ORIGINAL ARTICLE

Association Between Pittsburgh Sleep Quality Index Factors, Academic Performance and Health

Bijeta Mishra[1] · Niswas Sahu[1] · Suman Dhaka[2]

Abstract
Purpose The deconstruction of sleep quality into its particular components may help to specify how each one of them influence academic performance and health. Thus, the current study aims to assess sleep quality among students and the association of each component of the Pittsburgh Sleep Quality Index (PSQI) with academic performance, mental, and general health.
Methods One hundred and forty-three students participated in the study and filled up demographic forms, Pittsburgh Sleep Quality Index (PSQI), General Health Questionnaire (GHQ), and Depression, Anxiety, Stress Scale- 21 (DASS 21). Multiple regression analysis was performed to examine the correlation between PSQI, academic performance, and health among the participants. Logistic analysis was used to determine the significance of association between PSQI and factors like academic performance and health.
Results Analysis of data shows 51.74% participants experienced bad quality sleep. Poor sleep quality was a significant predictor of depression (36.3%), anxiety (19.6%) and stress (29.9%), positive health (21.8%) and negative health (42.6%). Sleep latency as an individual component has a significant negative impact on academic performance. 'Subjective sleep quality' and 'daytime dysfunction due to sleepiness' had a significant impact on both physical and mental health. Logistic regression analysis of the association between scores on academic performance, mental health, and sleep quality demonstrated significant correlations between quality of sleep and mental health scores (odds ratio = 1.05:1.03–1.06, $p < 0.01$).
Conclusion Sleep is an important determinant of academic performance, and health of the students. The findings of the study will aid to develop intervention strategies that address the overall health issues of students.

Keywords Sleep quality · Academic performance · General health · Mental health · Pittsburgh sleep quality index

1 Introduction

Sleep has been considered as one of the vital physiological processes that essentially attributes to the optimal functioning of the individuals of all age groups. It is defined as 'a state that is characterized by changes in brain wave activity, breathing, heart rate, body temperature and other physiological functions' [1]. Sleep pattern is determined by the interplay of hereditary, environmental, behavioral, and social factors. According to Giri et al. [2], and Hirshkowitz et al.

[3], an average duration of seven to nine hours of sleep for adults is an essential requirement for their daily-life functioning. Several or almost one-third of the population experience multiple difficulties related to sleep [4–6]. Furthermore, it has been observed that the student population is among the worst-hit group of sleep deprivation. Lund et al. [7] reported from a cross-sectional study that almost seventy-one percent of students failed to attain the recommended eight-hour sleep pattern and almost sixty percent of them were categorized as 'poor sleepers.' In India, around 48.29% undergraduate students report experiencing poor quality of sleep [8]. Adapting to multiple stressors like academic pressure [9, 10], leaving home, adequate management of the newly gained autonomy [11] take a toll on their sleep patterns. Apart from this, unhealthy lifestyle practices like overuse of the Internet, smoking, alcohol, drug use and caffeine intake, diet, and exercise can also contribute to the disturbed sleep cycle among university students [12, 13].

✉ Suman Dhaka
dhakas@iitj.ac.in

1   National Institute of Technology Rourkela, Rourkela, Odisha 769008, India

2   Department of Humanities and Social Sciences, Indian Institute of Technology Jodhpur, Jodhpur, Rajasthan 342037, India

1.1 Sleep and Academic Performance of Students

Sleep-related problems like deprivation, inconsistent schedules, and poor sleep quality have seen an increasing trend among adults, and it affects the student population more than the general population [14]. Research evidence has consistently indicated that poor sleep quality consisting of facets like shorter duration of sleep, daytime sleepiness, irregular sleep routines, and sleep deprivation is associated significantly to poorer scholastic performances and high failure rates among the university students [15–19]. Gilbert & Weaver [20] have opined that a major proportion of students have a poor sleep pattern and suggested that those who do not attain optimal sleep quality for a minimum stipulated duration perform alarmingly in academics. Irregular sleep–wake cycle and inadequate sleep duration have been associated with lower Grade Point Average (GPA) [21]. Therefore, they emphasized both on the quality and quantity of sleep as significant contributors of academic excellence.

