International Journal of Life Sciences, Biotechnology and Pharma Research Vol. 14, No. 2, February 2025 Online ISSN: 2250-3137
Print ISSN: 2977-0122

DOI: 10.69605/ijlbpr_14.2.2025.213

ORIGINAL RESEARCH

A Comparative Study of Cognitive Performance, Stress, Body Mass Index, and Lung Functions in Exercising Versus Non-Exercising Medical Students

[1]Dr. Robina Shamim, [2]Dr. Rita Kumari

[1]Tutor, Department of Physiology, Nalanda Medical College and Hospital, Patna, Bihar, India.
[2]Professor, Head of Department, Department of Physiology, Nalanda Medical College and Hospital, Patna, Bihar, India.

Corresponding Author: Dr. Robina Shamim
Tutor, Department of Physiology, Nalanda Medical College and Hospital, Patna, Bihar, India
Email: shamimrobina@gmail.com

Received: 12 January, 2025 Accepted: 29 January, 2025 Published: 17 February, 2025

ABSTRACT

Background: Students today experience a great deal of stress due to the highly competitive society they must confront. The present study was conducted to compare the levels of stress, cognition, BMI, and lung function in exercising and non- exercising medical students. **Materials & Methods:** 90 medical students of both genders were divided into 2 groups of 45 each. Group I was exercising group and group II was non- exercising group. Group I subjects were those who exercise regularly or play sports for at least five hours a week. The BMI was calculated using Quetelet's index. Stress and cognition were measured using the Perceived Stress Scale 10 (PSS-10) and the Modified Mini-mental State Examination (3MS), respectively. Pulmonary function was measured using a computerised spirometer. **Results:** Group I had 20 males and 25 females and group II had 18 males and 27 females. The mean PSS-10 score was 11.6±2.3 and 19.2±2.3, 3MS score was 98.2±1.5 and 95.4±10.4, BMI was 21.8±1.2 and 23.4±8.2, FVC was 3.9±1.1 and 3.5±0.5 and FEV1 was 3.4±1.9 and 3.0±0.8 in group I and II respectively. The difference was significant (P< 0.05). **Conclusion:** Compared to those who do not exercise, participants who engage in regular physical activity demonstrate superior cognition, reduced stress levels, healthier BMI values, and improved lung function.

Keywords: Stress, cognition, lung function

INTRODUCTION

Students today experience a great deal of stress due to the highly competitive society they must confront. Stress, which is an unavoidable aspect of life, impacts people differently at different points in their lives. Research has demonstrated that medical students experience significantly more stress than their peers in other fields.[1] The study by Childs and de Wit (2014) concluded that regular physical exercise is linked to greater emotional resilience to acute stress in healthy adults. Individuals who engaged in regular exercise experienced less negative mood and exhibited lower cortisol responses when exposed to stress compared to those who were sedentary. These findings suggest that habitual physical activity may serve as a protective factor against the adverse emotional and physiological effects of stress.[2]

Students experience academic pressure and anxiety stemming from their unsettling worries about the future.[3] The stress they endure across social, emotional, and physical dimensions is exacerbated by familial challenges, significantly impacting their cognition. Cognition refers to the mental activities involved in thinking, learning, remembering, being aware of one's environment, and exercising judgment.[4] Stress affects not just

DOI: 10.69605/ijlbpr_14.2.2025.213

the body, but also has a deep impact on a person's emotions, thoughts, and behaviours. Regrettably, this stress can lead students to the dangerous route of addiction to substances such as drugs, alcohol, and cigarettes, which can cause numerous severe health issues.[5] After exposure to acute or chronic stress, cytokines like Interleukin-1 beta (IL-1β), Tumour Necrosis Factor alpha (TNF-α), and IL-6 are released in the hypothalamus, hippocampus, and prefrontal cortex. This results in inflammation of the Central Nervous System (CNS) and reduced cognitive function.[6] Students can effectively manage stress by participating in physical activities such as sports, cycling, running, swimming, and other cardiovascular exercises.[7]

AIM AND OBJECTIVES

The present study was conducted to compare the levels of stress, cognition, BMI, and lung function in exercising and non- exercising medical students.

MATERIALS AND METHODS

Study Design

This was a comparative cross-sectional observational study conducted to assess stress, cognition, BMI, and lung function among exercising and non-exercising medical students.

