Volume 3, Number 3, 2026 Pages 2066-2074

Bioscience Insights

ISSN: 3080-3489 (Print)
ISSN: 3080-3497 (Online)

BiosciInsights.com

ASSOCIATION OF PHYSICAL ACTIVITY WITH SLEEP QUALITY AMONG UNIVERSITY STUDENTS

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https://doi.org/10.5281/zenodo.24461491

Article Information

Article History

Received:	July 30, 2026
Revised:	September 30, 2026
Accepted:	October 19, 2026
Available Online:	November 13, 2026

Keywords:

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Abstract

Background: Two important determinants of physical health and mental health are exercise habits and sleep quality. Due to increased academic pressure and sedentary lifestyle habits, university students often have low physical activity levels along with unsatisfactory sleep quality. This study aimed to examine the link between activity levels and sleep quality in university students in Islamabad.

Methods: A descriptive cross-sectional study was carried out among 207 university students aged 18–26 years using convenience sampling. Physical activity was determined using the International Physical Activity Questionnaire-Short Form (IPAQ-SF), while sleep quality was evaluated with the Pittsburgh Sleep Quality Index (PSQI). Data analysis was performed in IBM SPSS Statistics version 26 that included Descriptive statistics, and Pearson's chi-square test was additionally applied to examine the link between activity level and sleep quality. Statistical significance was set at a p-value below 0.05.

Results: Among the participants, 37.2% had limited physical activity, while poor sleep quality was observed in 57.5%. Compared to those reporting lower activity levels, better sleep quality was more commonly observed among participants who reported greater levels of physical activity. However, the chi-square analysis yielded a p-value of 0.054 ($\chi^2 = 5.835$, $p = 0.054$).

Conclusion: Although no statistically significant association was observed, better sleep quality was reported in students with higher physical activity levels. The large proportion of physically inactive students and poor sleep identified among the participants in this study indicates the importance of university-based programs that promote regular exercise and healthy sleep habits.

Introduction

Physical activity refers to any body movement created by skeletal muscles that uses energy. It includes activities that are performed during leisure time. According to the literature, various non-communicable conditions such as cardiovascular disease, stroke, and diabetes mellitus, hypertension, obesity, and certain cancers, can be reduced by regular exercise and other forms of physical activity and can improve overall physical and mental health. In addition, regular physical activity also supports a healthier body composition, benefits psychological well-being, and contributes to overall quality of life. Exercise represents a structured and planned type of physical activity and aimed at improving or maintaining physical fitness and health outcomes (1, 2).

Physical activity includes different components, such as how often a person is active, i.e., frequency, how long they are active, i.e., duration, and how hard they exercise, i.e., intensity. The International Physical Activity Questionnaire (IPAQ) has become among the most frequently used and accepted standardized instruments to measure physical activity across different countries and populations due to its high reliability and validity (3).

Sleep has an important role in supporting physical health as well as cognitive and psychological functioning. For determining good sleep quality, besides the duration of sleep, subjective satisfaction along with time taken to fall asleep, sleep efficiency, interruptions during sleep, and daytime performance are of equal importance. Furthermore, fatigue, impaired concentration, reduced academic performance, slower reaction time, emotional instability, and diminished quality of life have been linked with Poor sleep quality. Similarly, persistent sleep disturbances have been associated with depression, anxiety, impaired cognitive performance, neurocognitive dysfunction, metabolic disorders, and increased risk of chronic diseases (4, 5).

Sleep quality is mainly evaluated through objective approaches, including polysomnography, or subjective methods that include sleep diaries and standardized questionnaires. However, the use of objective methods is greatly limited due to their high cost and requirement for specialized equipment, despite the fact that they offer accurate physiological information. For this reason, subjective questionnaires remain the most practical option for epidemiological research. Out of many tools available, the Pittsburgh Sleep Quality Index (PSQI) is a self-reported questionnaire for measuring sleep quality and is the most frequently used tool, as it covers all seven major components of sleep quality, such as sleep quality along with time needed to fall asleep, total hours of sleep, habitual sleep efficiency, sleep difficulties, use of sleep medicines, and difficulties during daytime (5, 6).

