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Physical activity and sleep quality in relation to mental health among college students

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Abstract

Objective To examine the associations and interactive effects of physical activity and sleep quality on mental health among Indian college students.

Method A cross-sectional study was conducted among Indian college students. The sociodemographic data and body mass index were obtained from a convenience sample of 617 college students, age range from 18 to 30 years, including both genders (314 men, 51%). All participants completed three questionnaires: the Hospital Anxiety and Depression Scale, the International Physical Activity Questionnaire-Short Form, and the Pittsburgh Sleep Quality Index. Questionnaires were evaluated to ascertain the subjects' mental health level, physical activity level, and sleep quality. Analyses were conducted with binary logistic regression models.

Result The mean (± S.D.) anxiety and depression scores were 9.3 ± 4.4 and 7.4 ± 2.5 respectively, with anxiety and depression scores ranging from 0 to 20 and 0–17, respectively.

The prevalence of anxiety (30%) was more than that of depression (18%). Out of the total participants, 51% reported having low physical activity levels, and 51% had poor sleep quality. Odds ratio calculations indicated that the participants physical activity levels (moderate and high) were significantly and inversely associated with scores for anxiety (OR = 0.16 and 0.96; $p = 0.001$) and for depression (OR = 0.11 and 0.96; $p = 0.001$). The poor sleep quality was significantly positively associated with anxiety (OR = 1.38) and depression OR = 1.58 ($p = 0.001$).

Conclusion Mental health problems are common among both male and female college students. Significant associations were found between physical activity levels and sleep quality with mental health.

Keywords Mental health · Physical activity level · Sleep quality · College students

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Introduction

The World Health Organization (WHO) has identified positive mental health as "a state of well-being, both emotional and psychological, where the individual recognizes his or her potentials, adapts to the natural pressures of life, leads productive and supportive work and meets the demands of daily life" [1]. Good mental health is not only the non-occurrence of mental disorders but also includes active behaviors such as taking steps to maintain overall health and working well within the community. The WHO has outlined an Action Plan for Mental Health for the period 2013–2020; the goal of which was to support more evidence-based work to improve mental health on a global basis [1]. Anxiety is a "psychological and physiological state characterized by cognitive, physical, emotional and behavioral components." This state is usually

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disruptive and tends to promote efforts to reduce the source of anxiety, and thus can distract an individual from positive goal seeking and betterment of one's life and that of others. Depression is a common serious medical condition that negatively disturbs one's feelings, thoughts, and behaviors. Similar to the effects of anxiety, depression can cause various emotional and physical disturbances which ultimately reduce a person's ability to work and manage his/her home life functionally [2].

College students are "a special group of people who are having a critical transition period from adolescence to adulthood which can be one of the most stressful times in a person's life" [3]. Mental health issues are a growing concern among university campuses. The most common mental health complaints among university students are anxiety and depression [4, 5]. It has been found that depressive symptoms adversely impact the academic performance of students who are affected, thus setting into motion an internal chain of causation with negative consequences for the student's self-esteem, coping skills, and ultimately increasing their vulnerability to additional psychological health problems. In at least two studies, female students have been shown to exhibit poor mental health status when compared to male students, were more likely to be depressed, and more likely to experience anxiety during their university years [6, 7].

Reviews of various surveys have concluded that physical inactivity is the number one public health concern of the twenty-first century [8]. The association of physical activity with mental health has been established in many studies, with further evidence showing that physical activity can have beneficial effects on mental health status of adults [9, 10]. Considerable evidence supports the conclusion that physical activity is an important contributor to the reduction of mental disturbance, i.e., it can distract from negative rumination, can aid in the production of beneficial and mood-elevating neurotransmitters, and can, at least partially, reduce the severity of certain mental health disorders. Recent studies on physical activity's influence on depression and anxiety in nonclinical adult participants show that exercise and other physical activities can decrease symptoms of depression and anxiety [11–14].