Study Population

The study included 90 medical students of both genders, enrolled in an undergraduate medical program. Participants were selected irrespective of academic year, provided they met the inclusion criteria.

Study Place

The study was conducted in the Department of Physiology, Nalanda Medical College & Hospital, Patna, Bihar.

Study Period

The data collection was carried out over a period of two years from January 2023 to December 2024.

Inclusion Criteria

- Medical students aged 18 to 25 years.
- Both male and female students.
- Those who provided informed consent.
- For Group I (Exercising Group): Students engaging in regular physical activity (sports/exercise) for at least five hours per week.
- For Group II (Non-Exercising Group): Students not involved in any structured exercise or sports activity.

Exclusion Criteria

- Students with known respiratory, neurological, cardiovascular, or psychiatric disorders.
- Those on medications affecting cognition, stress levels, or respiratory function.
- Students with recent illness or surgery within the past 3 months.

Ethical Considerations

Ethical clearance was obtained from the Institutional Ethics Committee before initiating the study. All participants were informed about the study protocol and provided written informed consent prior to participation. Confidentiality of data was maintained throughout the study.

Study Procedure

1. Grouping: Participants were divided into two groups of 45 each:
   - **Group I: Exercising group.**
   - **Group II: Non-exercising group**.
2. Data Collection:
   - Basic demographic data: Name, age, gender, height, weight, and exercise habits were recorded.
   - BMI was calculated using Quetelet's Index:

BMI=Weight (kg) / Height (m)^2

1. Assessment Tools:
   - Stress: Evaluated using the Perceived Stress Scale-10 (PSS-10).
   - **Perceived Stress Scale (PSS-10):** The Perceived Stress Scale is a widely used psychological instrument for measuring the perception of stress. Participants respond to each item on a **5-point Likert scale** ranging from:
     - 0 = Never
     - 1 = Almost never
     - 2 = Sometimes
     - 3 = Fairly often
     - 4 = Very often

The scores of the 10 items are summed to obtain a total score ranging from 0 to 40, with higher scores indicating greater perceived stress.

- **Low stress:** 0–13
- **Moderate stress:** 14–26
- **High stress:** 27–40

   - Cognition: Assessed using the Modified Mini-Mental State Examination (3MS).
   - Lung Function: Measured with a computerised spirometer, including parameters like FVC (Forced Vital Capacity), FEV1 (Forced Expiratory Volume in 1 second), and FEV1/FVC ratio.
2. All assessments were performed under standardized conditions by trained personnel.

DOI: 10.69605/ijlbpr_14.2.2025.213

Outcome Measures

- Primary outcomes: Differences in stress levels, cognitive scores, BMI, and pulmonary function parameters between the two groups.
- Secondary outcomes: Correlation between level of exercise and each of the measured variables.

Statistical Analysis

- Data were compiled and entered into Microsoft Excel and analyzed using SPSS (Statistical Package for the Social Sciences) software version 25.0 [IBM® SPSS® software, USA].
- Continuous variables were expressed as mean ± standard deviation (SD).
- Independent t-test was used to compare means between the two groups.
- Chi-square test was used for categorical variables where applicable.
- A p-value < 0.05 was considered statistically significant.

RESULTS

Table 1: Gender wise distribution of participants

Groups	Group I (n=45)	Group II (n=45)
Status	Exercising	Non- exercising
M:F	20:25	18:27

Table 1 show that group I had 20 males and 25 females and group II had 18 males and 27 females.

Table 2: Assessment of Parameters in Exercising (Group I) and Non-Exercising (Group II) Medical Students

Parameter	Group I (Exercising)	Group II (Non-Exercising)	P value
PSS-10 score (units)	11.6 ± 2.3	19.2 ± 2.3	0.01
3MS score (out of 100)	98.2 ± 1.5	95.4 ± 10.4	0.03
BMI (kg/m²)	21.8 ± 1.2	23.4 ± 8.2	0.05
FVC (L)	3.9 ± 1.1	3.5 ± 0.5	0.04
FEV_1 (L)	3.4 ± 1.9	3.0 ± 0.8	0.04

PSS=Perceived Stress Scale, 3MS score= Modified Mini-Mental State, FVC=Forced Vital Capacity, FEV1=Forced Expiratory Volume in 1 second