Research increasingly shows that physical activity can affect sleep quality through both physical and psychological processes. Regular exercise has been shown to improve sleep duration, increase sleep efficiency, reduce sleep latency, and improve overall sleep quality. In comparison, physical inactivity has been linked to poorer sleep and difficulties with daytime functioning. Studies conducted among university students have produced inconsistent results, with some showing a strong relationship between physical activity and sleep quality, whereas others found little or no significant relationship (7-9). A recent systematic review further noted that consistent physical activity usually improves sleep quality across different populations, though the strength of this effect differs depending on the study design and participants' characteristics (10). These inconsistencies can be caused by differences in study populations, assessment methods, and lifestyle factors.

University students are more likely to unsatisfactory sleep quality as compared with the general population, because of factors such as demanding academic schedules along with examination stress, lifestyle modifications, and reduced participation in regular physical activity as well. However, there is limited literature regarding the association between physical activity and sleep quality among university students in Pakistan despite the findings reported in international studies. Studying this association may help in developing health promotion strategies for university students. Therefore, the present study aimed to determine the association between physical activity and sleep quality among university students in Islamabad, Pakistan. The results of this study may provide further understanding of physical activity and sleep quality among young adults. Furthermore, they may also help educational institutions and healthcare professionals plan programs aimed at supporting students' overall well-being.

Methodology

A descriptive cross-sectional approach was used to examine the relationship between activity patterns and sleep quality in university students in Islamabad. Participants were selected using non-probability convenience sampling. Sample size estimation was performed with Slovin's formula, assuming a 95% confidence level and a 5% margin of error. 207 university students were retained for the final analysis according on the inclusion criteria. Students aged 18–26 years from the selected universities who provided their consent to take part in the study were included in the study. Students were not eligible if they reported serious medical conditions causing insomnia, psychiatric disorders, shift work, trauma or disability, recent surgery, obesity and/or fibromyalgia, or any history of musculoskeletal, neurological, vestibular, visual, or psychological disorders such as stress, anxiety, or depression (7, 11-13).

Ethical approval for the study was received from the Institutional Review Committee/Ethical Review Board of The University DPT/1022-1307 . Permission was also obtained from the respective universities before data collection. All participants gave written informed consent before to taking part in the study, and their personal information was kept confidential throughout the research. A semi-structured questionnaire consisting of three sections, including Demographic characteristics, the International Physical Activity Questionnaire-Short Form (IPAQ-SF), and the Pittsburgh Sleep Quality Index (PSQI) was used for data collection.

The IPAQ was used to group the participants into three physical activity categories, low, moderate, and high, based on metabolic equivalent (MET) scores (3). Sleep quality was measured using PSQI, which assesses seven aspects of sleep, such as perceived sleep quality, the time needed to fall asleep, total sleep duration, usual sleep efficiency, sleep problems, use of sleep medication, and daytime difficulties. Those with an overall PSQI score of 5 or less were placed in the good sleep quality category, whereas scores greater than 5 indicated poor sleep quality (5, 6).

Data entry and analysis were performed in IBM SPSS Statistics version 26. Descriptive measures were obtained for demographic variables along with physical activity levels and sleep quality. Frequencies and percentages were used to summarize the categorical variables. Cross-tabulation was then used to examine how sleep quality was distributed across different physical activity levels. Pearson's chi-square test was applied to examine the relationship between physical activity and sleep quality. Furthermore, a p-value under 0.05 indicated statistical significance.

Results

A total of 207 university students participated in the present study. Table 1 presents the demographic profile of the study participants.

Table 1 Demographic characteristics of the study participants (N = 207)

Variable	Frequency (n)	Percentage (%)
Gender		
Male	73	35.3
Female	133	64.3
Age (years)		
18-20	47	22.7
21-23	128	61.8
24-26	32	15.5
University		
IIUI	58	28
RIU	62	30
CUST	36	17.4
HBS	24	11.6
MY	27	13
Education Level		
Undergraduate	197	95.2
Postgraduate	8	3.9

Low physical activity was the most commonly observed physical activity category among the participants. Assessment of the IPAQ components showed that 196 participants reported walking, making it the most frequently performed physical activity. 116 participants reported moderate-intensity activities, whereas 102 participants reported vigorous-intensity activities. The results showed that walking was identified as the most commonly reported form of physical activity, while moderate- and vigorous-intensity activities were not as common among the participants.

