

Original Research

The Impact of Physical Activity on Mental Health (DAS) in Medical Students: A Cross-Sectional Study in Madhya Pradesh, India

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ABSTRACT:

Background: Medical students are at a heightened risk for mental health issues, including depression, anxiety, and stress (DAS), due to the rigorous demands of medical education. Physical activity has been identified as a potential intervention for improving mental health outcomes, yet the relationship between physical activity and mental health distress among medical students in India remains underexplored. This study aimed to examine the association between physical activity levels and mental health outcomes among medical students at a medical college in Madhya Pradesh, India. **Results:** A cross-sectional survey was conducted with 410 medical students, assessing mental health through the Depression Anxiety Stress Scale (DASS-21) and physical activity through the Global Physical Activity Questionnaire (GPAQ). Female students reported higher levels of depression, anxiety, and stress compared to male students ($p = 0.037$ for depression, $p = 0.067$ for anxiety, $p = 0.050$ for stress). First-year students exhibited the highest levels of mental health distress. Low physical activity levels were significantly associated with higher levels of depression ($p = 0.014$), anxiety ($p = 0.028$), and stress ($p = 0.032$), compared to students with moderate or high physical activity levels. **Conclusions:** This study demonstrates that physical activity is strongly linked to improved mental health outcomes in medical students, particularly in reducing depression, anxiety, and stress. Female and first-year students were found to be more vulnerable to mental health distress, and they may benefit significantly from physical activity interventions. Medical schools should integrate physical activity into their curricula to support mental health, with a particular focus on gender-sensitive and year-specific interventions.

Keywords: Medical students, physical activity, mental health, depression, anxiety, stress, gender differences, medical education, India, well-being.

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BACKGROUND

Medical students face significant mental health challenges due to the intense academic pressures, long study hours, high-stakes examinations, and exposure to human suffering during their clinical training. These stressors often result in higher rates of depression, anxiety, and stress (DAS) compared to students in other disciplines. Previous studies have indicated that approximately 27.2% of medical students globally experience depressive symptoms, and 11.1% report suicidal ideation [1]. Moreover, anxiety affects more than 40% of medical students, severely impacting their academic performance and overall well-being [2]. In India, a multicentric study reported that 39.9% of medical students suffer from

depression, 28.5% from anxiety, and 15.3% from stress [3].

Despite the recognized prevalence of mental health issues among medical students, the role of physical activity (PA) as a mitigating factor has not been thoroughly explored, particularly in the Indian context. Physical activity has been associated with improved mental health outcomes, including reduced symptoms of depression, anxiety, and stress. Regular physical activity is known to regulate stress hormones, improve sleep quality, and increase the release of mood-enhancing neurotransmitters such as serotonin and dopamine [4,5]. Several studies have highlighted the protective role of physical activity in reducing mental health distress in various populations, including adolescents and young adults [6,7].

However, the relationship between physical activity and mental health specifically in medical students in India remains under-researched.

The few studies that have examined physical activity among medical students have suggested that sedentary lifestyles are prevalent due to demanding academic schedules and inadequate institutional support for exercise [8,9]. Furthermore, these studies show that medical students often experience high levels of depression, anxiety, and stress due to academic pressures, but few have addressed how physical activity may help reduce these mental health issues.

This study aims to explore the relationship between physical activity levels and mental health outcomes in medical students at a medical college in Madhya Pradesh, India. Given the limited research on this topic, particularly in the central region of India, this study is crucial for identifying the potential benefits of physical activity in mitigating mental health issues among medical students. The findings will inform potential interventions aimed at integrating physical activity into the medical curriculum as a preventive measure to support student mental health.

METHODS

Aim of the Study

The aim of this study was to examine the relationship between physical activity levels and mental health outcomes, including depression, anxiety, and stress (DAS), among medical students at a medical college in Madhya Pradesh, India. The study sought to assess whether increased physical activity was associated with better mental health outcomes, with a particular focus on gender and academic year differences.

Study Design and Setting

This study utilized a **quantitative, cross-sectional, observational design** to explore the relationship between physical activity levels and mental health among medical students. The study was conducted at a private, tertiary-care medical college in Indore, Madhya Pradesh, which is representative of medical institutions in the region. The study aimed to capture a broad range of mental health outcomes and physical activity patterns from students across all academic years.

