants are as follows: normal = 60; excessive = 35; and severe = 17. Students classified as having extreme and severe daytime somnolence scored significantly higher on the depression scale than students with normal daytime somnolence (normal, 3.42 ± 0.44; excessive, 5.40 ± 0.54; severe, 6.90 ± 0.57; $p < 0.05$; Figure 2B). Similarly, the stress scores were significantly higher in students classified as having extreme somnolence (3.82 ± 0.61) and severe somnolence (6.91 ± 0.97) than in students classified as

Figure 1: Pattern of sleep, sleep deprivation, and daily sleepiness among medical students.

The distribution of self-rated sleep hours shows that the sleep duration of most medical students on weekdays is below the recommended sleep duration for adults (A), and on weekends, the duration is within the recommended sleep duration for adults (B). The difference between sleep hours on weekdays and weekends is represented as the sleep deprivation index (C). The Epworth Sleepiness Scale shows the daytime sleepiness of medical students (D). Uncoloured bars represent normal daytime sleepiness, gray bars represent excessive daytime sleepiness, and black bars represent severe daytime sleepiness.

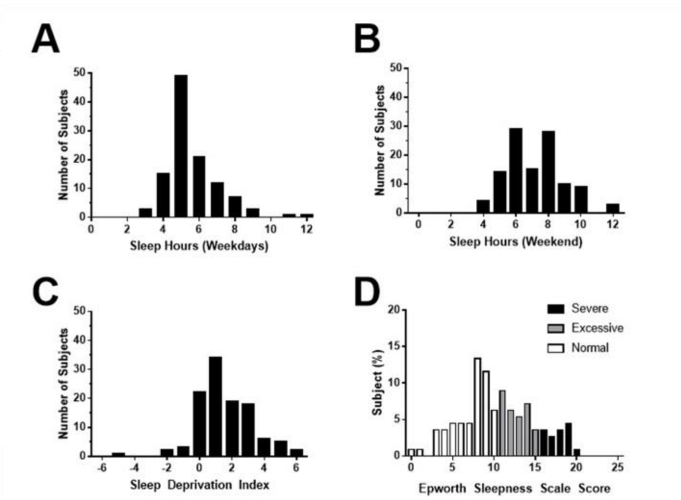

Figure 2: Depression anxiety stress scores and their association with sleep deprivation index and Epworth sleepiness scores.

(A) DASS shows a positive association with ESS (grey squares) and not SDI (black squares). Compared to normal day time sleepiness (white bars), severe daytime sleepiness (black bars) results in significantly higher levels of (B) Depression, (C) Anxiety, and (D) Stress. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

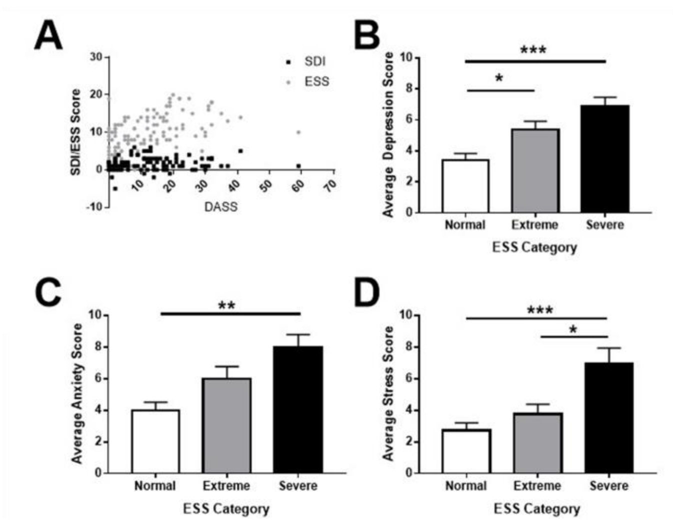

Table 3: Association between ESS and DASS with confounders

Parameters	B	SE	*p*	Odds Ratio	Lower limit	Uppr limit
Gender (Ref: Females)						
Males	-0.430	0.555	0.438	0.650	0.219	1.931
Levels (Ref: Level 600)						
200	1.003	0.657	0.127	2.727	0.753	9.880
300	-19.075	14380.318	0.999	5.198×10^9	0.000	
400	0.842	0.779	0.280	2.322	0.504	10.692
500	1.700	0.940	0.071	5.472	0.866	34.564
ESS scores	0.204	0.064	0.001*	1.226	1.083	1.389
SDI scores	0.014	0.174	0.935	1.014	0.721	1.426