1.2 Sleep and Health

Sleep plays a vital role in determining the physical and mental health of individuals. The quality and quantity of sleep often affects physical health [8, 22–26]. Students often engage in academic and social activities which in turn lead to unhealthy and inconsistent sleep patterns. This might result in poor health affecting the immune system [27]. Poor sleep quality is believed to be one of the many causes of triggering headaches [28, 29]. Sleep problems in university students have also been frequently associated with various mental health indicators [30]. Research evidence suggests that there exists a positive correlation between overall sleep quality and facets of mental health like stress, anxiety, and depression [31]. Problems like impatience, irritability, moodiness, and inability to focus might be the result of inadequate amounts of sleep [32]. Excessive daytime sleepiness caused due to improper sleep patterns is believed to affect cognitive abilities negatively [16].

Research studies have assessed the impact of overall sleep quality on factors like academic performance, mental and physical health. However, there is a paucity of research with regard to the impact of individual sleep components. The deconstruction of sleep quality into its particular components may help to specify how each one of them influences academic performance and health. To our knowledge, there is a dearth of research regarding the analysis of the relationship of Pittsburgh Sleep Quality Index (PSQI) components with the academic performance,

level of depression, anxiety and stress, and positive and negative health in students. Especially in the technical education institutes where students have the habit of working late night, active social life during night, homework and assignment requirements, and increased duration of exposure to video games, Internet, etc., students experiencing disturbed sleep patterns is a common phenomenon. Hence, there is a need to understand the impact of individual components of sleep quality which may affect academic performance and health of students differently. Therefore, decoding sleep quality into its particular objective components may help to specify the extent to which each one of them influences academic performance, general and mental health. This can facilitate the development of intervention strategies in order to address the overall health issues of the university students.

1.3 Objectives

The current study aims to assess the overall quality of sleep among students and examine the effect on academic performance, mental health, and general health. The second objective of the study is to find out if individual sleep factors of the PSQI scale have a significant impact on the above-mentioned factors. The study also aims to investigate the underlying association among facets of mental health, general health, and academic performance.

2 Materials and Methods

2.1 Participants

The participants had volunteered themselves for the study through an open advertisement on the website of the psychology laboratory of the institute. The selection was made on certain inclusion/exclusion criteria. The participants must possess at least fourteen years of formal education, and report no physical ailment. All participants were free from any neurological or psychiatric disorders and took no centrally acting medications. Initially, 146 students with a mean age of 21.90 (SD = 1.92) years were selected for the study. However, three participants dropped out of the study due to personal reasons. Therefore, 143 students including both males ($N = 98$) and females ($N = 45$) were considered for the study. To keep the study uniform and heterogeneous students of different streams and semesters participated in the study. Informed consent was obtained from each before participation. The study was approved by the ethics committee of the institute.

2.2 Measures

The study incorporates standardized measures for assessing sleep, mental health, and general health. All the standardized measures namely Pittsburgh Sleep Quality Index [33], Depression, Anxiety, Stress Scale-21 Items [34], and General Health Questionnaire [35] are validated and widely used in the Indian student population.

2.2.1 Pittsburgh Sleep Quality Index (PSQI)

Pittsburgh Sleep Quality Index [36] comprises 19 self-rated questions and 5 questions where the rating is done by a roommate (if available) of the student. However, only the self-rated questions are considered for scoring. Seven 'component' scores are formed out of the 19 items rated by the participants, ranging between '0–3' points. A score of '3' denotes severe difficulty in sleep, whereas a score of '0' implies an absence of difficulty in sleep patterns. A 'global score' ranging from '0–21' points, indicating ascending levels of sleep difficulties, is obtained from the summation of the component scores.