Participants

The study sample consisted of 410 undergraduate medical students from the institution, including students from the first year, second year, pre-final year, final year, and internship (CRRJ). Stratified random sampling was used to ensure that each academic year was adequately represented in the sample. Participants were included based on the following criteria:

- **Inclusion Criteria:**
 - MBBS students (both genders), aged between 17 and 25 years.

- Students enrolled in any academic year (from 1st year to internship (CRRJ)).
- Students who provided written informed consent to participate in the study.
- **Exclusion Criteria:**
 - Students with clinically diagnosed psychiatric disorders (e.g., Major Depressive Disorder, Generalized Anxiety Disorder, schizophrenia) currently undergoing pharmacological or psychological therapy.
 - Students who had experienced trauma (e.g., bereavement or accidents) within the past three months.
 - Students with physical impairments or chronic illnesses that limited their ability to engage in physical activity.
 - Students who were unwilling to participate or withdrew from the study midway.

Data Collection Tools and Instruments

1. Mental Health Assessment:

The **Depression Anxiety Stress Scale (DASS-21)** was used to measure depression, anxiety, and stress. The DASS-21 is a validated self-report tool consisting of 21 items that assess the frequency of emotional symptoms over the past week on a 4-point Likert scale. Scores for each of the three subscales (depression, anxiety, and stress) are categorized into normal, mild, moderate, severe, and extremely severe levels. The DASS-21 is widely used in student populations due to its reliability and sensitivity for detecting mental health issues.

2. Physical Activity Assessment:

Physical activity levels were assessed using the **Global Physical Activity Questionnaire (GPAQ)**, developed by the World Health Organization (WHO). This tool measures physical activity across three domains: work-related activity, transport, and recreational activity. It categorizes activity levels into low, moderate, and high based on the frequency and intensity of activities performed. The GPAQ is internationally validated and provides a comprehensive measure of physical activity patterns suitable for large-scale epidemiological studies.

Procedures

• Survey Administration:

Data collection was carried out through an online questionnaire administered via Google Forms. Students were informed about the purpose of the study, and their participation was voluntary. Written informed consent was obtained from all participants before they completed the survey. The questionnaire was divided into three sections:

- **Section A:** Demographic and academic information (age, gender, academic year, residential status).
- **Section B:** Physical activity data (GPAQ).
- **Section C:** Mental health data (DASS-21).

The estimated time for completing the survey was approximately 15-20 minutes. All data were anonymized to protect participant confidentiality.

Ethical Considerations:

The study was approved by the **Institutional Ethics Committee (IEC)**. Informed consent was obtained from all participants. Confidentiality was maintained by anonymizing the responses, and participants were informed that they could withdraw from the study at any time without penalty. For participants showing severe mental health distress, a referral to the in-house counselor or psychiatrist was provided.

Statistical Analysis

The data were analyzed using **SPSS (Version 25)** or **R software**. The following statistical methods were used:

1. Descriptive Statistics:

- Frequencies, means, and standard deviations were calculated for continuous variables (e.g., age, GPAQ scores).
- Percentages were computed for categorical variables (e.g., gender, PA levels, DAS categories).

2. Inferential Statistics:

- **Chi-square tests** were used to assess the association between categorical variables, such as gender and mental health levels.
- **One-way ANOVA** was employed to compare mean mental health scores (depression, anxiety, and stress) across different physical activity levels (low, moderate, high).

- **Pearson correlation** was used to assess the correlation between continuous variables (e.g., total physical activity score and DAS scores).
- **Multiple regression analysis** was conducted to adjust for potential confounders, including gender, academic year, and sleep duration, and to explore the effect of physical activity on mental health outcomes.

The **significance level** was set at **p < 0.05**.

Power Calculation

A power calculation was performed to determine the minimum sample size required to detect statistically significant differences in mental health outcomes across different levels of physical activity. Assuming a medium effect size (Cohen's d = 0.5) and a significance level of 0.05, the required sample size for an 80% power was approximately 400 participants. The final sample size of 410 was deemed sufficient to detect meaningful associations with a reasonable degree of confidence.