Ref, reference category; Significant predictor; ESS, Epworth Sleepiness Scale; DASS, Depression, Anxiety, Stress Scale; SDI, Sleep Deprivation Index having normal somnolence (2.70 ± 0.49; $p < 0.05$; Figure 2C). The average anxiety score was reported as 3.98 ± 0.52 in students with normal somnolence, which was not significantly lower than that of students classified as having excessive somnolence (6.00 ± 0.75) but was significantly lower than that of students classified as having severe somnolence (8.00 ± 0.76; $p < 0.05$; Figure 2D). The ESS was found to be a significant predictor of DASS (Table 3).

DISCUSSION

In this study, we found a positive correlation between daytime sleepiness and indicators of poor mental health. Additionally, daytime sleepiness was identified as a predictor of poor mental health. Students experiencing severe daytime sleepiness had significantly worse scores for depression, anxiety, and stress as measured by the DASS. Clinical medical students slept less and had higher levels of anxiety than preclinical medical students. However, they did not have higher levels of depression or stress. According to scientific evidence, young adults should sleep for 7 to 9 hours each night. [1]. Students in our study fall below this recommendation. This is not strange, as sleep deprivation and poor sleep quality are particularly prevalent among medical students [19–21]. Studies in Ghana, Kenya, and Nigeria have also found that medical school students are not getting enough sleep [22–24]. Sleep deprivation can lead to daytime drowsiness, which can impair concentration and other cognitive functions, such as attention and working memory. These deficits can have a negative impact on academic performance [25,26]. A study of medical students in Ghana found that sleep quality was positively correlated with self-reported academic performance. This suggests that getting enough sleep is important for students to succeed academically [9].

In this study, we used the SDI to assess sleep deprivation. The SDI is a reliable tool that can account for individual differences in sleep duration [10]. The SDI provides information on the ideal number of hours of sleep a person will have once the demands of academia are reduced over the weekend. In our study, the SDI did not correlate with DASS, while ESS did. This may suggest that, as a tool, the SDI cannot offer any inferences as far as mental health is concerned within our study population [10]. If the SDI is a valid tool, the difference between the SDI and ESS results suggests that there may be a disconnect between sleep deprivation and increased daytime sleepiness. Investigating the potential difference between these two may shed more light on neurophysiological mechanisms mediating the therapeutic effect of sleep deprivation in the treatment of some depression cases [26,27]. It may also shed light on why short-term sleep deprivation < 48 hours does not impair cognitive function in all persons [29]. For instance, could there be a significant role of wake-time experiences in ameliorating the effects of sleep deprivation? Answers to this question could influence the design of teaching strategies to maximize the engagement of students who may be sleep deprived. This, in turn, should improve performance with the knock-on effect of potentially reducing signs of depression, anxiety and stress. In this study, we observed a positive correlation between ESS and DASS. The validity of the ESS to assess daytime sleepiness is well established, making it a dependable tool when investigating the relationship between sleep and mental health. The ESS measures the likelihood of individuals dozing off while engaged in several different activities [17,30]. Increased daytime sleepiness is indicative of deficits such as depression, hypothyroidism, and obstructive sleep apnea [31–33]. Obstructive sleep apnoea, for example, is significantly associated with an impairment of cognitive function due to sleep disturbance and subsequent daytime sleepiness [34]. Among medical students, increased daytime sleepiness due to sleep deprivation is commonly reported [35]. In a study of over 4,000 teens, sleep deprivation at baseline predicted measures of depression after a 1-month follow-up [36].