2.2.2 Depression, Anxiety, Stress Scale-21 Items (DASS-21)

The Depression, Anxiety, Stress Scale-21 (DASS-21) [37] incorporates three self-report measures that assess the emotional states of depression, anxiety and stress. A total of 21 items are divided into three subscales, with seven items assigned to each emotional state. The scores of each item ranges between '0' and '3,' where '0' indicates 'never applies to me,' and a score of '3' indicates 'almost always applies to me.' Scores for depression, anxiety, and stress are calculated by summing the scores for the relevant items and are categorized as 'normal,' 'mild,' 'moderate,' 'severe,' and 'extremely severe' for each subscale. The 'normal' range for depression, anxiety, and stress are '0–4,' '0–3,' and '0–7,' the 'mild' range is '5–6,' '4–5,' and '8–9,' the 'moderate' range is '7–10,' '6–7,' and '10–12,' the 'severe' range is '11–13'and '13–16,' and the 'extremely severe' range is '14 or more,' '10 or more,' and '17 or more,' respectively. Thus, higher scores indicate higher levels of depression, anxiety and stress experienced.

2.2.3 General Health Questionnaire (GHQ-12)

The General Health Questionnaire-12 [38] is a psychometric screening tool to identify common psychiatric conditions. The questionnaire comprises a number of questions, each with a four-point Likert scale for responses. There are versions with 12, 28, 30, and 60 questions. The GHQ 12 comprises six 'positive' and six 'negative' items. The positively worded items had responses 'better than usual,' 'same as usual,' 'less than usual,' and 'much less than usual.' Negatively worded items had responses, 'not at all,' 'no more than usual,' 'rather more than usual,' and 'much more than usual.' The responses were coded on a four-point Likert scale. Negatively worded items were coded such that 'not at all' represented '0' and 'much more than usual' represented '3.' Positively worded items were coded such that 'better than usual' represented '3' and 'much less than usual' represented '0.'

2.2.4 Academic Performance

The academic performance of the participants was measured using the Grade Point Average (GPA) from the last two semesters which was self-reported by the participants and was further verified in the academic section. The grade points range from 0 to 10 where a GPA of '0–5' indicates poor academic performance and '6–10' is indicative of average to excellent academic performance. The cumulative grade point of the last two semesters was considered the measure of academic performance for the participants.

2.3 Procedure

The study aimed to encompass participants of both graduate and postgraduate levels. After reassessing the questionnaire, and following the scrutiny process including the inclusion and exclusion criteria, a consent form was circulated to the interested students. The registered students were then approached and given adequate explanation with regard to the study. They were then asked to fill up the questionnaires namely PSQI, DASS-21 and GHQ-12. The participants filled up a demographic form where they provided details of the course pursued, and their grades of the last two semesters, which were further verified at the academic section of the institute. A total of 146 students completed the questionnaires. Out of the 146 participants three participants opted out of the study citing personal reasons. Therefore, the scores of 143 participants were scored after careful evaluation.

2.4 Data Analysis

Data were analyzed using statistical software (SPSS version 24). Descriptive statistics were reported as means. Linear regressions were conducted to analyze the effect of various components of sleep on the academic performance, and facets of mental and general health. Multivariate analysis was used to analyze the differences between study groups based on the effect of sleep quality, i.e., good and bad quality of sleep, in terms of academic performance, mental health, and general health. Pearson's correlation was carried out to understand the association between different

Table 1 Descriptive Statistics of the Groups of Participants

Group	N	Academic Performance	Depression	Mean (SD)		Positive Health	Negative Health
Quality of Sleep				Anxiety	Stress		
Good	69	8.13 (.84)	9.71 (7.08)	8.6 (5.72)	9.44 (7.21)	12.38 (2.05)	4.16 (2.86)
Bad	74	7.87 (.77)	19.00 (11.53)	14.62 (9.33)	17.29 (9.42)	10.62 (3.59)	8.12 (4.32)

Source: Author's Calculation

sleep components and the dependent variables (academic performance, mental, and general health); and the relationship among the dependent variables.

A recent study by Cole et al. [39] found support for a three-factor model (in CFA) of the PSQI, we examined the fit of three-factor models in the present sample. Further, we conducted a confirmatory factor analysis (CFA) using the AMOS 24.0 software package, to assess the validity of variables. Several indices were used to evaluate model fit: (1) Chi-square corrected for non-normality (non-normal χ^2); (2) standardized root mean squared residual (SRMR); (3) root mean square error of approximation (RMSEA); and (4) comparative fit index (CFI). The non-normal χ^2 and the SRMR are indices of absolute fit. A nonsignificant χ^2 is evidence of acceptable fit. Smaller values of SRMR indicate better model fit, with values ≤ 0.08 indicating acceptable fit. The RMSEA is a commonly used parsimonious index, with values ≤ 0.06 indicating acceptable fit [40]. The CFI is an incremental fit index, with values ≥ 0.95 indicating acceptable fit.