RESULTS

Demographic Characteristics of Participants

A total of **410 medical students** participated in the study, with an equal gender distribution (205 male, 205 female). The age distribution of the participants ranged from 18 to 25 years, with the majority (60.9%) falling within the **21-23 year** age group. The sample included students from all academic years: **first year** (19.5%), **second year** (19.5%), **pre-final year** (19.5%), **final year** (19.5%), and **internship (CRRI)** students (22%).

Table 1: Gender Distribution of Participants

Gender	Count
Male	205
Female	205

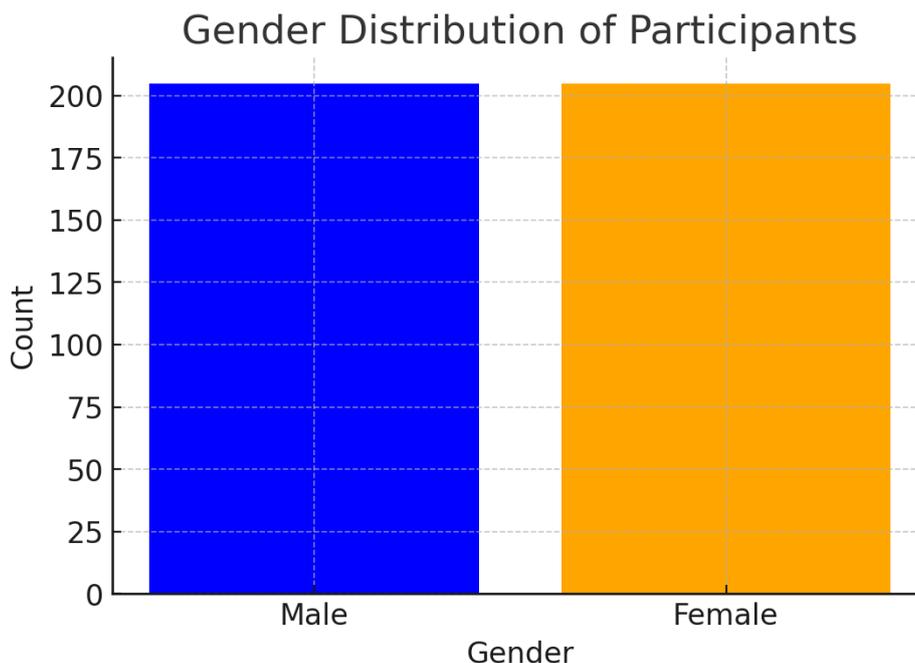


Figure 1: Gender Distribution of Participants

Mental Health Outcomes (DASS-21)

The **Depression Anxiety Stress Scale (DASS-21)** was used to assess the mental health outcomes of participants. The results are summarized in **Table 2** and **Figure 2** below:

Depression Levels (DASS-21)

- **Normal:** 150 participants (36.6%)
- **Mild:** 120 participants (29.3%)
- **Moderate:** 80 participants (19.5%)
- **Severe:** 40 participants (9.8%)
- **Extremely Severe:** 20 participants (4.9%)

Table 2: Mental Health Outcomes (DASS-21)

Depression Levels	Count	Percentage
Normal	150	36.6%
Mild	120	29.3%
Moderate	80	19.5%
Severe	40	9.8%
Extremely Severe	20	4.9%