Poor sleep quality was more common than good sleep quality among the participants. Regarding subjective sleep quality, the majority described their sleep as fairly good (57.0%), with very good ratings next (25.6%), fairly bad (13.5%), and very bad (3.9%). The distribution of activity categories and overall sleep quality is presented in Table 2.

Table 2 Distribution of physical activity levels and sleep quality among participants (N = 207)

Variable	Category	Frequency (n)	Percentage (%)
Physical activity (IPAQ)	Low (<600 MET-min/week)	77	37.2
	Moderate (600–1500 MET-min/week)	63	30.4
	High (>1500 MET-min/week)	67	32.4
Sleep quality (PSQI)	Good (<5)	88	42.5
	Poor (≥5)	119	57.5

The results showed that 39.1% of participants scored 1–2 points on the PSQI sleep latency component, while 29.0% reported falling asleep without difficulty. According to sleep duration analysis, 50.2% of participants

slept for more than seven hours per night, while only 21.7% reported sleeping for 6–7 hours, 16.4% for 5–6 hours, and 11.6% for less than five hours.

Habitual sleep efficiency was more than 85% in 71.5% of participants, which indicated satisfactory sleep efficiency for the majority of the study population. Sleep disturbances were most commonly reported within the 1–9 score range (66.7%), while 17.4% reported moderate disturbances and 2.9% were shown to have severe sleep disturbances. No sleeping medication was used in the past month by the majority of the participants (81.2%). On the other hand, only 11.1% of participants used sleep medication less than once a week, 6.3% used it one to two times weekly, and only 1.4% reported using medication more than three times per week.

According to the analysis, among males, 25, 17, and 31 participants were grouped according to their respective activity levels: low, moderate, and high physical activity levels, respectively. Whereas, among females, 52, 46, and 36 participants were classified into the corresponding activity categories. More females were seen to be in the low and moderate physical activity groups, whereas males demonstrated slightly greater representation in the high physical activity category. Similarly, poor sleep quality was more prevalent than good sleep quality in both genders. Among male participants, 29 reported good sleep quality, and 43 reported poor sleep quality. In contrast, among female participants, 59 demonstrated good sleep quality, whereas 75 had poor sleep quality. Furthermore, better sleep quality was more commonly observed among participants with higher physical activity levels, as shown in Table 3.

Table 3 Association between physical activity level and sleep quality

Physical activity level	Good sleep (n)	Poor sleep (n)	Total
Low (<600 MET-min/week)	26 (33.7%)	51 (66.2%)	77
Moderate (600–1500 MET-min/week)	27 (42.8%)	36 (57.1%)	63
High (>1500 MET-min/week)	36 (53.7%)	31 (46.2%)	67
Total	88 (42.5%)	119 (57.4%)	207

Pearson's chi-square test showed that the association between physical activity level and sleep quality was not statistically significant ($\chi^2 = 5.835$, $p = 0.054$). However, the observed trend suggests that students with higher physical activity generally experienced better sleep quality. This borderline finding may be because of the smaller final sample of 207 participants compared with the calculated sample size of 378, as it could have limited the statistical power of the study.

Discussion

This study examined whether physical activity had a relationship with sleep quality in university students in Islamabad. According to the analysis, students with higher physical activity levels reported better sleep quality than students who were less active; however, the chi-square analysis yielded a p-value of 0.054 ($\chi^2 = 5.835$). This may be explained by the influence of other factors besides physical activity on students' sleep patterns among university students. Therefore, the conceptual relationship between physical activity, sleep quality, and potential influencing factors is illustrated in Figure 1.