Finally, logistic regression was used to determine the significance of association between PSQI and academic and health scores after setting the quality of sleep (i.e., 0: good; 1: bad) as independent variable, while setting various facets of health, namely, depression, anxiety, stress, positive health and negative health as dependent variables. Average values are expressed as mean $\pm$ standard deviation (SD). A 'p' value of less than 0.05 is considered statistically significant. In addition, before all regression analysis, preliminary analyses were conducted to ensure that no violation of the assumptions of normality, linearity, and multicollinearity existed.

3 Results

3.1 Sleep Quality

The participants were categorized based on their quality of sleep. Out of 143 participants, 48.25% ($N = 69$) participants reported experiencing 'good sleep,' whereas 51.74% ($N = 74$) participants experienced 'bad sleep'. Table 1 presents the mean and standard deviations of the groups of participants on the dimensions of academic performance, mental, and general health.

Table 2 Summary of multivariate analysis of variance

Effect	Value	F	Hypothesis df	Error df	Partial η^2
Intercept	0.006	3635.445**	6	136	0.994
Quality of Sleep	0.737	8.076**	6	136	0.263

* and ** represent 5 and 1% level of significance respectively
Source: Author's Calculation

Table 3 Summary of effect of independent variables on dependent variables

Source	Dependent Variable	df	F	Partial η^2
Quality of Sleep	Academic Performance	1	3.611	0.025
	Depression	1	33.086**	0.190
	Anxiety	1	21.181**	0.131
	Positive Health	1	12.634**	0.082
	Negative Health	1	41.056**	0.226
	Stress	1	30.927**	0.180

* and ** represent 5 and 1% level of significance, respectively
Source: Author's Calculation

3.2 Effect of Sleep Quality on Academic Performance, Mental, and Physical Health

Multivariate analysis was conducted to analyze the effect of sleep quality on the dependent variables. It was conducted to test the hypothesis if there exists any significant difference between students experiencing good and bad quality of sleep on the dimensions of academic performance, depression, anxiety, stress, and positive and negative health aspects (Table 2). Wilk's Lambda test statistic was used to report results from MANOVA. A statistically significant MANOVA effect was obtained for quality of sleep; the multivariate effect size was estimated at 0.263, suggesting that 26.3% of the variance of the combined effect of dependent variables is explained by the quality of sleep.

Furthermore, test of between-subject effects (Table 3) were analyzed to determine how the dependent variables (academic performance, depression, anxiety, stress, and positive and negative health) differ for the independent variable (sleep quality). Moreover, it was observed that quality of

sleep was significantly associated with depression, anxiety, positive health, negative health, and stress. It was observed that students with bad quality of sleep experienced the highest amount of depression, anxiety and stress, and had the worst health conditions as compared to their counterparts experiencing good sleep quality.

3.3 Association of Components of Sleep with Academic Performance, Mental Health, and General Health

Replicating the confirmatory factor analysis conducted by Casement et al. [41], which suggested the three-factor model provided an acceptable fit to the PSQI data, we conducted a confirmatory factor analysis (CFA) with three latent variables, namely sleep efficiency, perceived sleep quality, and daily disturbances. Standardized parameter estimates for the three factor model are shown in Fig. 1. All freely estimated standardized parameters were statistically significant other than 'sleep medication use' which was grouped in the latent variable 'perceived sleep quality.' All the fit measures of the variables, non-normal χ^2 ($df = 11$) = 16.75, $p > 0.05$, SRMR = 0.051, RMSEA = 0.06, CFI = 0.94, GFI: 0.98, NFI: 0.90, indices were in the acceptable range [39] confirming validity of the measure.

