Original Research

Correlates of Sleep Quality: A Pilot Descriptive Cross-Sectional Survey among Undergraduate Students in a Ghanaian University

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Abstract

Background and Objective: A gap exists in evidence of the association between sleep quality and the academic performance of university students in sub-Saharan Africa. A limited number of studies have been conducted in this regard, which have mainly focused on medical students, thus neglecting the larger population of undergraduate non-medical students.

Materials and Methods: This pilot study evaluated the correlates of sleep quality and the academic performance of 500 randomly sampled undergraduate non-medical students at Kwame Nkrumah University of Science and Technology, Ghana. Data was collected using the Pittsburgh Sleep Quality Index (PSQI) and a demographic questionnaire. The participants' demographic characteristics, academic performance, and sleep quality were first analyzed, descriptively, using SPSS software. Relationships between participants' sleep quality and demographic factors, and sleep quality and academic performance were determined using Spearman's rank correlation. The causation between these variables was then determined using simple linear regression.

Results: Poor quality of sleep was prevalent among undergraduate students with a mean (SD) PSQI score of 6.43 (2.78). The respondent's sleep quality had a weak correlation with their academic performance (r_s = -0.146; P = 0.001), although poor quality of sleep was a predictor of academic performance [R^2 = 0.022; 95% CI (-0.640, -0.168)].

Conclusion: Health education and sleep promotion interventions should be used to encourage good sleep quality and practices among students. Furthermore, the findings point to the need for further studies using a larger population.

Keywords: Sleep quality; Students; Academic performance; Ghana

Introduction

Sleep plays a very important and critical role in the academic performance and overall well-being of students of all educational levels (1-3). The quantity and quality of sleep play an important role in regulating an individual's psychological and physical well-being (4). For instance, sleep allows the brain to conduct memory consolidation and integration. Adequate quality sleep, therefore, eliminates concentration difficulties (5) and allows the brain to better process new experiences and knowledge which increases understanding and retention (6). In its absence, judgments, mood, and the ability to learn and retain information are weakened (7, 8). University students are particularly susceptible to the effects of inadequate quality of sleep since they sleep less compared to the general population because of academic stress (9-14).

Poor sleep and sleep disorders have detrimental effects on the daily life of the student such as academic work and social interactions. The sleep quality of the students has been shown to correlate with their academic performance (15-18), indicating that students who do not have good sleep may have poor academic performance.

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Moreover, poor sleep has been shown to affect students' ability to handle stress and social interactions (19, 20). This may result in a cycle where sleep quality is in turn affected by poorly handled stress and social interactions.

Globally, some 60% of sampled tertiary students experienced poor sleep quality (11, 21). In Australia, Batten et al. observed that almost two-thirds of the sampled Australian university students perceived their sleep as insufficient (22). Similarly, Kumar et al. reported that 51.3% of sampled medical students in India had poor sleep quality (23). A poor sleep prevalence rate of 55.8%, 55.8%, 49.5%, and 56.2% was, respectively, reported among university students in Morocco, university students in Ethiopia (24), among Nigerian medical students (25), and among medical students in Ghana (17). This prevalence of poor sleep among university students is an antecedent of commonly reported psychological correlates such as stress, anxiety, and depressive symptoms (26, 27). The sources of such psychiatric morbidities with their associated effect on sleep quality are reported to be academic workload and psychosocial concerns, including sporting activities and the use of social media (28-31). Regardless of the growing studies on the correlates of sleep quality on academic performance among university students in sub-Saharan Africa, the vast majority of researches have focused on medical students (24, 32). This leaves a knowledge gap in the case of university students studying other programs.

Sleep quality affects many aspects of the student's mental, social, and physical well-being which may, in turn, impact their academic performance; thus, sleep is an important aspect of the student's life. It regulates the student's psychological and physical well-being, affects their handling of stress and social interactions, memory, concentration, and understanding and retention of information (5-8, 19). We set out in this study to measure the sleep quality of a cohort of undergraduate students and its relationship with their academic performance. We sought to explore the differences that may exist in the sleep quality of the students across the various levels of study and other demographic qualities.

Materials and Methods

Study design and participants: A descriptive, cross-sectional pilot survey was carried out among undergraduate students at Kwame Nkrumah University of Science and Technology, Kumasi, Ghana. The university runs various programs in six colleges, namely Colleges of Science, Health Sciences, Social Sciences, Engineering, Art and Built Environment, and Agriculture and Natural Resources. This university is the second largest in Ghana, and a very small proportion of the population was randomly chosen for participation in this pilot study. At the time of the study, all the participants were taking part in end-of-academic-year examinations and as such were considered to have spent at least 1 academic year in school.

