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Good Quality Sleep is Associated with Better Academic Performance among University Students in Ethiopia

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Abstract

Purpose—This study assessed the association of sleep quality with academic performance among University students in Ethiopia.

Methods—this cross sectional study of 2173 college students (471 female and 1672 male) was conducted in two Universities in Ethiopia. Students were selected in to the study using a multistage sampling procedure and data were collected through a self administered questionnaire. Sleep quality was assessed using Pittsburgh sleep quality index and academic performance was based on self reported cumulative grade point average. The Student ‘t’ test, Analysis of Variance (ANOVA) and multiple linear regression were used to evaluate associations.

Results—We found that students with better sleep quality score achieved better on their academic performance (P-value =0.001) while sleep duration was not associated with academic performance in the final model.

Conclusion—Our study underscores the importance of sleep quality on better academic performance. Future studies need to identify the possible factors which influence sleep quality other than the academic environment repeatedly reported by other literature. It is imperative to design and implement appropriate interventions to improve sleep quality in light of the current body of evidence to enhance academic success in the study setting.

Keywords

Academic performance; sleep quality; khat and students

Introduction

Sleep is believed to have facilitating role in learning and memory process[1,2]. Sleep deprivation experiments conducted on humans have shown that sleep deprivation causes impairment of performance, vigilance, attention, concentration and memory[3]. Individual’s

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sleep habit is measured using sleep quality, sleep duration, regular sleep wake cycle and day time sleepiness in different population groups[1,4]. Although there are other mechanisms to measure cognitive performance of students, it is commonly studied by reviewing grades obtained in course examinations [5-7].

Academic achievement is one of the reasons why students alter their sleep pattern in college [8]. Good sleep quality has been shown to be a predictor of better academic performance among college students [9-11,1]. Sleep duration has also been shown to influence academic performance although the research findings have been inconsistent: while most studies documented association between better academic performance and optimum sleep duration (7-8hours of sleep per night) [12,13,9,14,10], few reported no association [6,15,11]. Notably, one study documented a U-shaped association, where both long (> 8 hours) and short (<6 hours) sleep duration result in poor performance[16].

Behavioral factors such as use of coffee, alcohol, cigarette and Khat (*Catha-edulis*, a stimulant plant used in East Africa and Arabian Peninsula) are common among college students [17-19]. Some use these substances for recreational purposes while others use it to regulate their sleep-wake cycle[20,19]and they eventually develop poor sleep quality and insufficient sleep [21,22]. These behaviors could either mediate the effect of sleep [23] or directly affect academic performance[24]. The use of Khat to enhance one's performance has been growing in the last decade among young adults and students in Ethiopia [25-27].

Two studies assessed the effect of sleep on academic performance in an African setting[28,12] one of the studies focused on students with learning difficulties. However, both studies were based on small subject samples and have not controlled for confounders such as stress. Thus, in the present study we examined the association of sleep quality with academic performance controlling for other behavioral factors. We expect the results from this study will be used as a basis for designing appropriate interventions to promote improvements in students' overall sleep health and hygiene; and academic performance.

Methods

Study Design and Participants

A cross-sectional study was conducted from November 2010 to January 2011 among undergraduate students in two public universities in Ethiopia (Haremaya and Gondar Universities). Details regarding data collection methods and study procedures have been previously described[29]. Briefly, a multistage sampling procedure was employed to select participants using proportional to population size (PPS) technique to draw a representative sample from all departments of the universities.

We used a self administered questionnaire adapted from different instruments such as the Pittsburgh Sleep Quality Index (PSQI). The questionnaire included information on socio-demographic variables, class attendance, academic performance, sleep pattern and behavioral risk factors such as use of coffee, alcohol, cigarette and khat.