T tests assessing the association among the latent PSQI factors exhibit statistically significant correlations among all the factors. The magnitude of association was highest among perceived sleep quality and daily disturbances

($r = 0.8$; $t = 3.95$), $p < 0.001$. Similarly, sleep efficiency and perceived sleep quality also had a significant association ($r = 0.6$; $t = 4.65$), $p < 0.001$, whereas sleep efficiency and daily disturbances exhibited the association of least magnitude ($r = 0.5$, $t = 3.20$), $p < 0.001$.

Pearson's correlation was performed to understand the strength of relationship among the various components of sleep and dependent variables, namely academic performance, depression, anxiety, stress, positive health, and negative health (Table 4). The results reveal that academic performance had a negative significant association with perceived sleep quality ($r = -0.195*$), suggesting that students taking longer time to fall asleep or having poor

Table 4 Intercorrelation of the dependent variables with components of sleep

	Perceived sleep quality	Sleep efficiency	Daily disturbances
Academic performance	− 0.195*	− 0.112	− 0.046
Depression	0.443**	0.409**	0.463**
Anxiety	0.350**	0.201*	0.439**
Stress	0.412**	0.297**	0.484**
Positive health	− 0.338**	− 0.188*	− 0.380**
Negative health	0.482**	0.329*	0.535**

* and ** represent 5 and 1% level of significance respectively
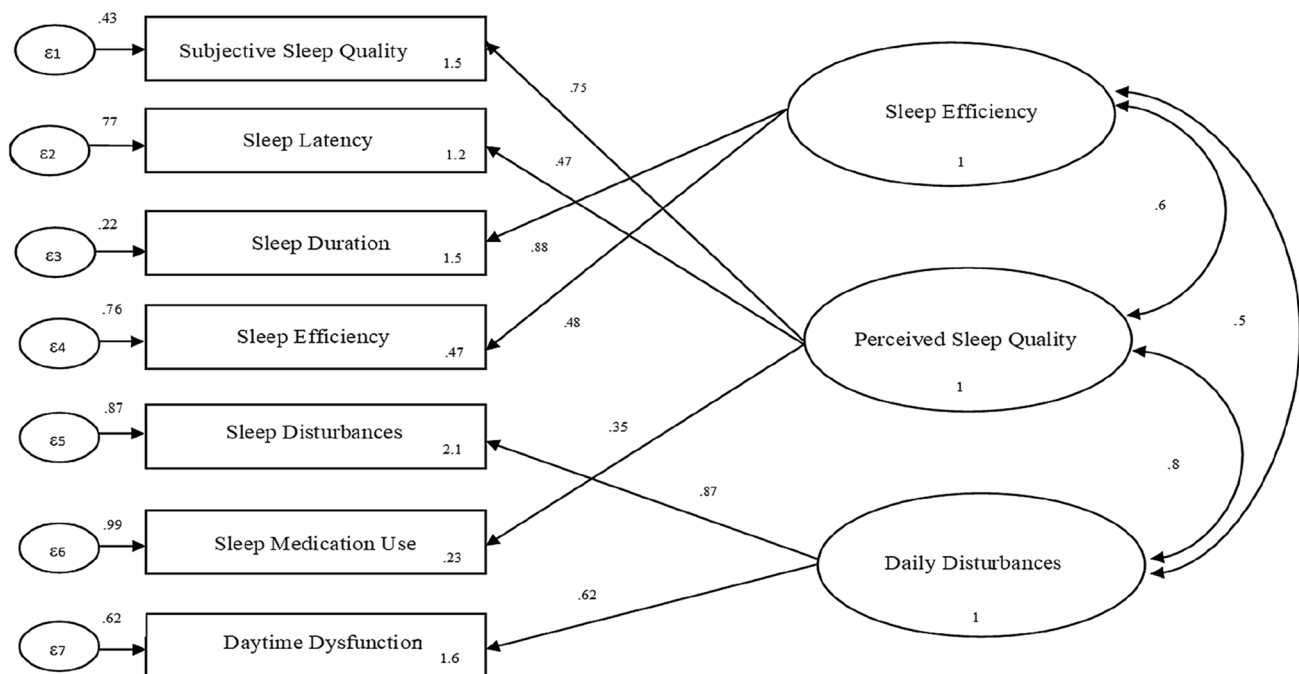
Source: Author's Calculation