In line with the university's system, the participants were stratified according to the years of study spent at the university. Participants in their first, second, third, and fourth years of studies were grouped into Level 100, Level 200, Level 300, and Level 400, respectively. Students who were not residents of the campus or its environs because they were having internships were excluded from the study. Moreover, participants who stated before participation that they had a current medically diagnosed mental health disorder for which they were taking any psychoactive medication, were excluded from the study because their current treatment could directly affect their responses.

In April 2019, the researchers distributed 600 questionnaires among the invited undergraduate students who resided within and outside the university campus using a list of 50 university-approved residential halls and hostels. A list of these halls and hostels was made and 12 participants were selected from each of them. Following an invitation to participate, sealed envelopes containing either "yes" or "no" written on a sheet of paper were presented to eligible participants. Only one participant per room was required for participation. Participants who picked "yes" were selected for the study. This was repeated from one room to the other until the desired population was achieved. Moreover, using a participant information leaflet, the objective and scope of the study were explained to potential participants, and verbal consent was sought from those who picked "yes". Upon the provision of consent to participate in the study, a hard copy of the questionnaire was left with the participant to fill out and was collected within 7 days. Out of the 600 questionnaires, 527 were returned, yielding a response rate of 87.8%. However, 27 of the returned question-

naires were not included in the analysis because they were incomplete.

Sample size and sampling technique: Being the pilot of a study with the aim of exploring the sleep quality of all students of the university, a small representative sample of 500 participants was chosen by the researchers for the pilot phase of the study. However, data collection could not be continued due to financial constraints. A simple random sampling technique was used to select participants for the study.

In one month in April 2019, the researchers distributed questionnaires among 600 invited undergraduate students who resided within and outside the university campus using a list of university-approved residential halls and hostels. Of these, 527 questionnaires were returned, yielding a response rate of 87.8%. However, 27 of these were less than 50% completed, and thus, were not included in the analysis.

Data collection instrument: The data collection tools used were a questionnaire designed to collect participants' demographic data and the Pittsburgh Sleep Quality Index (PSQI) (33). The PSQI is a self-rating tool that assesses the quality of sleep in the past month. It consists of 10 main questions which are analyzed to achieve 7 component scores. The component areas are subjective sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction. Questions 1 to 4 require the participant to indicate time in hours, while questions 5 to 10 are scored on a Likert-scale ranging from 0 to 3 in order of increasing severity. Responses were computed for each component to yield scores of zero (0) to three (3), with lower scores indicating the better quality of the component being measured. The component scores were then added up to achieve a global PSQI score, which is the measure of the overall sleep quality. A global PSQI score of greater than 5 indicated poor sleep quality (33), with higher scores indicating lower quality of sleep. The PSQI tool was chosen for its high level of internal consistency and performance consistency which has been evaluated in many studies (34-37). Manzar et al. assessed the tool's internal homogeneity and found the tool to have a Cronbach's alpha of 0.74, signifying a high level of internal consistency (34), while Salahuddin et al. found the tool to have a moderate Cronbach's alpha of 0.59 in Ethiopia (35). Furthermore, Fon-

tes et al. reported that the tool has an adequate test-retest correlation of 0.76 (P < 0.001) and a Cronbach's alpha of 0.70 (37).

For this study, the demographic section of the questionnaire also asked for the participant's cumulated weighted average (CWA), which is used as the measure of participants' academic performance (in continuous assessments and end-of-semester examinations) at the University. These are updated at the end of every academic semester and reported in percentages. Since no personal identifiers like names were obtained which would have enabled the researchers to obtain participants' CWA from the university academic board, participants were required to self-report their CWA based on the last update.

Study outcomes: During analysis, the CWA was categorized based on the performance classification system used by the university (First class ≥ 70.0%, upper second class = 60%-69%, lower second class = 50%-59%, Pass = 45%-49%, and Fail < 45%). This was used as a measure of the participants' academic performance.

Participants' sleep quality was determined based on their computed global PSQI score. Participants who had a PSQI score of ≤ 5 were categorized as having good sleep quality or "good sleeper(s)" and those with a PSQI score ≥ 6 were classified as having poor sleep quality or "poor sleeper(s)". Associations were measured between categorized sleep qualities and respondents' CWA and demographic characteristics.