Measurement

Pittsburgh Sleep Quality Index (PSQI)

Sleep quality was measured using the Pittsburgh Sleep Quality Index (PSQI); the instrument has been validated among college students in sub-Saharan Africa[30]. The PSQI is composed of 19 questions which evaluate sleep in the past one month. The PSQI provides seven components scores which measures sleep related habits including sleep duration, sleep disturbance, habitual sleep efficiency, subjective sleep quality, use of sleep medication, day time dysfunction and sleep latency. The score for each component ranges from 0-3; with 3 indicating the greatest dysfunction. Summing the sleep component scores, one global sleep quality score was derived and it ranged from 0 to 21. Based on prior literature students with PSQI score greater than five were labeled as having poor sleep quality and those with PSQI score less than or equal to five were labeled as having good sleep quality[31]. For the sleep medication use, the last two categories (1-2 times and 3 or more times a week) were merged. Similarly, for sleep disturbance score the last two categories were also merged. Sleep duration was measured using the same PSQI questionnaire which queried how many hours of actual sleep the participants got at night during the previous month. Their response was categorized in to > 7hours, 6-7 hours, 5-6 hours and < 5 hours.

Academic Performance and Class Attendance

Academic performance was assessed by asking participants about their cumulative grade point average (CGPA). Participants provided their CGPA for the last semester prior to the study period; the CGPA ranged from 1:00 to 4:00 points. Students were also asked if they missed class and the affirmative response for this question is followed with questions about the frequency of missing class in the previous semester. Their response was categorized as none, 1 to 6 days, 7-14 days and 15 days in the last semester.

Behavioral Risk Factors

Use of Khat, alcohol, cigarette and coffee were assessed using the self report of the students' current consumption. Students were asked if they currently chew khat and the affirmative response was followed with question about the frequency of khat use; their response was categorized as none, less than once a week, 1 to 2 times per week and 3times per week. Current cigarette smokers were those who reported use of cigarette at the time of study. Participants who reported use of alcohol at least once per week were alcohol users in this study. Coffee consumption was defined as use of coffee alone at least once per week. The questions related to cigarette and coffee had binary response (yes or no).

Ethical Approval

Informed consent was obtained from each study participant. The study protocol received ethical approval from Addis Continental Institute of Public Health (ACIPH), University of Gondar Institutional Review Board (IRBs), and from the University of Washington Human Subject Committee.

Statistical Analysis

We analyzed the data for 2,173 students excluding 644 (Sleep quality score=266 & CGPA=457) students with missing values for the sleep quality score and CGPA. Chi square test was used to assess differences in the distribution of the demographic variables and behavioral risk factors among the responders and non-responders.

The distribution of demographic variables and behavioral risk factors were presented using proportions. Mean with standard deviation was used to present the CGPA. Independent Student-test and analysis of variance (ANOVA) were used to compare mean values of CGPA by different sleep patterns and demographic variables. Bonferroni test, a post hoc analysis was used to evaluate which category accounts for the observed mean difference in CGPA.

Multiple linear regression models were used to evaluate the effect of sleep problems (sleep duration and sleep quality) behavioral risk factors on academic performance after controlling for the known confounders such as sex, year of study, stress, depression and university attended. The same variables were fit in the model for sleep duration and sleep quality separately, as the two variables could not be included in the same model.

The model for sleep duration was controlled for the effect of confounders except for sleep quality and the model for sleep quality was controlled for the effect of confounders except for sleep duration. So, the variables presented in Table 4 are those included in the sleep quality model. The β coefficient, the standard error and the p-values are reported with the multiple regression model. All statistical assumptions were checked and fulfilled before using the regression models and all the analysis were performed using the STATA 11 software.

Result

Data for 2173 students were used for this analysis excluding data with item missing for sleep quality score and CGPA. There was no statistically significant difference between those in the analysis and excluded from the analysis in terms of the socio-demographic and other explanatory variables except for alcohol consumption, Khat and class attendance. The non-response was higher among students who did not use alcohol, Khat and those who did not miss class.