Fig. 1 Parameter estimates of the three-factor model of PSQI

efficiency of sleep have poor academic performance. Moreover, depression had significant positive correlation with all the three latent factors of sleep, namely perceived sleep quality($r=0.443**$), sleep efficiency ($r=0.409**$), and daily disturbances ($r=0.463**$), suggesting that higher the score of sleep quality, worse is the quality of sleep and higher is the level of depression. Similarly, anxiety had the highest significant positive association with scores of daily disturbances ($r=0.439**$), followed by perceived sleep quality ($r=0.350**$), and sleep efficiency ($r=0.201**$). Further, stress was significantly positively associated with all the components of sleep, implying, higher the scores, lower is the quality of sleep and higher is the level of stress. Moreover, positive health has significant negative association with all the three factors, which implies that lower scores on PSQI scale indicate better sleep quality which in turn fosters good health. Contrarily, negative health is positively related to higher scores of perceived sleep quality, sleep efficiency, and daily disturbances, suggesting the association between poor sleep pattern and deteriorated health conditions.

3.4 Association Between Facets of Mental Health and General Health

Pearson's correlation was conducted (Table 5) to analyze the association of the dependent variables namely academic performance, depression, anxiety, stress, and positive and negative health. It was observed that depression has a significant positive association with anxiety, stress and negative health, whereas it has a significant negative relationship with positive health at 10% level of significance. Furthermore, anxiety has significant positive association with stress, negative health, and has negative relationship with positive health which is statistically significant, indicating the fact that anxious individuals will have lower levels of positive health. Moreover, stress was found to be statistically significant and positively correlated with negative health, suggesting that stress leads to deterioration in one's health conditions. Positive health on the other hand had a significant negative association with negative health.

3.5 Sleep Quality Components as Predictors of Academic Performance, Mental and General Health

Multivariate linear regression (Table 6) was carried out to predict the dependent variables based on the various components of sleep. It was observed that the collective effect of the component of sleep had a significant effect on academic performance and explained almost 24% of the variance. The individual predictors were further examined and indicated that perceived sleep quality ($t=-2.495$, $p<0.01$) was a significant predictor of academic performance. Further, it was observed that the collective effect of the components of sleep had a significant effect on depression and explains 34.2% of the variance. The individual predictors were further examined and indicated that all the three factors namely perceived sleep quality ($t=2.923$, $p<0.05$), sleep efficiency ($t=3.250$, $p<0.01$), and daily disturbances ($t=3.993$, $p<0.01$) were significant predictors of depression. It was observed that, in case of anxiety, 22.9% of the total variance was explained by the collective effect of the components of sleep. The individual predictors were further examined and indicated that perceived sleep quality ($t=2.288$, $p<0.05$), and daily disturbances ($t=4.249$, $p<0.01$) were significant predictors of anxiety. Moreover, the collective effect of the components of sleep had a significant effect on stress, explaining 30.2% of the total variance. The individual predictors were further examined and indicated that perceived sleep quality ($t=2.720$, $p<0.01$), and daily disturbances ($t=4.622$, $p<0.01$) were significant predictors of stress. Furthermore, 18.5% of the total variance of positive health was explained by the combined effects of sleep. The individual predictors were further examined and indicated that perceived sleep quality ($t=-2.385$, $p<0.01$), and daily disturbances ($t=3.373$, $p<0.01$) were significant predictors of positive health. In addition, the collective effect of the components of sleep was seen to have a significant effect on negative health, explaining 38.2% of the total variance. The individual predictors were further examined and indicated that perceived sleep quality ($t=-3.658$, $p<0.01$), and daily disturbances

Table 5 Pearson's correlation matrix for dependent variables

	Academic Performance	Depression	Anxiety	Stress	Positive Health	Negative Health
Academic Performance	1					
Depression	− 0.136	1				
Anxiety	− 0.047	0.647**	1			
Stress	− 0.127	0.717**	0.758**	1		
Positive Health	0.031	− 0.637**	− 0.314**	− 0.406	1	
Negative Health	− 0.070	0.796**	0.607**	0.651**	− 0.673**	1