Both sleep disturbances and mental health problems represent costly public health burdens, with effects that have an impact at the individual and community level [15, 16]. There is a growing amount of psychological and physiological evidence that sleep and mental health are closely associated, and indeed may have reciprocal and mutually facilitating effects [17]. Sleep disturbances have traditionally been seen as a result of mental health disorders. Although this is not controversial, current evidence also proposes that sleep problems or difficulties can contribute to the development of different mental health problems as well as to the maintenance of those already present [18, 19]. More specifically, a growing amount of

evidence suggests that sleep disorders, which produce circadian rhythm disturbances, may be at the root of mood disturbances and depression, and that depressed mood may have further negative feedback effects, which can exacerbate the original sleep disturbance. This pathological cycle may, in turn, trigger the onset of a variety of additional mental health problems [20].

To the best of our knowledge, few studies have been conducted to investigate the association between physical activity, sleep quality, and mental health among Indian students. The present cross-sectional study aimed to investigate the association between physical activities and sleep quality with mental health among an Indian collegiate student population using self-reported questionnaires. The study hypothesized that there is a significant effect of physical activity and sleep quality on mental health among college students.

Methods

Participants

The study population was a convenience sample of college students from different departments of Jamia Millia Islamia, New Delhi, India. Inclusion criteria were male or female students, 18–30 years of age, able to follow the instructions and to have reasonable fluency in the English language. Exclusion criteria included having any type of physical or mental condition that limits motor, sensory, or cognitive abilities, having contraindications for physical activity, being medically diagnosed as having a primary sleep disorder (e.g., sleep apnea or primary insomnia), or suffering from any confounding conditions, such as a neurologic, medical, or surgical disorder or having a history of sleep disorders.

The participants were informed about the objectives of this study. The participants' privacy rights were protected. All participants read and signed a consent form acknowledging that their participation was voluntary. The study was approved by the Institutional Ethics Committee (IEC) of Jamia Millia Islamia.

Measures

Hospital Anxiety and Depression Scale (HADS)

The Hospital Anxiety and Depression Scale (HADS) is a validated self-rating scale that measures the presence and severity of anxiety and depression in both hospital and community settings [21]. The HADS is comprised of 14 items divided equally between the two states (seven questions relating to anxiety and seven to depression). The questions cover how the person felt in the week just preceding the study and require 2–5 min to complete [22, 23].

Scoring and item presentation are based on a four-point Likert Scale on which "0 = not at all; 1 = not very much; 2 = quite a lot; and 3 = definitely." A maximum score of 21 points is possible for each subscale (anxiety and depression). For each scale, a respondent's score of 0 to 7 is interpreted to mean that the respondent has no apparent depression or anxiety symptoms; a score of 8 to 10 indicates evidence of a mild degree of depression or anxiety; a score of 11 to 14 indicates that symptoms are present to a moderate degree; scores in the range of 15 to 21 indicate a severe degree.

For the general adult population (nonclinical), the HADS scale is usually accepted to be a binary classification system for symptoms, i.e., one in which the respondent is deemed to merit further medical/psychiatric evaluation (labeled as a "caseness" level of symptom severity) only if the responses produce a score of greater than or equal to 11 points (moderate to severe symptoms) [22, 24–26].

International Physical Activity Questionnaire-Short Form

The International Physical Activity Questionnaire-Short Form (IPAQ-SF) is a self-report questionnaire evaluating levels of usual physical activities among adults ranging from 15 to 69 years [27].

The IPAQ-SF consists of 7 items and records physical activity at four intensity levels: (1) vigorous intensity activities such as aerobics, (2) moderate-intensity activities such as leisure cycling, (3) walking, and (4) sitting. The IPAQ-SF asks participants to report activities performed for at least 10 min during the 7 days prior to completing the questionnaire. Respondents are asked to report the amount of time spent in physical activities performed during leisure time, work, domestic activities, and while traveling, at each of three intensities: mild, moderate, and vigorous [27]. The physical activity of the last 7 days is calculated by measuring the time spent in activity intensity and by considering the estimated metabolic equivalent (MET) for that activity and ultimately converting the METs into an energy expenditure score. For a mild activity such as walking, the IPAQ-SF assigns a MET value of 3.3, moderate activity rates 4.0 METs, and vigorous intensity activity 8.0 METs [27].