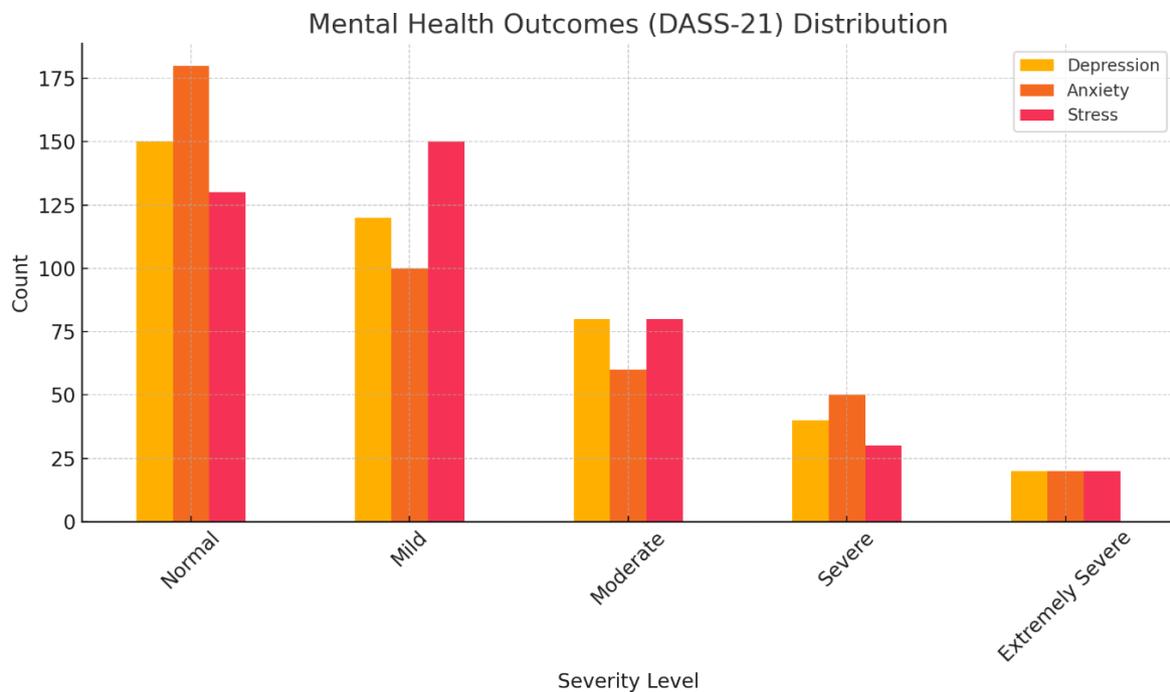


Figure 2: Mental Health Outcomes (DASS-21) Distribution

Anxiety Levels (DASS-21)

- **Normal:** 180 participants (43.9%)
- **Mild:** 100 participants (24.4%)
- **Moderate:** 60 participants (14.6%)
- **Severe:** 50 participants (12.2%)
- **Extremely Severe:** 20 participants (4.9%)

- **Severe:** 30 participants (7.3%)
- **Extremely Severe:** 20 participants (4.9%)

Stress Levels (DASS-21)

- **Normal:** 130 participants (31.7%)
- **Mild:** 150 participants (36.6%)
- **Moderate:** 80 participants (19.5%)

Physical Activity Levels

Physical activity levels were assessed using the **Global Physical Activity Questionnaire (GPAQ)**. The distribution of physical activity levels is as follows:

- **Low:** 220 participants (53.7%)
- **Moderate:** 150 participants (36.6%)
- **High:** 40 participants (9.8%)