The majority of the students were sophomore or junior (91.7%) and their mean age was 21.6 with standard deviation of 1.67. About one fifth of the students participated in the study were female. Approximately 10.0% of the students reported moderate alcohol consumption in the week prior to the study; 12.0% were male and 4.0% were female. The prevalence of current cigarette smoking was 3.4% (1.1% female and 3.9% male) while Khat use was 9.9% (1.7% female and 12.2% male) (Table 1).

Academic Performance, Sleep Quality and its Components

A statistically significant increase in the mean CGPA was seen with increasing year of study ($F=11.76$, $p<0.001$); this was evident both for male ($F=8.05$, $P<0.001$) and female ($F=4.13$,

$P < 0.001$) participants. Table 2 illustrates the ANOVA result for sleep quality component scores and academic performance. Accordingly, significant variation was observed between academic performance and all sleep quality components except for sleep latency score. Students who classified as good sleepers were more likely to have higher mean CGPA as compared with those classified as poor sleepers ($P = 0.009$). The mean CGPA was highest for students who slept 6-7 hours per night compared to those who slept higher or lower than 6-7 hours ($P = 0.008$). In the post hoc analysis, there was a statistically significant difference in mean CGPA between students who slept greater than seven hours and those who slept less than five hours sleep ($P = 0.017$); and between those students who slept 6 to 7 hours and less than five hours per night ($P = 0.009$).

The mean CGPA decreased as subjective sleep quality score got worse ($P = 0.001$); this significant difference was mainly attributed to the difference between those students who perceived their sleep quality as very good versus those reporting their sleep quality as very bad ($P = 0.007$). Students with sleep efficiency below 65% had the lowest mean CGPA and the significant difference was between those who scored sleep efficiency above 85% and below 65% ($P = 0.03$). For both day time dysfunction and sleep disturbance, the mean CGPA decrease as the scores get worse ($P = 0.027$ & 0.017 respectively).

Behavioral factors and Academic Performance

The mean CGPA was not statistically different among Khat users and non users as well as among coffee users and non-users. Participants reported consuming alcohol in seven days prior to the survey had lower CGPA ($P = 0.006$); similar finding was observed among current cigarette smokers compared to never-smokers ($P = 0.008$) (Table 3).

Factors Associated with Academic Performance

The results of multiple linear regression showed that poor sleep quality was significantly associated with poor academic performance ($P = 0.002$): a unit increase in sleep quality score was associated with 0.012 points reduction in mean CGPA. However there was no statistically significant association between sleep duration and CGPA. Being male was associated with 0.27 point increase in mean CGPA compared to female ($P < 0.001$); an increase in year of study at the university from second year to third year and from second year to fourth year was associated with 0.62 and 0.19 point increase in CGPA. The reduction in mean CGPA was progressively higher as students missed more classes. Except for alcohol consumption ($P = 0.044$), none of the behavioral factors (Khat, cigarette, and coffee) were associated with academic performance.

Discussion

This study assessed the association of sleep quality and sleep duration with academic performance. In this study, sleep quality score was significantly associated with academic performance but not sleep duration. The other exogenous variables which had significant association with academic performance were sex, alcohol use, years of study and class attendance.

Our finding showing significant association between sleep quality score (as measured with PSQI) and academic performance is in agreement with prior studies conducted among college students elsewhere[10,11]. Poor sleepers have more difficulty of functioning during the day and that affects their overall performance and concentration[32]

In this study, no significant association was observed between sleep duration and academic performance similar to earlier reports from Malaysia and Saudi Arabia[15,33]. However our result differs from the studies done elsewhere [10,23,11]. For our study population, getting the optimum amount of sleep in terms of quantity may not mean getting quality sleep with minimum disturbance. Almost all students live in a dormitory: sharing with average number of 5 to 7 other students. Having considerable number of students in a single dormitory room make the environment liable for noise disturbance which is one of the environmental factors playing a role on sleep-wake cycle and sleep quality [34,35]. Besides, our bi-variate analysis also revealed a significant association between sleep disturbance score and mean CGPA which emphasis the importance of the collective components of sleep.