**represent 1% level of significance

Source: Author's Calculation

Table 6 Summary of regression analysis of dependent variables with components of sleep

Sleep component	Academic performance			Depression			Anxiety			Stress			Positive health			Negative health		
	B	SE B	β	B	SE B	β	B	SE B	β	B	SE B	β	B	SE B	β	B	SE B	β
Perceived sleep quality	− 0.130	0.052	− 0.235**	1.665	0.57	0.230**	1.102	0.482	0.195*	1.387	0.510	0.221**	− 0.209	− 2.385	0.018**	0.791	0.216	0.279**
Sleep efficiency	− 0.043	0.055	− 0.069	1.969	0.606	0.243**	0.222	0.512	0.035	0.833	0.542	0.118	− 0.034	− 0.410	0.682	0.386	0.230	0.121
Daily disturbances	0.127	0.072	0.161	3.142	0.787	0.304**	2.826	0.665	0.350**	3.255	0.704	0.362**	− 0.286	− 3.373	0.001**	1.572	0.299	0.388**
Mean (SD)	8.004 (0.816)			14.520 (10.686)			11.72 (8.343)			13.51 (9.279)			11.47 (3.069)			6.21 (4.184)		
R²	0.247			0.342			0.229			0.302			0.185			0.382		
F	3.010*			24.084**			13.765**			20.000**			10.551**			28.643**		

* and ** represent 5 and 1% level of significance, respectively

Source: Author's Calculation

Table 7 Summary of logistic regression analysis of dependent variables with sleep quality

Dimensions	B	S.E	OR (95% CI)	p
Academic performance	− 0.398	0.213	0.73 (0.442–1.02)	0.06
Depression	0.101	0.021	1.107 (1.061–1.154)	< 0.01**
Anxiety	0.106	0.026	1.113 (1.056–1.171)	< 0.01**
Stress	0.113	0.024	1.120 (1.067–1.174)	< 0.01**
Positive health	− 0.213	0.066	0.815 (0.711−0.919)	< 0.01**
Negative health	0.297	0.058	1.350 (1.201–1.51)	< 0.01**

** represent 1% level of significance

Source: Author's Calculation

($t = 5.265$, $p < 0.01$) were significant predictors of negative health.

Logistic regression was carried out to understand the association between sleep quality, and factors like academic performance and health. Table 7 shows that the odds ratio for mental health was 1.10, and the 95% confidence interval was 1.06–1.15 as a risk ratio and for academic performance was 0.73, and the 95% confidence interval was 0.44–1.02 as a risk ratio. It shows that mental health is affected negatively more seriously in poor sleep quality groups (coded 1) than the good sleep quality group (coded 0) in comparison to academic performance. It was observed that quality of sleep had significantly correlations with various facets of health, namely depression ($B = 0.101$, S.E $= 0.021$, $p < 0.01$), anxiety ($B = 0.106$, S.E $= 0.026$, $p <,01$), stress ($B = 0.113$, S.E $= 0.024$, p, 0.01), positive health ($B = − 0.213$, S.E $= 0.066$, $p,0.01$), and negative health ($B = 0.297$, S.E $= 0.058$, $p,0.01$). However, the quality of sleep was not significantly correlated with academic performance. The results indicated that participants with poor quality sleep experienced higher levels of depression, anxiety, and stress and were at a poorer state of health as compared to their counterparts experiencing good sleep quality.

4 Discussion

With the changing times, the lives of students have become extremely challenging taking a toll on their academic performance and health, thereby hampering their optimal functioning. The study encompassed three major objectives in order to gain clarity concerning the functioning of the university students. The study aims to assess the quality of sleep and impact of various components of sleep among university students on academic performance, mental, and physical health. It also aims to find out relationship among health and academic performance of the students.

The findings of the study are alarming, where almost 51.74% participants experienced bad quality sleep. The results were concurrent with the findings of [36] which reported that 54.4% of the university students experienced bad sleep quality. Consistent with the findings of [37], factors like increased academic stress, lessened parental guidance and control, increased involvement in extracurricular activities can be attributed to poor quality of sleep. As cited in various literature, other factors like smoking [38], smartphone dependency [42], increased social media use [43], faulty food habits like high sugar intake [44], and use of psychoactive substances [7] also contribute to poor quality of sleep among university students.

