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# THE IMPACT OF PHYSICAL ACTIVITY AND STRESS ON ACADEMIC PERFORMANCE: A CROSS-SECTIONAL STUDY AMONG MEDICAL STUDENTS

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## ABSTRACT

**Background:** Medical students often face high academic demands, which contribute to elevated stress and reduced physical activity, factors that may potentially impact their academic performance. This study assessed the relationship between physical activity, stress, and academic self-efficacy.

**Methods:** A cross-sectional study was conducted among 200 MBBS students using validated tools, including the Academic Self-Efficacy Scale (ASES), the Global Physical Activity Questionnaire (GPAQ), and the Perceived Stress Scale (PSS-10). Data on sleep, smoking, alcohol use, and sociodemographics were also collected. Correlation, ANOVA, and multiple regression analyses were used.

**Results:** The mean ASES score was 66.9±7.8. Academic performance positively correlated with physical activity ($r = 0.32$, $p < 0.01$) and negatively with stress ($r = -0.49$, $p < 0.01$). Students with high physical activity and low-stress levels had significantly higher ASES scores ($p < 0.01$). Regression analysis revealed that physical activity ($\beta = 0.26$), stress ($\beta = -0.33$), and sleep ($\beta = 0.22$) were significant predictors, accounting for 44% of the variance ($R^2 = 0.44$).

**Conclusion:** Physical activity and stress have a significant influence on academic self-efficacy among medical students. Integrating wellness programs into medical education may enhance academic outcomes and student well-being.

**Keywords:** Academic performance, medical students, physical activity, perceived stress, self-efficacy

## INTRODUCTION

The pursuit of medical education is steadily rising in our society. However, the rigorous academic demands and complex curriculum structure of medical training often place medical students under significant psychological strain, leading to increased stress and a reduction in physical activity.[1]

Physical activity is widely recognized for its physical health benefits and positive influence on cognitive functions and academic performance. Moreover, it has been shown to mitigate mental health issues such as anxiety, depression, and mood disorders.[1]

Several studies have explored the association between physical activity, cognitive domains, and learning capacity, indicating a potential link between an active lifestyle and enhanced academic achievement .[2] Conversely, a sedentary lifestyle has been associated with systemic health issues such as obesity and respiratory conditions like asthma and chronic obstructive pulmonary disease (COPD), which can adversely affect academic engagement and performance.[3]

The continuous pressure to achieve academic excellence and to emerge as competent future healthcare professionals has cultivated a high-stress, physically inactive environment among medical students.[4] While physical activity is now frequently recommended as an adjunct therapy for mental health conditions, evidence regarding its direct impact on academic performance remains mixed.[4]

Stress, defined as a physical, emotional, and psychological response to challenging circumstances, has become a prevalent issue in medical education .[5] The increasing complexity of medical curricula, coupled with rising societal expectations, contributes to elevated stress levels, mental health deterioration, and emotional exhaustion among students .[6,7] Persistent stress, in combination with reduced physical activity, compromises coping mechanisms, occasionally leading to academic withdrawal or even suicidal ideation.

Chronic stress has been linked to a range of psychological and somatic disorders, erosion of self-esteem, and reduced academic performance.[8,9] Prolonged exposure to such stressors may also result in memory impairment, diminished self-efficacy, and disruptions in social functioning. Furthermore, the mental burden of medical education may predispose students to additional psychological challenges, including substance use and addiction.[10]

Despite the evident adverse effects of stress and physical inactivity, research on their combined influence on the academic performance of medical undergraduates has been limited. In particular, the potential role of gender differences remains underexplored. Therefore, the present study aims to examine the impact of physical activity and stress on the academic performance of MBBS students through a cross-sectional observational design.

## MATERIALS AND METHODS

### Study Design and Participants

This cross-sectional study was conducted among 200 undergraduate medical students from a medical college in Gujarat, India. Participants were selected using convenience sampling, and inclusion criteria included current enrolment in any academic year and willingness to provide informed consent. Students with known psychiatric diagnoses or chronic illnesses were excluded from the study.