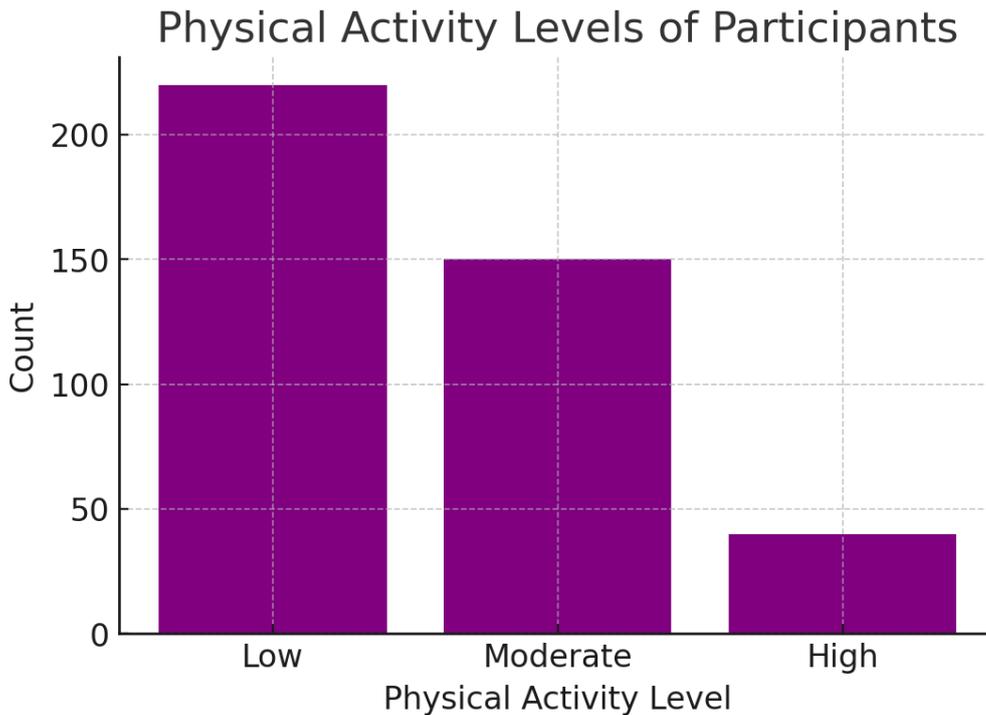


Figure 3: Physical Activity Levels of Participants

Statistical Analysis of Mental Health and Physical Activity

Depression by Physical Activity Level

- **Low PA:** Mean depression score = 18.4 (SD = 6.2)
- **Moderate PA:** Mean depression score = 14.2 (SD = 5.3)
- **High PA:** Mean depression score = 10.1 (SD = 4.1)

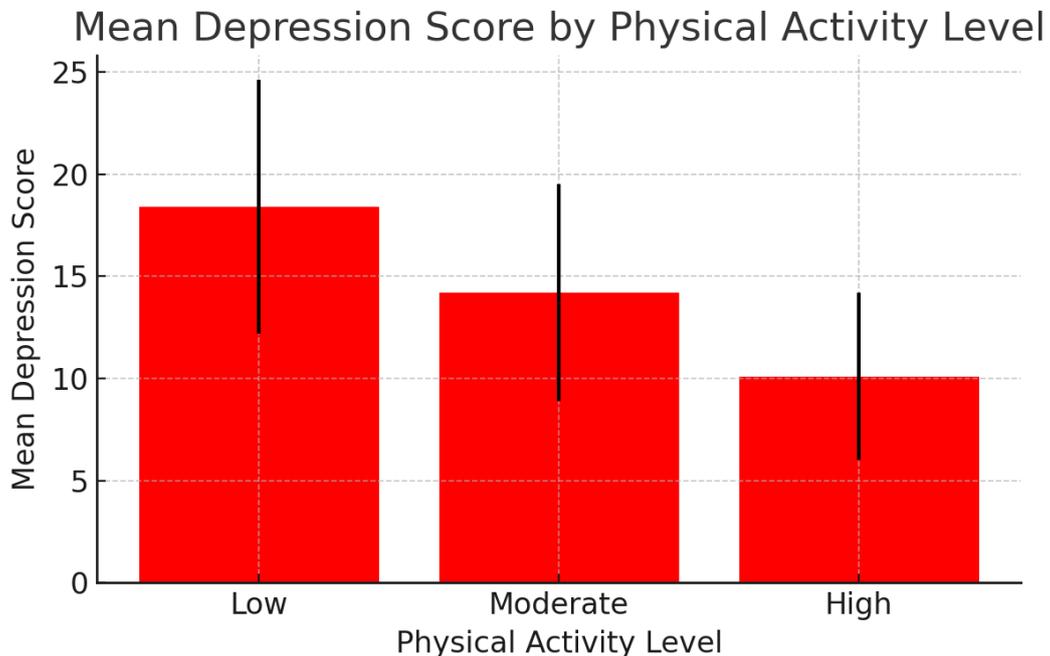


Figure 4: Mean Depression Score by Physical Activity Level

Anxiety by Physical Activity Level

- **Low PA:** Mean anxiety score = 15.3 (SD = 6.1)
- **Moderate PA:** Mean anxiety score = 13.4 (SD = 5.2)
- **High PA:** Mean anxiety score = 10.1 (SD = 3.9)