Our current study demonstrates that daytime somnolence is a predictor of depression, anxiety, and stress, as measured by the DASS among medical school students. Multiple studies have found a correlation between daytime sleepiness and certain mental health factors, including anxiety, depression, stress, attention, and mood regulation [10,25,34,37,38]. As such, sleep deprivation among medical school students could have significant implications for their overall well-being. For instance, neurophysiological impairments that are associated with sleep deprivation can affect serotonin, adenosine, cortisol, and plasticity levels [28,37,39–43]. It is well known that substances that modulate melatonin, adenosine, serotonin, and dopamine can also modulate depression, anxiety, and stress, strengthening the relationship between sleep and mental health [44–49]. Thus, the effects of sleep deprivation could negatively affect the attention, stress response, and learning process of medical students.

It has previously been reported that clinical-year students suffer more sleepiness than their preclinical colleagues [50]. Although clinical-year students slept less than preclinical-year students, we did not find that they had higher levels of depression or stress. This was surprising because the clinical years are typically the most demanding years in medical school. It is expected that increased pressure and decreased sleep would lead to worse mental health, but this was not the case in our study. This study had a weak correlation between ESS and DASS, whereas SDI did not correlate with DASS. Since there was no significant difference in ESS scores between preclinical- and clinical-students, we could expect the same for DASS scores. However, as the sample size in this study was limited, further studies are needed to determine whether DASS can be used as a predictive tool to assess mental health in our setting. Previous studies have suggested that female students in medical school are sleep deprived and prone to mental health disorders [51,52]. However, this study did not find any significant differences between the sexes. Sex-dependent differences in depression have previously been reported in Ghana, although this was among an elderly population [53]. The absence of sex-dependent differences in this study could be due to the relatively small sample size used. Additionally, factors unique to our study sites such as support systems and teaching schedules, could account for the absence of sex-dependent differences reported by other researchers. In animal models, chronic sleep restriction for more than a week was shown to cause alterations in the serotonergic system, corticotropin-releasing hormone receptor systems, and the neuroendocrine stress systems via the hypothalamic-pituitary-adrenal axis [8].

The changes in the sleep-wake cycle and circadian rhythm observed in this study are similar to those reported for major depression [5]. This suggests that these changes may be involved in the pathogenesis of major psychiatric disorders, particularly depression 5]. Further research into this relationship could help to explain the role of wake-time experiences in the bidirectional relationship between sleep and depression [54]. Many questions remain unanswered regarding the bidirectional relationship between sleep and mental health. There is no consensus on the differences between acute and chronic sleep deprivation as far as the effects on mental health are concerned [8,55,56]. The beneficial effect of restorative sleep or wake-time experiences after sleep deprivation is also unclear [2]. Sleep deprivation during the week, followed by restorative sleep during the weekend, could introduce a dynamic element into the relationship between sleep and mental health [2,8,55,56]. This evidence suggests that medical school students should try to catch up on sleep during the weekend to help protect their mental health from the negative effects of sleep deprivation during the week.

This study has some limitations. Because the sample size was too small, we cannot draw any firm conclusions about the similarities between the sexes. We were also unable to compare the students by their academic years. Moreover, the small sample size limits the generalizability of the study findings. Further studies with larger samples are needed to establish the results of this study. We were unable to collect data from different times of the academic year, which could have revealed changes in sleep patterns throughout the year. A cohort study that assesses changes in the pattern during the academic year is needed.

Conclusion

Our findings suggest that daytime sleepiness may be a potential tool for rapidly screening the mental health status of medical students. This could help to identify students who may be struggling with their mental health and who may need additional support. It could also lead to the development of new teaching strategies that can help to reduce daytime sleepiness and improve mental health.

DECLARATIONS

Ethical considerations

This study was approved by the ethical and review committee of the Department of Community Health, the University of Ghana Medical School (Approval ID: Mt-0981/23_ATComHe_22)

Consent to publish

All authors agreed to the content of the final paper.

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Competing Interest

No potential conflict of interest was reported by the authors.

Author contributions

AT designed the study, collected the data and drafted the manuscript. TAT designed the study, analysed the data, and drafted and revised the manuscript. DEB analysed the data and drafted and revised the manuscript.

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Availability of data

Data is available upon request to the corresponding author.

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