### Data Collection Tools

**Academic Performance:** Academic performance was assessed using the Academic Self-Efficacy Scale (ASES), a validated instrument measuring students' confidence in handling academic tasks. Scores range from 0 to 100, with higher scores indicating greater self-efficacy.

**Physical Activity:** Physical activity was assessed using an adapted version of the Global Physical Activity Questionnaire (GPAQ), tailored for student populations. Total activity was calculated in MET-minutes per week and categorized into three levels: low (<600 MET-min/week), moderate (600–2999 MET-min/week), and high (≥3000 MET-min/week).

**Perceived Stress:** Perceived stress was measured using the 10-item Perceived Stress Scale (PSS-10). Based on standard cut-off scores, stress levels were classified as low (0–13), moderate (14–26), and high (27–40), reflecting increasing levels of psychological stress.

**Lifestyle Factors:** Participants self-reported smoking and alcohol use (coded as Yes/No) and average nightly sleep duration (in hours).

**Sociodemographic variables,** including age, gender, and academic year, were recorded using a structured questionnaire.

**Procedure:** Data were collected anonymously using a self-administered online questionnaire. The survey was disseminated through institutional email lists and classroom announcements. Participation was voluntary, and informed consent was obtained electronically.

**Data analysis:** The collected data were entered into Microsoft Excel and analyzed using Epi Info 7. Descriptive statistics, including the mean, standard deviation, and range, were used to summarize continuous variables such as age, academic self-efficacy scores, physical activity (in MET-minutes per week), perceived stress scores, and sleep duration. Categorical variables like gender, smoking, and alcohol use were expressed as frequencies and percentages. Pearson's correlation was applied to assess the relationship between physical activity, perceived stress, and academic self-efficacy. One-way analysis of variance (ANOVA) was used to compare mean academic self-efficacy scores across categories of physical activity and stress levels. Multiple linear regression analysis was conducted to identify independent predictors of academic self-efficacy, with variables including physical activity, stress, sleep, smoking, alcohol use, age, and gender. A p-value of less than 0.05 was considered statistically significant.

## RESULTS

A total of 200 medical students participated in the study, with a mean age of 21.4 years and 58% identifying as female. The average academic self-efficacy score was 66.9, while the scores for physical activity and perceived stress showed wide variability across participants. Correlation analysis revealed that higher physical activity was associated with lower stress and better academic self-efficacy, while stress demonstrated a strong negative association with academic performance. A one-way ANOVA revealed that academic self-efficacy increased significantly with higher physical activity levels and decreased with higher stress levels. In multiple regression analysis, physical activity, perceived stress, and sleep duration emerged as significant predictors of academic performance, whereas smoking and alcohol use showed slight but notable negative effects.

**Table 1: Descriptive Statistics of Study Variables**

| Variable | Mean (SD) | Range |
|---|---|---|
| Age (years) | 21.4 (1.8) | 18–25 |
| Gender (% Female) | 58% | — |
| Academic Performance (ASES Score)[#] | 66.9 (7.8) | 50–85 |
| Physical Activity Score (GPAQ) [$] | 2315.6 (980.3) | 400–4500 |
| Perceived Stress Score (PSS-10)[+] | 18.7 (4.6) | 10–35 |
| Sleep Duration (hours/night) | 6.4 (1.1) | 4–9 |

[#]Academic Self-Efficacy Scale, [$] Global Physical Activity Questionnaire , [+] Perceived Stress Scale

As shown in Table 1, students exhibited moderate levels of academic self-efficacy, physical activity, and stress, suggesting that lifestyle-focused interventions may support improved academic outcomes.