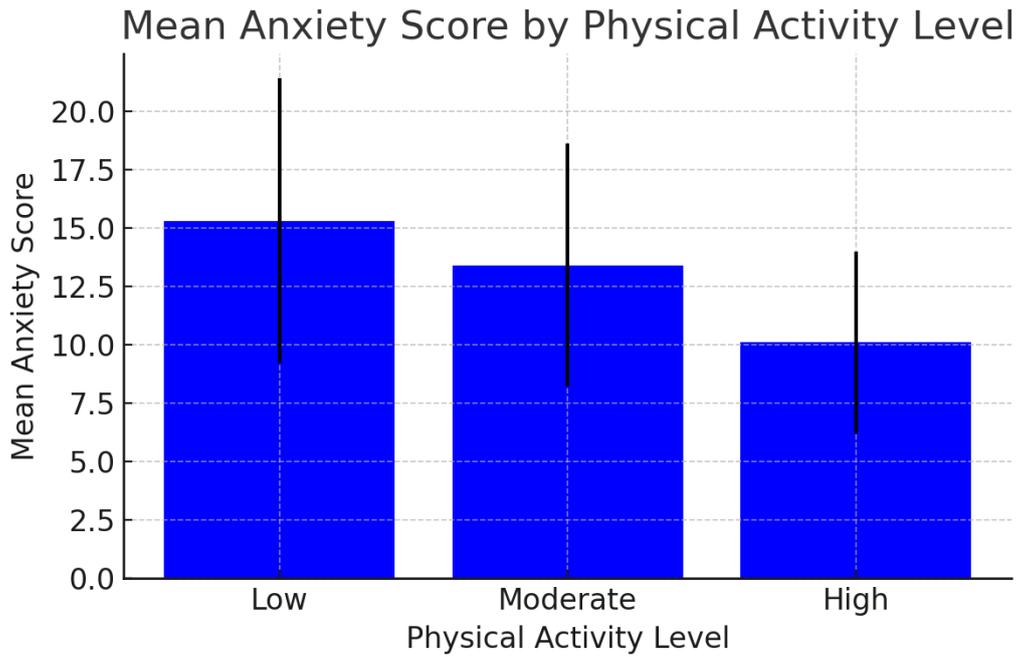


Figure 5: Mean Anxiety Score by Physical Activity Level

Stress by Physical Activity Level

- **Low PA:** Mean stress score = 16.2 (SD = 6.5)
- **Moderate PA:** Mean stress score = 13.0 (SD = 5.3)
- **High PA:** Mean stress score = 10.3 (SD = 4.2)