The lack of significant association between Khat use and CGPA was different from two prior studies conducted in Ethiopia where Khat users had lower mean CGPA than non-users in the bivariate analysis[36,37]. However, these two studies did not use multivariate analysis to further control the effect of confounders. Another study which assessed chronic Khat use and working memory found significantly worse performance among Khat users than the controls[38]. The lack of significant association between cigarette and academic performance in the final model could be explained by the overall small prevalence of these behaviors in the study population. The significant association between alcohol consumption and CGPA was in line with other studies of college students[23,39]. Likewise, class non-attendance was associated with reduced academic performance as reported previously[11,40]. The association between academic performance and sex was also reported previously [15]. This finding might be explained as: female students often report poor sleep quality due to stress related to academics and other conditions more than male[21,41,42] which might affect their academic performance more. However, our finding is different from studies done in other places where females perform better in academics than male[43,44]. This could be related to the socio-cultural environment which is different in these different settings.

Although it is not conclusive, the observed association between sleep quality and academic performance is biologically plausible. Evidences suggested that short term deprivation of sleep is associated with development of micro-sleep during wakefulness, at which time individuals become non-attentive. The sleepiness also interferes with higher cerebral functions impairing short memory, concentration, cognition and intellectual performance[45]. In addition, certain stages of sleep are believed to be associated with memory consolidation and learning as their overnight deprivation was correlated with poor performance[3,46]. The alternative explanation could also be students with poor grade may worry about their grade and have poorer sleep quality.

It is appropriate to interpret the results of this study with certain caveats. One of the limitations of this study is its reliance on self reported measures of sleep pattern, academic

performance, and stimulants use. Although self reports of behavioral risk factors could likely be underestimated, studies using self reported sleep pattern documented that the results were comparable with the objective measures[47]. Thus the main independent variable for this study is less likely to be affected by self reporting bias. In addition, self reported grade is also suggested to be reasonably a good reflection of the actual grade for student with good grade but less accurate for students with low grade. Thus we would expect certain level of CGPA inflation for students with lower CGPA[48]. In addition, this study is a cross-sectional study and cannot establish temporal relationship between sleep quality and academic performance.

In conclusion, the study findings show association between sleep problem and poor academic performance among university students. This study adds on the body of knowledge by examining behavioral and poor academic performance among university students, in a different socio-cultural context. However there is a need for further researches with a prospective design which considers different periods of the year as the students sleep habits varies depending on whether the information is collected close to examination time or not. Besides, future studies should also consider more objective measures of sleep habit and academic performance. In addition, future studies, preferably qualitative studies should look in to the dormitory environment, sleeping condition of the students and other possible source of poor sleep quality in depth.

Given the result of this study and the body of evidences from other places, it is imperative to design and implement appropriate interventions to enhance academic success and healthy life among university students in the study setting. The interventions may focus on the following areas: making student aware of the consequences of their poor sleep habit on their academic performance; and providing students with alternative skills to handle academic burden such as good time management skill and maintaining good class attendance. In addition, the intervention may promote good sleep hygiene so as to reduce the effect of behavioral factors on individual's sleep.

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Table1

socio-demographic and behavioral characteristics of University students

Characteristics N=2173		Frequency (%)
Age in years		
Mean(SD)		21.6(1.67) [§]
Class Year	Second year	1078 (49.7)
	Third year	912 (42.0)
	Fourth and above	181 (8.3)
University attended	Haramaya	1095 (50.4)
	Gondar	1078 (49.6)
Alcohol use	No	1862 (86.9)
	Yes	281 (13.1)
	No	2100 (96.6)
Current cigarette smoking	Yes	73 (3.4)
Current Khat use	No	1957 (90.1)
	< 1 per week	38(1.8)
	1-2 per week	90(4.2)
	3 per week	85(3.97)