**Table 2: Correlation Matrix Among Key Variables**

| Variable | Physical Activity | Perceived Stress | Academic Performance |
|---|---|---|---|
| Physical Activity | 1.00 | -0.36** | 0.32** |
| Perceived Stress | -0.36** | 1.00 | -0.49** |
| Academic Performance | 0.32** | -0.49** | 1.00 |

**$p < 0.01$*

Correlational patterns (Table 2) revealed that higher physical activity was associated with reduced stress and enhanced academic performance, while elevated stress was strongly linked to diminished self-efficacy, underscoring stress as a central factor influencing academic outcomes.

**Table 3: Comparison of Academic Performance by Physical Activity Levels**

| Physical Activity Level | N | Mean ASES Score | SD | F-value | p-value |
|---|---|---|---|---|---|
| Low (<600 MET[#]-min/week) | 60 | 62.4 | 8.6 | | |
| Moderate (600–2999) | 84 | 67.2 | 7.2 | 5.97 | 0.003 |
| High (≥3000) | 56 | 70.1 | 6.8 | | |

[#]Metabolic equivalent

As shown in Table 3, academic self-efficacy scores increased progressively with higher physical activity levels, indicating a positive gradient effect and suggesting that greater physical engagement may be linked to improved academic confidence. A clear stepwise decline in academic self-efficacy was observed across rising stress levels, reflecting a strong negative influence of perceived stress on students' academic confidence (Table 4).

**Table 4: Comparison of Academic Performance by Stress Levels**

| Stress Level (PSS-10) | N | Mean ASES Score | SD | F-value | p-value |
|---|---|---|---|---|---|
| Low (0–13) | 48 | 71.5 | 6.3 | | |
| Moderate (14–26) | 98 | 66.1 | 7.4 | 8.65 | 0.001 |
| High (27–40) | 54 | 61.2 | 8.3 | | |

The regression model (Table 5) revealed that stress, physical activity, and sleep were key predictors of academic self-efficacy, while smoking and alcohol consumption had smaller negative effects; age and gender were not significant predictors.

**Table 5: Multiple Linear Regression Predicting Academic Performance**

| Predictor | β Coefficient | SE | t-value | p-value |
|---|---|---|---|---|
| Physical Activity | 0.26 | 0.08 | 3.25 | 0.001 |
| Perceived Stress | -0.33 | 0.06 | -5.50 | <0.001 |
| Sleep Duration | 0.22 | 0.07 | 3.14 | 0.002 |
| Smoking (Yes=1) | -0.12 | 0.06 | -2.00 | 0.047 |
| Alcohol (Yes=1) | -0.10 | 0.05 | -2.00 | 0.045 |
| Age | 0.03 | 0.03 | 1.00 | 0.320 |
| Gender (Female=1) | 0.08 | 0.05 | 1.60 | 0.110 |
| Constant | 58.2 | 3.4 | 17.12 | <0.001 |

Model $R^2 = 0.44$, Adjusted $R^2 = 0.42$

## DISCUSSION

The present study provides compelling evidence supporting the positive role of physical activity, stress management, and adequate sleep in enhancing academic self-efficacy among medical students. A clear and statistically significant gradient was observed, where academic self-efficacy scores increased progressively with higher physical activity levels. Students engaging in high levels of physical activity (≥3000 MET-min/week) achieved a mean ASES score of 70.1 ± 6.8, compared to 67.2 ± 7.2 among those with moderate activity and 62.4 ± 8.6 in the low activity group ($p = 0.003$). These results support a dose-response relationship between physical activity and academic confidence.

Al-Drees et al.[11] reported comparable trends, who found that 47.2% of physically active students achieved higher GPAs, with a significant association between physical activity habits and academic performance ($\chi^2 = 10.65$, $p = 0.001$). Notably, fifth-year students who were physically active had the highest odds of achieving a high GPA (OR = 5.07; 95% CI: 1.48–17.31; $p = 0.010$). These findings emphasize that physical activity benefits students even in the more academically demanding phases of medical education.