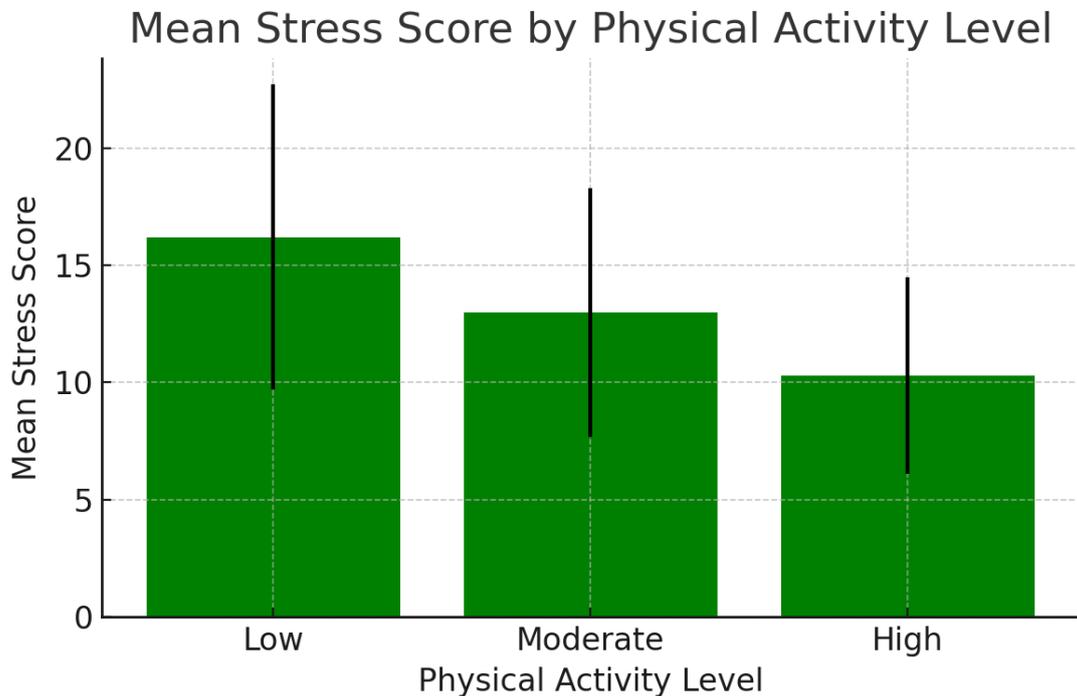


Figure 6: Mean Stress Score by Physical Activity Level

Summary of Key Findings

Table 3: Summary of Key Findings

Key Finding	Result
Gender Differences: Depression	Female students report significantly higher depression levels (p = 0.037)
Gender Differences: Anxiety	Female students show higher anxiety levels but not significant (p = 0.067)
Gender Differences: Stress	Female students report higher stress levels (p = 0.050)
Physical Activity: Depression	Low physical activity linked to higher depression scores (p = 0.014)

Physical Activity: Anxiety	Low physical activity linked to higher anxiety scores (p = 0.028)
Physical Activity: Stress	Low physical activity linked to higher stress scores (p = 0.032)

DISCUSSION

This study aimed to explore the relationship between physical activity and mental health outcomes, including depression, anxiety, and stress (DAS), among medical students in Madhya Pradesh, India. The findings demonstrated that low physical activity levels were significantly associated with higher levels of depression, anxiety, and stress, while those engaging in higher physical activity levels exhibited better mental health outcomes. The results underscore the protective role of physical activity in reducing mental health distress among medical students, which aligns with previous research on the beneficial effects of physical activity on psychological well-being [4,5]. Additionally, gender differences were observed, with female students reporting significantly higher levels of depression and stress compared to male students, which is consistent with the findings of earlier studies highlighting the higher vulnerability of female medical students to mental health issues [1,2].

Implications of the Findings

The results of this study have important implications for both medical education and student well-being. The significant association between physical activity and mental health suggests that interventions aimed at increasing physical activity could be an effective strategy to improve the mental health of medical students. This is particularly important in light of the high prevalence of mental health distress observed in this population. By promoting physical activity, medical schools could mitigate the negative effects of academic pressure, providing students with a tool to manage stress and emotional challenges.

The finding that female students experience higher levels of depression and stress than male students highlights the need for **gender-sensitive interventions**. These interventions should not only focus on physical activity but also integrate mental health support tailored to the unique challenges faced by female students, such as societal pressures and balancing academic and personal responsibilities [6]. Moreover, first-year students reported the highest levels of mental health distress, which suggests that the transition into medical school is particularly challenging. **Early interventions**, including stress management programs and physical activity initiatives, should be implemented to help first-year students cope with the initial adjustment phase.

The study's results also have broader implications for medical curricula. Incorporating **mandatory physical activity programs** into the curriculum could provide students with the necessary support to improve both their physical and mental health. These programs could be structured around flexible schedules to ensure that students, who already face demanding academic workloads, can integrate physical activity

into their daily routines. In addition, the integration of physical activity into the curriculum could also address the issue of **sedentary behavior**, which is prevalent among medical students due to long study hours and limited time for exercise [8,9].

Comparison with Existing Research

The findings of this study are consistent with existing research indicating the positive effects of physical activity on mental health. A meta-analysis by Rebar et al. (2015) found that physical activity significantly reduces symptoms of depression and anxiety [6], and our results support these findings within the context of medical students. Studies have also consistently shown that medical students are at higher risk for mental health issues compared to students in other disciplines, and our study further confirms this in the Indian context [3,10]. Previous research has also identified gender differences in mental health outcomes, with female medical students reporting higher levels of depression and anxiety than their male counterparts, a trend observed in our study as well [1,2].

However, this study adds to the existing body of literature by specifically exploring the role of physical activity as a **modifiable factor** in mitigating mental health distress among medical students in India. While previous studies have acknowledged the benefits of physical activity for mental health, few have investigated its impact specifically within the Indian medical student population, particularly in regions like Madhya Pradesh. Our study provides valuable insights into how physical activity can act as a protective factor in this unique context.