Pittsburgh Sleep Quality Index

The Pittsburgh Sleep Quality Index (PSQI) is a self-reported questionnaire that asks respondents to report on their sleep quality and signs of sleep disturbance for the 1-month period prior to completing the questionnaire [28]. The PSQI, which has been extensively evaluated and used across many different populations, was designed for use by both clinicians and researchers [29, 30].

The PSQI includes 19 questions, categorized into seven groups that collectively make up a global sleep quality score. This aggregate score is derived from questions relating to "sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbance, use of sleeping medications and daytime dysfunction. The PSQI items use different response categories that include recording the usual bedtime, usual wake time, the number of actual hours slept, and the number of minutes to fall asleep" [28, 31].

Each constituent question produces a score on a scale from 0 to 3, with a score of 3 indicating the greatest dysfunction. The total score is made up of scores from each of the seven subgroups of questions, giving a cumulated score between 0 and 21, with lower scores indicating better sleep quality and higher scores indicating poorer sleep quality [28]. If the PSQI score is less than 5, it is inferred that the respondent has a good quality of sleep, and vice versa for higher scores. These scoring criteria re-based on multiple studies using a range of population samples, including college student respondents, and are believed to generalize to the current sample studied [32–34].

Statistical analysis

The Statistical Package for the Social Sciences 21.0 (SPSS Inc., Chicago, Illinois) was used for data analysis. Descriptive statistics were used for the presentation of participant characteristics. Binary logistic regression analysis was performed for the association between the independent variables (physical activity and sleep quality) and the dependent variable (mental health). Significance level of $p \leq 0.05$ was fixed for the analysis.

Results

The data were collected using the questionnaires administered to students of different departments of Jamia Millia Islamia, India. The three questionnaires (HADS, IPAQ-SF, and PSQI) were distributed to a convenience sample of 649 participants. The 649 participants were screened based on their eligibility for inclusion in the study. Six hundred and seventeen participants met the inclusion criteria for the study. Of the 32 participants who were excluded, 19 were excluded because they did not meet the inclusion criteria, whereas the remaining 13 were excluded due to improper completion of the questionnaires. Completion of the consent form and the questionnaires took approximately 15–20 min. Sociodemographic findings, anthropometrics, and questionnaire responses for the study participants are summarized in Table 1.

Table 1 Sociodemographic characteristics of the study population

Characteristics		Mean ± SD frequency (%)
Age (years)		23.4 ± 3.6
Gender	Male	314 (51%)
	Female	303 (49%)
Level of education	Undergraduate	330 (54%)
	Postgraduate	165 (26%)
	PhD scholar	122 (20%)
Years in college	Freshman (Junior)	210 (34%)
	Senior	407 (66%)
	Hostel in college	274 (44%)
Type of residence	Rented outside the college	195 (32%)
	Home (with family)	148 (24%)
Height (cm)		165.3 ± 9.4
Weight (kg)		61.1 ± 10.9
Body mass index (kg/m^2)		22.5 ± 3.7
HADS score		
	Anxiety score	9.3 ± 4.4
	Normal	438 (70%)
	Caseness	179 (30%)
	Depression score	7.4 ± 2.5
	Normal	515 (82%)
	Caseness	102 (18%)
PSQI global (total) score		5.3 ± 2.5
Sleep quality	Healthier sleep quality (PSQI < 5)	302 (49%)
	Poor sleep quality (PSQI ≥ 5)	315 (51%)
Physical activity level	Low	317 (51%)
	Moderate	234 (38%)
	High	66 (11%)

Association between physical activity and mental health

Table 2 shows associations between the predicted variables (anxiety and depression) and the predictor variables (physical activity level and sleep quality). The physical activity level was significantly and inversely associated with anxiety, $p < 0.05$. The odds of moderately physically active students to have anxiety symptoms was (OR = 0.16; 95% CI, 0.10–0.24) when compared to students with low activity levels, i.e., the physically active students were 6.45 times less likely to have anxiety with every one unit increase in the physical activity score. The highly physically active students were found to be (OR = 0.10; 95% CI, 0.04–0.23), which means that more physically active students (or with high activity levels) where 10.42 times to have a low anxiety level for every one unit increase in the physical activity score when compared to the physically inactive students.