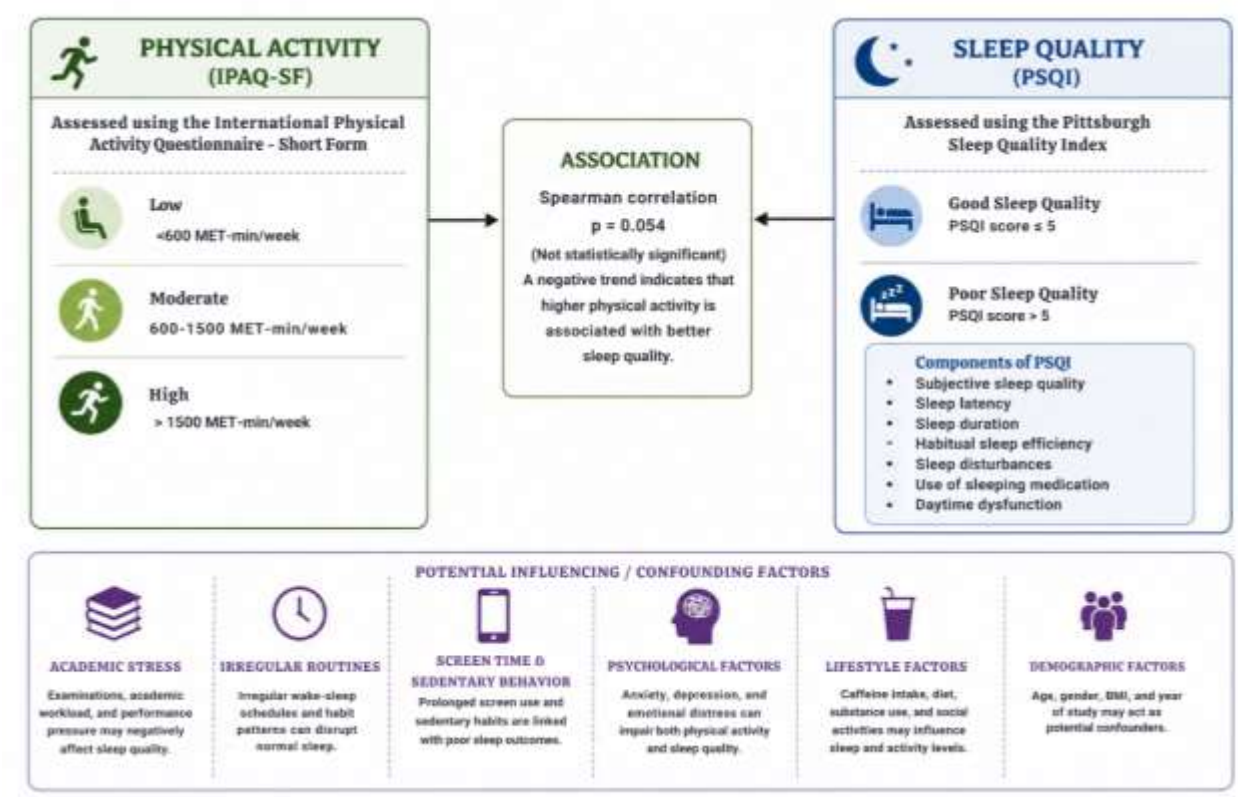

Figure 1 Conceptual model of the association between physical activity and sleep quality.

The largest proportion of participants belonged to the low physical activity group, accounting for more than one-third of the sample. Around one-third had moderate activity, while another similar proportion was placed in the high activity category. The relatively high proportion of students with low physical activity suggests that physical inactivity may be a concern among university students, and this may be because of academic factors such as long hours spent in lectures, studying, completing assignments, and using computers or smartphones for academic purposes. These factors may contribute to a more sedentary routine (14). This finding is important as regular physical activity contributes to better cardiovascular health, weight management, psychological well-being, sleep, and overall quality of life (1, 2).

Furthermore, poor sleep quality was observed in more than half of the study participants. At the same time, many students reported sleeping for more than seven hours and had satisfactory habitual sleep efficiency. These findings suggest that adequate sleep duration alone may not necessarily reflect overall sleep quality. Sleep quality covers several areas, including satisfaction with sleep, the time required to fall asleep, sleep disturbances, and usual sleep efficiency, daytime problems, and the use of sleeping medication (4, 5). Therefore, the high prevalence of poor sleep in this study may be due to problems in one or more aspects of sleep, instead of just not getting enough sleep.

Students reporting greater physical activity usually reported better sleep quality, while the chi-square test produced a p-value of 0.054. There could be several reasons for this result. Sleep is influenced by factors such as stress, anxiety, depression, academic workload, electronic device use, body mass index, disturbed circadian rhythm, and other lifestyle behaviors (4, 5). These factors were not measured in this study and may have affected both physical activity and sleep quality, which may have attenuated the observed association between physical activity and sleep quality.

Regarding differences between male and female participants, male students were more frequently represented in the high physical activity group, while females were more frequently found in the low and moderate activity categories. Daily routine, recreational choices, social activities, and individual preferences may contribute to

these differences; however, these factors were not directly examined in this study. Sleep problems, on the other hand, were common in both genders. Similar findings have been reported among university healthcare students, where physical activity, recreational screen time, mood, and sleep quality were found to be related (15).