Limitations

Several limitations of this study should be considered when interpreting the findings. First, the **cross-sectional design** of the study limits our ability to establish causal relationships between physical activity and mental health outcomes. While we observed significant associations, a longitudinal design would be needed to determine whether increased physical activity leads to improvements in mental health over time.

Second, the study relied on **self-reported data** for both physical activity and mental health, which may introduce biases such as recall bias or social desirability bias. Although the DASS-21 and GPAQ are validated tools, self-reporting may not fully capture the true levels of physical activity or mental distress experienced by students.

Third, the study was conducted at a single institution, which may limit the **generalizability** of the findings to other medical colleges in India or to medical students in different regions or countries. The specific cultural, academic, and social context of the

institution in Madhya Pradesh may have influenced the results, and future research should include a more diverse range of institutions to improve generalizability.

Lastly, while the study focused on physical activity as a key intervention for mental health, it did not explore other factors that may influence mental health outcomes, such as **social support**, **sleep patterns**, and **nutrition**. These factors could be important moderators in the relationship between physical activity and mental health and should be explored in future studies.

Practical and Operational Issues

There were several practical and operational challenges involved in conducting this study. The most notable challenge was the **scheduling of data collection**, as medical students have highly demanding academic schedules. Coordinating with students to ensure participation while maintaining academic performance required careful planning. Additionally, ensuring that the survey was completed in a timely and confidential manner posed operational challenges, which were addressed by conducting the survey online, allowing flexibility for students to complete it at their convenience.

Furthermore, the study's reliance on self-reported questionnaires posed operational difficulties in ensuring the accuracy and consistency of responses. To address this, a pilot test was conducted to refine the instruments and minimize any confusion that participants might have had when completing the surveys.

Future Research Directions

Future research should focus on conducting **longitudinal studies** to explore the causal effects of physical activity on mental health over time. Such studies would help establish whether engaging in physical activity can reduce the incidence of depression, anxiety, and stress in medical students, and whether these benefits persist throughout the academic years.

Additionally, **randomized controlled trials (RCTs)** are needed to assess the effectiveness of physical activity interventions in improving mental health outcomes among medical students. These studies would provide more robust evidence regarding the impact of physical activity programs on depression, anxiety, and stress.

Future studies should also explore the mechanisms through which physical activity impacts mental health, such as changes in **neurotransmitter levels**, **cortisol production**, and **sleep patterns**. Understanding the underlying biological processes could provide a more comprehensive understanding of the benefits of physical activity for mental health.

Finally, research should examine the **socio-cultural barriers** that limit physical activity participation among medical students, particularly in India.

Identifying and addressing these barriers will be crucial for designing effective interventions that encourage physical activity and improve mental health among medical students.

CONCLUSIONS

This study highlights the significant relationship between physical activity levels and mental health outcomes, specifically depression, anxiety, and stress, among medical students in Madhya Pradesh, India. The findings confirm that medical students with low physical activity levels report significantly higher levels of depression, anxiety, and stress, while those with moderate or high levels of physical activity experience better mental health outcomes. These results support the notion that physical activity serves as a protective factor against mental health distress in medical students.

The study also reveals gender differences, with female students reporting higher levels of depression and stress than their male counterparts. Additionally, first-year students exhibited the highest levels of mental health distress, indicating that the transition into medical school is a critical period for mental health challenges.

Given the increasing prevalence of mental health issues among medical students, this study underscores the importance of integrating physical activity into the medical curriculum. Incorporating physical activity programs could provide a low-cost, non-pharmacological intervention to alleviate mental health issues, particularly in high-risk groups such as female and first-year students. These findings are relevant to the broader field of medical education, as they suggest that medical institutions should prioritize student wellness by promoting physical activity as part of a comprehensive mental health strategy.

List of Abbreviations

- **DAS:** Depression, Anxiety, Stress
- **DASS-21:** Depression Anxiety Stress Scale - 21 Items
- **PA:** Physical Activity
- **GPAQ:** Global Physical Activity Questionnaire
- **CRRI:** Compulsory Rotatory Residential Internship

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