Furthermore, the physical activity level was significantly inversely associated with the depression, $p < 0.05$. The odds for moderately physically active students to have depressive symptoms was (OR = 0.11; 95% CI, 0.06–0.21), when compared to the inactive students, i.e., the moderately physically active students were 8.93 times more likely not to have depression with every one unit increase in the physical activity score. Among students who had high physical activity levels, the odds of having depressive symptoms was (OR = 0.10; 95% CI, 0.03–0.31) the same as the odds of having anxiety.

Association between sleep quality and mental health

The findings showed that poor mental health, as measured by the presence of higher levels of anxiety and/or depressive symptoms, was associated with poor sleep quality. The overall association between the predicted variables (anxiety and depression) and the predictor variable (sleep quality) is shown in Table 2. Poor sleep quality was significantly positively associated with the anxiety and depression, $p < 0.05$. The odds for students who had a higher PSQI score, i.e., poorer sleep quality (high scores on the PSQI denote the greatest sleep

Table 2 Binary logistic regression analysis: physical activity level and sleep quality with anxiety and depression

Predictors	95% CI for EXP (β)				95% CI for EXP (β)			
	Sig.	Exp (β)	Lower	Upper	Sig.	Exp (β)	Lower	Upper
Anxiety					Depression			
PA LEVEL Ref:								
Low	.001				.001			
Moderate	.001	.16	.10	.24	.001	.11	.06	.21
High	.001	.10	.04	.23	.001	.10	.03	.31
PSQI TOT	.001	1.39	1.28	1.50	.001	1.52	1.38	1.68

Significant at 5%; Ref, reference category; Exp (β), the exponentiation of the β coefficient; CI, confidence Interval; PA LEVEL, physical activity level; PSQI TOT, total score of PSQI

dysfunction) were 1.39 times more likely to have anxiety (OR = 1.39; 95% CI, 1.28–1.50) than those with good sleep quality and 1.52 times more likely than those with good sleep quality to have depressive symptoms (OR = 1.52; 95% CI, 1.38–1.68) for every one unit increase in the total score of PSQI.

Discussion

The WHO has concluded that mental health disorders account for approximately 15% of all diseases. This percentage equates to around 450 million people worldwide who are suffering from a mental disorder, a figure which may underestimate the prevalence in low and middle-income countries, where psychiatric or mental health services tend to be more limited. Nevertheless, the effect of mental health problems on physical health and on basic needs such as sleep is being increasingly appreciated.

The use of college students as a study sample is particularly relevant for the larger issue of global public health, not merely because students represent a convenient target group for survey research, which is frequently carried out in university-based research installations, but also because depression and anxiety are among the most often encountered complaints from those who are facing the challenges of college and university life. Moreover, depression and anxiety symptoms are the most commonly reported difficulties among those who have been diagnosed with mental illness. The present investigators, therefore, believe that the choice of college students was appropriate in view of the broader generalizability of mental health issues that are experienced during the university-age years.

In the current study, the prevalence of anxiety was found to be higher than the reported prevalence of depression. These findings are consistent with those of other studies, a fact which is not surprising since college students share many of the vulnerabilities with the general population. MacKean found that university students have a higher risk for negative mental health consequences since they are exposed to two causes of stress accruing from their transitional status, i.e., "stress related to the transition from high school to university, and stress related to the transition from adolescence to adulthood" [35]. Anxiety is the most frequently occurring mental health problem among college students, with around 12% of students having been shown to have an anxiety disorder [36]. Based on the Anxiety and Depression Association of America, anxiety-based conditions are widespread and represent one of the most commonly reported types of mental health disorders among university students. It has been demonstrated that of the 40 million Americans who have self-reported or have been diagnosed with anxiety; 75% stated that they experienced their first incident or event of anxiety at around 22 years of age. Another widespread mental health condition among students is depression, with prevalence rates among university students having been shown to be 7–9% [36, 37].