Statistical analysis: Upon collection of the questionnaire, it was coded sequentially and stored for coding and further processing. The collected data were coded for analysis using the Statistical Package for Social Sciences (SPSS) software (version 25, IBM Corp., Armonk, NY, USA). Participants' demographic characteristics and sleep quality were described using frequencies and percentages. Spearman's rank correlation analysis was used to evaluate the relationships between the participant's demographic characteristics and PSQI score. A causation analysis was then conducted to increase our understanding of the correlation analysis using simple linear regression. In this study, 2 models of simple linear regression were conducted. The first model consisted of an individual regression of the sleep quality (PSQI), age, gender, level of study, and program of study on the participants' self-reported academic performance (reported with CWA). This helped

to ascertain the individual influence of the independent variables on the dependent variable (CWA). All 5 variables were then regressed on the dependent variable (CWA). The second model helped to ascertain whether the interactions between the independent variables moderated their influence on the dependent variable.

Ethical considerations: Before data collection, administrative approval was obtained from the Dean of Student Affairs of the university. Furthermore, ethical clearance (CHRPE/AP/148/19) for the survey was obtained from the Committee on Human Research Publication and Ethics (CHRPE), School of Medical Sciences (SMS), Kwame Nkrumah University of Science and Technology (KNUST). The aim of the study was explained to the participants and participation was voluntary. Participants were not required to provide identification numbers, index numbers, or names to ensure anonymity.

Results

Participants' characteristics: Among the participants, 230 (46.0%) were between the ages of 19 and 21 years and the majority of the participants were men (n = 273; 54.6%). Level 300 participants were the most represented of the groups [182 (36.4%)] and the most represented college was the College of Social Sciences (27.2% of the participants). Moreover, more than half (n = 266; 53.2%) of the participants were in the upper second class designation, with an average CWA of 62.5%. Table 1 presents details of participants' demographic characteristics as well as their academic performance.

Participants' sleep quality: The mean global PSQI score of the participants was 6.43 (SD = 2.78) with an average hours of sleep of 6.14 (SD = 1.23) hours, showing that the average participant in this study had poor sleep quality and slept less than the recommended adult sleep hours. Moreover, 203 participants (40.6%) had a good quality of sleep (PSQI ≤ 5). The majority of the participants (56.0%) rated their sleep quality as fairly good, while 22.6% of them had 7 or more hours of sleep and 96.8% of them recorded a sleep efficiency of higher than 84%. In addition, 361 participants (72.2%) did not use medication to aid their sleep. Details of participants' sleep characteristics are presented in table 2.

Correlates of sleep quality and academic performance: Spearman's rank correlation showed a weak statistically insignificant negative correlation between sleep quality and age [r_s (4) = -0.060; P = 0.180], and between sleep quality and level of study [r_s (3) = -0.027; P = 0.753].

Table 1. Demographic characteristics of participants

Variable	Frequency	Percentage
Age (years)		
16-18	50	10.0
19-21	230	46.0
22-24	191	38.2
25-27	23	4.6
28 ≥	6	1.2
Gender		
Male	273	54.6
Female	227	45.4
Level of study		
Level 100	65	13.0
Level 200	116	23.2
Level 300	183	36.6
Level 400	136	27.2
College of study		
Health sciences	79	15.8
Social sciences	136	27.2
Engineering	54	10.8
Art and built environment	71	14.2
Agriculture and natural resources	79	15.8
Sciences	81	16.2
CWA (Mean = 62.5)		
First class	70	14.0
Upper second class	266	53.2
Lower second class	137	27.4
Pass	23	4.6
Fail	4	0.8

Level 100: First year; Level 200: Second year; Level 300: Third year; Level 400: Fourth year; CWA: Cumulative weighted average

There was, however, a weak negative, and statistically significant correlation between participants' CWA and global PSQI score; indicating that increasing academic performance was associated with a corresponding decrease in global PSQI score [r_s (3) = -0.146; P = 0.001]. Moreover, the analysis showed a negative correlation between participants' duration of sleep and their CWA [r_s (5) = -0.160; P < 0.001] (Table 3).

Simple regression analysis and academic performance: Notwithstanding the weak negative correlation, 2 simple linear models were run to ascertain the underlying causation between the independent variables and the dependent variables. The first model of simple linear regression established that about 22% of the variation in the participants' academic performance was explained by their sleep quality. Although the remaining 4 independent variables were insignificant predictors of the dependent variable, they had an underlying influence on the sleep quality of the participants.