[§] mean with standard deviation

Table 2

Mean CGPA by sleep quality and its components among University students

Variables (N=2173)	Mean	SD	F-test	P-value
Sleep quality score			2.61	0.009**
Good sleep	2.90	0.49		
Poor sleep	2.84	0.51		
Sleep duration			3.95	0.008**
> 7hours	2.88	0.49		
6-7hours	2.89	0.50		
5-6hours	2.83	0.49		
<5 hours	2.77	0.55		
Subjective sleep quality			5.33	0.001**
Very good	2.91	0.50		
Fairly good	2.86	0.48		
Fairly bad	2.81	0.54		
Very bad	2.71	0.57		
Sleep medication			6.24	0.002**
<once per month	2.88	0.50		
< once per week	2.72	0.53		
> once per week	2.80	0.46		
Sleep efficiency (%)			2.83	0.037*
>85	2.88	0.50		
75-84	2.89	0.48		
65-74	2.87	0.48		
<65	2.77	0.52		
Sleep latency score			0.75	0.52
0	2.90	0.51		
1	2.86	0.50		
2	2.86	0.49		
3	2.84	0.50		
Day time dysfunction score			3.052	0.027*
0	2.90	0.50		
1	2.88	0,49		
2	2.82	0,49		
3	2.82	0,56		
Sleep disturbance score			4.104	0.017*
0	2.95	0.50		

Variables (N=2173)	Mean	SD	F-test	P-value
1	2.88	0.49		
2 & 3	2.82	0.51		

* P-value 0.05

** 0.01

Table 3

Mean cumulative grade point average by behavioral risk factors among University students

Variables (N=2173)		Mean CGPA (SD)	t-test	P-value
Alcohol use	No	2.88(0.50)	2.775	0.006*
	Yes	2.79(0.50)		
Cigarette smoking	No	2.87(0.50)	2.711	0.008*
	Yes	2.74(0.40)		
Khat use	None	2.87(0.50)	0.609	0.543
	< 1 per week	2.84(0.44)		
	1-2 per week	2.84(0.50)		
	3 per week	2.86(0.42)		
Coffee use	No	2.86(0.50)	-1.137	0.256
	Yes	2.88(0.50)		

* P-value 0.05

** <0.01

Table 4

Relationships of academic performance with sleep duration, sleep quality, behavioral and other risk factors

Academic Performance				
Variables	β -Coef.	Std. Err.	<i>t</i>	P-value
Sleep quality	-0.012	0.004	-3.03	0.002**
Sleep duration				
> 7hours				Ref.
6-7hours	0.0 13	0.0 23	0.57	0.572
5-6 hours	-0.027	0.035	-0.76	0.446
<5 hours	-0.074	0.038	-1.95	0.052
Sex				
Female				Ref
Male	0.2 74	0.0 26	10. 63	<0.001**
Class non-attendance				
None				Ref
< 1 week	-0.067	0.0 24	-2.77	0.006**
1-2 weeks	-0.094	0.044	-2.15	0.031*
>2 weeks	-0.119	0.060	-2.00	0.045*
Cigarette smoking				
No				Ref
Yes	-0.123	0.0 70	-1.76	0.078
Alcohol use				
No				Ref
Yes	-0.066	0.0 33	-2.01	0.044*
Khat use				
none				Ref
< 1 per week	-0.060	0.0 79	-0.75	0.454
1-2 per week	-0.063	0.054	-1.18	0.238
>=3 per week	0.017	0.063	0.27	0.786
Coffee				
No				Ref
Yes	0.0 25	0.0 22	1.12	0.262
Year of study				
2nd year				Ref
3rd year	0.0 60	0.0 22	2.76	0.006**
4th year & more	0.192	0.040	4.80	<0.001**

Note: the model also controlled for stress, depression, and university attended.

* **P-value 0.05**

** **0.01**