Our results are supported by other studies, which have shown that the anxiety level were higher among females than males [6, 38]. Our results are supported by one study conducted in India, which found the prevalence of depression to be slightly higher among males than females [39]. This was in contrast to the observations made in several studies where depression was found to be significantly higher among females than males [37, 40]. By contrast, one study reported that depressive symptoms occurred more frequently among males, possibly due to the influence of certain external factors, such as anxiety arising from the need for timely employment to take up familial responsibilities, from the influence of substance abuse, or from peer group pressures [39]. A study by Verger et al. supports our results showing that the first-year students were at a higher risk of having mental health disorders [41]. This finding may have been due to reasons confirmed in other studies showing that younger students often have inefficient coping capabilities and an absence of independence or autonomy when compared to students in more advanced years of study. The greater prevalence of mental health symptoms shown by first-year students may have been affected by the college environment and the stresses linked to

transitioning away from their families and friends, as well as the need to be self-sufficient and to carry out tasks and functions independently. Also, Eisenberg et al. reported that the incidence of depression and anxiety was 15.6% among undergraduate students and 13% among graduate students, a finding which is consistent with our own [6]. Nevertheless, further studies are needed to more broadly generalize our conclusions among Indian college students to other population groups.

Our findings are in line with those of Asztalos et al., who established that the association between physical activity and mental health were always positive, regardless of the intensity of activity [42]. Hence, all physical activity types were either positively associated with emotional well-being or inversely associated with psychological complaints such as depression and anxiety. In terms of the association between physical activity and mental health, current evidence suggests that physical activity can be used as an important intervention in the treatment of mental health disorders [10, 14]. Moreover, physical activity is an effective strategy to assist in reducing negative emotions and thus may represent a strategy for promoting better mental health among nonclinical groups [43]. A recent meta-analysis of the effect of physical activity on depression and anxiety in nonclinical adults showed that physical activity moderately decreased depressive symptoms as well as anxiety to a lower but nevertheless significant extent [13]. Exercise has been found to achieve a greater reduction in depressive symptoms than no treatment, placebo, or other interventions such as meditation. Taken together these findings were interpreted to support the conclusion that "exercise is moderately more effective than a control intervention for reducing symptoms of depression" [12].

Earlier research has shown that sleep disturbance is related to poorer mental health results from childhood to adulthood (including more depression, anxiety, and aggression behaviors). The confirmed associations between sleep and mental health have been investigated among adolescents and young adults. A study reported that about 67% of adolescents with several disturbances in sleep (such as trouble falling asleep, remaining asleep, and awakening early) were diagnosed as having a DSM (Diagnostic and Statistical Manual of Mental Disorders)-related anxiety or depressive condition. Poor sleep quality has been correlated with increased rates of rule-breaking behaviors, aggressive behaviors, depression, and anxiety [44]. Another paper has suggested that in university students in particular, night-time sleep difficulties are linked to depression, obsessive-compulsive behaviors, and psychological distress [45]. Additionally, a bidirectional association has been found between disturbances in sleep, anxiety, and depression, suggesting that each contributes to the development of the other [46].

There were certain shortcomings with the present study. First, a cross-sectional study limits the strength of relationships and does not assess cause and effect. This

methodological concern limits the interpretation of the study's findings. Second, the questionnaires utilized self-reported symptoms but not symptoms that were clinically verified, thus affecting the validity of the variables of interest. Third, despite the substantial size of the sample, it may not have been sufficient to generalize the findings, especially to other populations.

The present study has demonstrated the interrelatedness of physical activity level, sleep quality, and mental health in college students from different educational levels, including students of both genders and in different types of residences. The findings suggest that college students may benefit from support systems for improving the mental status of the students improving coping skills.

Conclusions

There was a significant association between physical activity and sleep quality with mental health. Further studies are needed to clarify the causal relationships between physical activity levels, sleep quality, and mental health.

Compliance with ethical standards

The study was approved by the Institutional Ethics Committee (IEC) of JMI New Delhi.

Conflict of interest None of the authors have any conflict of interests to be disclosed with respect to this study.

Informed consent information All the participants gave written informed consent before enrolment into the study.

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