Table 2. Sleep Qualities

Component	Outcomes	Frequency	Percentage
Perception of sleep quality	Very good	66	13.2
	Fairly good	280	56.0
	Fairly bad	112	22.4
	Very bad	42	8.4
Sleep latency	0	129	25.8
	1	220	44.0
	2	133	26.6
	3	18	3.6
Sleep duration (hours)	More than 7	113	22.6
	6 to 7	211	42.2
	5 to 6	112	22.4
	Less than 5	64	12.8
Sleep efficiency	85% or more	484	96.8
	75 to 84%	15	3.0
	65 to 74%	0	0
	Less than 65%	1	0.2
Sleep disturbances	0	24	4.8
	1	340	68.0
	2	135	27.0
	3	1	0.2
Use of sleep medication	Not during the past month	361	72.2
	Less than once a week	76	15.2
	Once or twice a week	47	9.4
	Three or more times a week	16	3.2
Daytime dysfunction	0	163	32.6
	1	156	31.2
	2	128	25.6
	3	53	10.6
Sleep quality score	Good sleep (PSQI ≤ 5)	203	40.6
	Poor sleep (PSQI > 5)	297	59.4
Mean PSQI (SD) = 6.43 (2.78)			
Mean sleep duration in hours (SD) = 6.14 (1.23)			

Their interacting influence is seen in the 8% increase in the variance explained in the model to 30% when all the independent variables were regressed together.

Table 3. Correlates of sleep quality

Variable	Category	Sleep quality [f (%)]		r_s	P-value
		Good sleep	Poor sleep		
Age (years)	16-18	21 (10.3)	29 (9.8)	-0.060	0.180
	19-21	83 (40.9)	147 (49.5)		
	22-24	87 (42.9)	104 (35.0)		
	25-27	10 (4.9)	13 (4.4)		
	28 and Above	2 (1.0)	4 (1.3)		
Gender	Male	120 (59.1)	153 (51.5)	0.75	0.094
	Female	83 (40.9)	144 (48.5)		
Level of study	Level 100	25 (12.3)	40 (13.5)	-0.027	0.551
	Level 200	49 (24.1)	67 (22.6)		
	Level 300	68 (33.5)	114 (38.4)		
	Level 400	61 (30.0)	76 (25.6)		
College of study	Health Sciences	32 (15.8)	47 (15.8)	0.014	0.753
	Social Sciences	61 (30.0)	75 (25.3)		
	Engineering	17 (8.4)	37 (12.5)		
	Art and Built Environment	28 (13.8)	43 (14.5)		
	Agriculture and Natural Resources	31 (15.3)	48 (16.2)		
	Sciences	34 (16.7)	47 (15.8)		
CWA	First class	32 (15.8)	38 (12.8)	-0.146	0.001
	Upper second class	122 (60.1)	144 (48.5)		
	Lower second class	45 (22.2)	92 (31.0)		
	Pass	4 (2.0)	23 (7.7)		
	Fail	1 (0.2)	3 (0.6)		

CWA: Cumulative weighted average

Table 4. Two models of simple linear regression analysis of influence of students' Pittsburgh Sleep Quality Index score (PSQI) on their academic performance in Ghana

Variable	Model 1			Model 2		
	β	95% CI	R^2	β	95% CI	R^2
Global PSQI score	-0.404	-0.640, -0.168*	0.22	-0.392	-0.630, -0.154	0.30
Age	-0.557	-1.409, 0.295	0.003	-0.560	-1.621, 0.502	0.30
Gender	-0.966	-2.297, 0.366	0.004	-0.843	-2.195, 0.508	0.30
Level of study	-0.421	-1.081, 0.239	0.003	-0.152	-0.969, 0.664	0.30
Program of study	-0.059	-0.442, 0.324	0.00	-0.015	-0.399, 0.368	0.30

*Statistically significant at < 0.05

This implies that any targeted intervention should focus on improving the sleep quality of students irrespective of sociodemographic characteristics. The respective standardized beta values (β) imply that any unit of increase in poor sleep quality reduces the participants' academic performance by the respective beta values (Table 4).

Discussion

In this pilot study, we set out to determine and evaluate the correlates of sleep quality and academic performance among non-medical undergraduate students at the Kwame Nkrumah University of Science and Technology in Ghana.

This study is one of the few in Ghana conducted to evaluate the association between sleep and academic performance among university students. To the best of our knowledge, there exists only one other study of this kind performed by Lawson, Wellens-Mensah, and Attah Nantogma among Ghanaian tertiary students. Similarly, it is one of the few studies of its kind in the sub-Saharan sub-region (15, 17, 38). Considering the important role of sleep in the student's life reported in studies from around the world (15, 16, 18, 39-41), more research needs to be carried out in this part of the world to better inform educators and healthcare personnel on sleep promotion programs.