It was found that participants who experienced poor quality of sleep reported the highest levels of depression, anxiety, and stress. They were also at a poor health as compared to the other participants having good sleep quality. This association has been concurrent with other research findings [45] that reported a significant relationship between sleep quality and stress. This was also highlighted by [46] who opined that 30% of the university students who were stressed, had poor quality of sleep. Similarly, our empirical findings support the existing literature which suggests the association between poor quality of sleep and depression [47]. Further, the findings of [48] suggesting a positive relationship among anxiety and sleep quality align with the findings of our study which depicts a significant positive association between anxiety and poor-quality sleep. Additionally, we found good sleep quality has a positive association with enhanced health conditions among the students which is in accordance with the previously conducted research [49].

In addition, intercorrelation of the dependent variables with various sleep components was conducted. There was a significant negative correlation between academic performance, and perceived sleep quality, aligning with the previous findings of [50]. It suggests that increased time taken to fall asleep, lack of sound sleep, and increased use of medication to induce sleep are indicative of lower levels of academic performance [51]. In addition to that, other factors like night outings, class attendance [52], academic motivation, personality attributes like agreeableness and conscientiousness, and circadian preferences, etc., are important predictors of academic performance [14].

The study demonstrates significant association of mental health factors like depression, and anxiety, with perceived sleep quality and daily disturbances. Additionally, depression also correlated with sleep efficiency. Regression analysis showed that poor sleep quality predicted 34.2% and 22.9% of depression and anxiety, respectively. These findings were consistent with the findings of Becker et al. [53]. Stress, on the other hand, was positively associated with all the components of sleep and poor sleep quality. Poor quality sleep was found to be a significant predictor of stress,

explaining the variance by 30.2%. Therefore, the findings of our study, aligning with the already existing literature [54], suggest a link between poor sleep quality and mental health problems like depression, anxiety, and stress.

Quality of sleep is a significant predictor of both positive and negative aspects of health explaining 18.5% and 38.2% of variance, respectively. Further, positive aspects of health are associated with lower scores of perceived sleep quality, sleep efficiency, and daily disturbances suggesting that better sleep quality fosters positive health. On the other hand, a significant positive association of negative health aspects with higher scores of perceived sleep quality, sleep efficiency, and daily disturbances, which is indicative of the fact that poor sleep is detrimental to the overall health of individuals. The findings of the study are consistent with Wong et al. [26] which suggest that healthy sleep patterns would enhance health conditions among students and stimulate college adaptation optimally.

Additionally, the findings of our study reflect upon the significant correlations among the mental health factors like depression, anxiety, and stress with positive and negative aspects of health also stated in earlier research evidence [55–57]. This association warrants the need to cater to the mental health needs among the students in order to ensure their optimal functioning.

However, the study has several limitations. The sample size of the study is limited to one study environment as it has been conducted in one institute. Taking multiple study environments can help in giving clarity and lead to better generalization of the findings. Our study has not incorporated various lifestyle practices such as food habits, use of psychoactive substances, addiction to smart phones and Internet, etc., which might act as the causal factors for poor quality of sleep. Further, we have not analyzed the impact of gender-based differences and socioeconomic status in the way sleep quality affects academic performance, physical and mental health.

5 Conclusion

The study aims to assess sleep quality among students and the association of factors of the Pittsburgh Sleep Quality Index (PSQI) with academic performance, mental and general health. The results add up to the existing literature that poor sleep quality hampers academic performance and also takes a toll on the physical and mental health of the students. Hence, we suggest that an adequate amount of sleep which is fulfilling in nature will enhance the overall health of students as well as improve their academic performance. The study has shown that 'sleep latency' has a significant negative impact on academic performance. Furthermore, 'subjective sleep quality' and 'daytime dysfunction due

to sleepiness' were significant predictors of poor physical and mental health. These findings of the study can be used in designing intervention strategies in order to address the overall health issues of university students. We recommend these individual factors to be studied on a longitudinal basis and on a larger sample size which will give us a deeper insight into the findings.

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