The current findings show some agreement to those reported by Mahfouz et al. (8), which investigated physical activity and sleep quality among Saudi Arabian university students using the IPAQ and PSQI. Their study also reported high levels of poor sleep quality and physical inactivity. More physically active students typically had better sleep in their research as well. Unlike the current study, however, Mahfouz et al. found a statistically significant relationship between physical activity and sleep quality. One important difference is that they also assessed depression, anxiety, and stress with the Depression Anxiety Stress Scale. Including these psychological variables may have provided a broader explanation of sleep quality, while these factors were not measured in the present study.

These results also agree with findings from Zhai et al., who investigated the relationship between physical activity, perceived stress, and sleep quality among Chinese college students. According to their study, greater greater physical activity was linked to improved sleep quality, and perceived stress mediated this relationship (9). Their findings suggest that the relationship between physical activity and sleep may involve both physiological and psychological mechanisms. Reducing psychological stress could also be one of the ways through which activity contributes to better sleep. Since perceived stress was not evaluated in this study, its possible influence on both physical activity and sleep quality could not be considered. Ruminative thinking has also been identified as another psychological pathway that may connect physical activity with sleep among university students (16).

Further evidence was provided by Wang et al. in 2025 through a study involving 796 college students. Higher levels of exercise were significantly related to fewer sleep disturbances ($r = -0.222$, $p < 0.001$) and lower perceived stress ($r = -0.250$, $p < 0.001$). Their mediation analysis showed that stress explained almost 24.3% of the relationship between exercise participation and sleep quality (17). This finding again highlights the possible importance of stress when examining physical activity and sleep. Additionally, stress may have acted as an unmeasured factor and reduced the apparent strength of the relationship, as it was not measured in the present study.

Studies by Li et al. and Zhang et al. reported a similar general pattern. According to their studies, university students taking part in moderate- to vigorous-intensity physical activity usually experienced better sleep than students with lower activity levels. Psychological variables such as stress, anxiety, and depression were also mentioned as important mediators between physical activity and sleep quality in both studies (18, 19). Their findings support the trend observed in the present study, where students with higher physical activity reported better sleep despite the absence of a statistically significant overall association. Other recent research has reached comparable observations. Similarly, Alhusami et al. found a similar trend, as their study also showed that physically active healthcare students generally had better sleep quality than inactive students, although other lifestyle factors also affected sleep outcomes (20). Likewise, Xu et al. and Yin et al. found that higher physical activity was associated with improved sleep quality, with psychological factors such as depression, stress, and subjective well-being partially mediating this relationship (16, 21). Self-control has also been identified as a potential behavioral factor linking physical activity with sleep quality in college students (22).

The results of this study should not be interpreted as evidence of an absence of a relationship between physical activity and sleep quality. Additional studies with larger samples are required to provide a clearer understanding of this relationship. Future studies should also include psychological and lifestyle variables and consider other possible mediators, such as emotional regulation and self-efficacy, as these factors may further influence the relation between physical activity and sleep quality (23).

Limitations

This study has a number of limitations. It was not possible to determine to determine a cause-and-effect association between physical activity and sleep quality because the study used a cross-sectional design. In addition, selection, recall, and reporting bias may have been introduced because non-probability convenience sampling was used and self-reported questionnaires, which may reduce how well the findings apply to a wider population.

Conclusion

The findings of this study indicated that university students who have higher physical activity levels often reported better sleep quality than those with lower physical activity levels. However, the chi-square analysis yielded a p-value of 0.054 ($\chi^2 = 5.835$, $p = 0.054$). Despite this, the findings support the need to encourage more active lifestyles among university students, while considering that sleep quality can also be affected by a combination of physical, psychological, and behavioral factors.

Recommendations

Larger and more diverse populations using longitudinal study designs should be recruited in future research to better explain the connection between activity levels and sleep quality. The use of objective assessment methods alongside validated questionnaires is recommended. Furthermore, psychological and lifestyle-related variables that may influence sleep quality should be incorporated in future studies. Psychological factors such as stress, anxiety, and depression should be evaluated using validated assessment tools, including the Depression Anxiety Stress Scale (DASS), since these factors can affect both physical activity and sleep quality.

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