Consistent with previous studies among medical students (11, 17, 23, 29, 42), a majority (59.4%) of the participants in this study were found to have poor sleep quality (Global PSQI Score > 5). Our higher PSQI score, compared to those reported particularly among medical students, could partly be explained by the timing of data collection and full-time residency on campus. Collecting the data a week before the end of the semester examination is characterized by intense preparation. Such preparation forms part of a stressful period for most students, which negatively impacts their sleep needs and satisfaction (43). The high prevalence of poor sleep among our study group could imply that students might have relegated revision to the last weeks leading to the examination, and thus, needed more time to revise. Such an episode could result in poor academic preparation before the examination, and in some cases, could affect the mental health of the students following a suddenly extended duration of poor sleep. Full-time residence on campus is also characterized by intense preparations for lectures. Unlike the medical students, Alsaggaf et al. (44) and Lawson et al. (17), for instance, reported a prevalence of 30% for poor sleep quality among medical students who partly attended lectures and clinical practice. In sum, these two factors had a significant impact on the high prevalence of poor sleep among the study sample.

This high prevalence of poor sleep among the student population is worrying and demands more attention and interventions such as health education, time management, appropriate study techniques, and good sleep promotion. This is to alert students to the dangers of periods where they are likely to have poor sleep such as when preparing for or writing examination.

Data analysis showed that the average daily sleep hours were 6.14 hours with only 22.6% having more than 7 hours of sleep. This adds to the growing number of studies (11, 45-48) that show that a large proportion of tertiary students receive less than 7 hours of sleep, in contrast to recommendations by the American Academy of Sleep Medicine and Sleep Research Society (49). Yang et al. reported that sleep promotes branch-specific dendritic formations that are essential in memory formation and knowledge retention (50). In light of this, poor sleep and short sleep duration may severely impact students' academic performance as reported in various studies (15-18). It was, however, found among the study participants that their fewer hours of sleep did not substantially affect their academic performance as the majority of students were upper second class.

Nevertheless, the average of their academic performance (62.5) meant that any unit increase in poor sleep could plunge the students into the lower second class. A substantial issue in this study is the 8% difference in the variations in the independent variables which explains the dependent variable. The variation suggests that academic performance is affected by other factors and not merely the hours of sleep a student had. Such variation calls for further studies to investigate the unaccounted factors which may explain the variation, particularly in the light of this study where the individual independent variables insignificantly predicted the participant's academic performance.

Interestingly, the majority of the sampled students had a very good or fairly good perception of their sleep quality and almost all of them had more than 85% sleep efficiency. This seems a contradiction to their recorded sleep quality. This may also be evidence of their mental toughness which has been defined as the ability of many young people to successfully endure stressful situations with less than optimal sleep (51). Moreover, the use of sleep medications was low in this population. This was similar to the findings from Goodhines et al. who reported that as little as 25% of university students used sleep medication at least once a week (52). Similarly, daytime dysfunction was also low in this population, a phenomenon that has also been associated with high sleep efficiency.

Limitations: This study was a pilot study and did not use an appropriate sample size that represents the whole university population to enable the researchers to draw statistical inferences. Care must be taken not to generalize the findings of this study. Even though this study has established a direct and positive relationship between sleep quality and academic performance, we recognize that academic performance is affected by a host of other factors such as mode of instruction, and co-curricular activities the student was engaged in, among other factors, all of which are beyond the scope of the current study. Therefore, the present study findings may be biased, and thus, we will benefit from further research in this regard. Participants were required to self-report their CWA, in which case participants could have overstated their CWA due to social desirability bias. This limitation, however, was caveated by the study's ethical consideration which promised autonomy and voluntariness of participation. Lastly, this study is limited as it does not determine the causation of poor sleep quality among the participants.

Conclusion

In conclusion, the participants of this study demonstrated a poor quality of sleep like students in other studies elsewhere, and good sleep quality and longer sleep duration were linked with better academic performance. However, there may be other factors that influence this. The findings call on university health services to institute health education and promotion regarding good quality of sleep among students. Furthermore, environmental conditions such as noise levels and night lighting that have been known to impact sleep should be considered for modification by campus housing providers. Future studies should be carried out on a larger sample to further explore the findings of this study.

Conflict of Interests

Authors have no conflict of interests.

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