Similarly, Neuman et al.[12] found that students in the highest GPA group (3.60–4.00) engaged more frequently in all intensities of exercise compared to lower GPA groups. Their analysis revealed statistically significant differences in physical activity levels between high and low academic achievers ($p = 0.012$). Moreover, 74% of students in the high-GPA group reported satisfaction with their mental health, and 54% with physical health, outcomes that strongly reflect the role of physical activity in promoting well-being alongside academic success.

Moawd et al.[13] added further insight by demonstrating that the link between physical activity and academic performance among female medical students was mediated through cardiorespiratory fitness. Their study found significantly higher GPA values among students with moderate to high physical activity levels, and bootstrapped mediation analysis confirmed that physical activity improved academic performance indirectly through its effects on fitness ($p < 0.001$). This physiologic mediation aligns with the broader literature on the cognitive benefits of improved oxygenation, neurotrophic factor release, and enhanced cortical activation.

In the current study, perceived stress was found to have a strong negative association with academic self-efficacy. Students with low stress levels (PSS-10 score 0–13) had significantly higher ASES scores ($71.5 \pm 6.3$) than those with moderate ($66.1 \pm 7.4$) or high stress levels ($61.2 \pm 8.3$), with $p = 0.001$. The correlation coefficient of $r = -0.49$ confirms the robustness of this relationship. These results echo the findings of Jose et al.[14] who reported that medical students with higher physical activity levels exhibited both lower anxiety and depressive symptoms and better academic performance. In their cohort, 40.7% of students classified as highly active had significantly better internal marks compared to those who were physically inactive.

Sleep duration also emerged as a significant predictor of academic performance, with a regression coefficient of $\beta = 0.22$ ($p = 0.002$), indicating that longer and consistent sleep patterns positively influenced academic self-efficacy. Neuman et al.[12] similarly found that students with better physical and mental well-being, including adequate sleep, clustered in the high-performing academic group. This convergence across studies reinforces the importance of restorative behaviors in achieving optimal academic outcomes.

While minor negative effects were noted for smoking ($\beta = -0.12$, $p = 0.047$) and alcohol consumption ($\beta = -0.10$, $p = 0.045$), the focus of this discussion remains on modifiable protective factors. Age and gender were not significant predictors, suggesting that the benefits of physical activity, sufficient sleep, and stress reduction are consistent across demographic subgroups in the medical student population.

Overall, the findings strongly support the integration of structured physical activity and wellness strategies into medical curricula. Encouraging healthy behaviors may serve as a practical and evidence-based approach to foster resilience, boost academic performance, and support the mental and physical health of future healthcare professionals.

## LIMITATIONS AND FUTURE RESEARCH DIRECTIONS

This study has several limitations. The cross-sectional design restricts the ability to infer causality between physical activity, stress, and academic performance. Future longitudinal or experimental studies are necessary to determine temporal relationships and causative pathways. The use of self-reported instruments, such as the GPAQ, PSS-10, and ASES, may be subject to social desirability and recall bias, potentially affecting data accuracy. Additionally, the study was conducted at a single tertiary medical college using convenience sampling, which limits the generalizability of the findings to other institutions or regions. Academic performance was assessed using perceived self-efficacy rather than objective academic scores, which may not fully represent academic success.

Furthermore, potential confounding variables such as dietary habits, screen time, social support, and mental health history were not controlled for. Future research should include diverse student populations across multiple institutions to enhance generalizability and validity. Incorporating objective academic outcomes (e.g., GPA, exam scores) alongside self-efficacy measures may offer a more comprehensive understanding of academic performance. Intervention studies evaluating the

effects of structured physical activity and stress reduction programs on academic metrics could provide more substantial evidence. Additionally, exploring gender-specific or year-wise differences in coping mechanisms and lifestyle behaviors may yield valuable insights for targeted interventions.

## CONCLUSION

In conclusion, our findings support the growing body of evidence that promoting healthy habits—particularly physical activity and stress management—can enhance academic self-efficacy in medical students. Institutional wellness programs and time-management workshops could be valuable in fostering these behaviours and improving both academic and psychological outcomes.

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