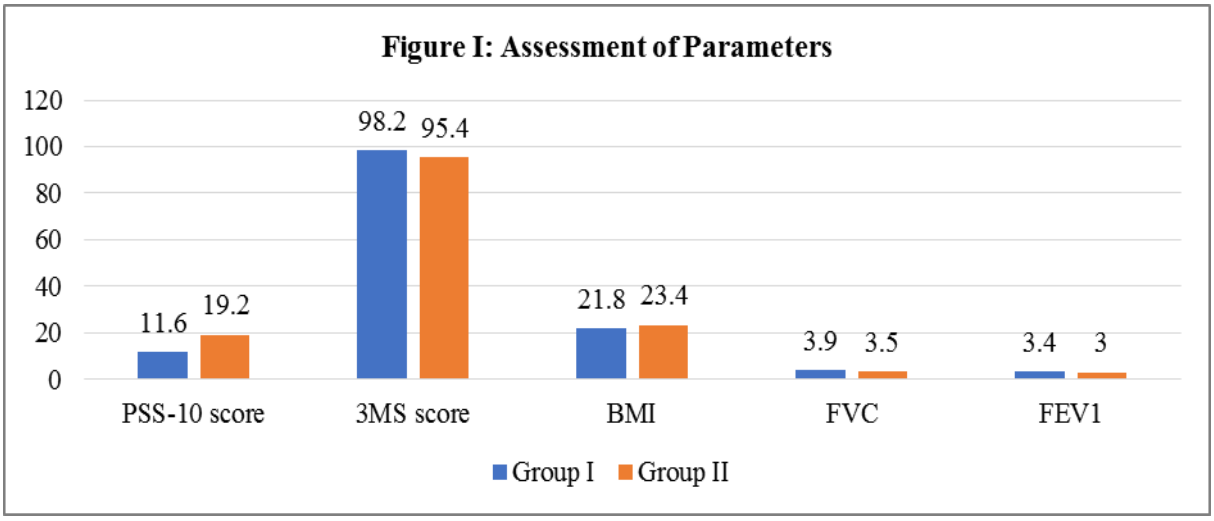

Table 2 and Figure I show that the mean PSS-10 score in Group I was significantly lower (11.6 ± 2.3) compared to Group II (19.2 ± 2.3), with a p value of 0.01, indicating a statistically significant difference in perceived stress levels. The Modified Mini-Mental State Examination (3MS) scores indicate that cognitive performance was higher in the exercising group (98.2 ± 1.5) than in the non-exercising group (95.4 ± 10.4), with a statistically significant difference (p = 0.03). The Body Mass Index (BMI) of students in Group I was lower (21.8 ± 1.2 kg/m²) compared to Group

DOI: 10.69605/ijlbpr_14.2.2025.213

II (23.4 ± 8.2 kg/m²), with a p value of 0.05, which is at the threshold of statistical significance. Forced Vital Capacity (FVC) was higher in Group I (3.9 ± 1.1 L) compared to Group II (3.5 ± 0.5 L), with a statistically significant p value of 0.04. Forced Expiratory Volume in 1 second (FEV_1) was also higher in the exercising group (3.4 ± 1.9 L) than in the non-exercising group (3.0 ± 0.8 L), with a significant p value of 0.04.

DISCUSSION

Cognition assessment involves taking BMI into account. Studies have demonstrated that increased BMI correlates with elevated stress levels.[8] When a person is stressed, cortisol is released. Elevated levels of this hormone are closely linked to obesity.[9] Moreover, cognitive decline is associated with a higher BMI. Exercise boosts a person's functional vital capacity and aids in preserving lung function.[10,11] People often turn to cigarette smoking as a response to stress, but this habit can impair lung function and contribute to serious health issues such as chronic obstructive pulmonary disease. It is known that impaired lung function can lead to cognitive decline.[12] The present study was conducted to compare the levels of stress, cognition, BMI, and lung function in exercising and non- exercising medical students.

We found that group I had 20 males and 25 females and group II had 18 males and 27 females. Ankireddy et al.[13] compared the levels of stress, cognition, BMI, and lung function in exercising and non- exercising medical students. It included 110 participants categorised into an exercising group and a non- exercising group. Stress and cognition were measured using the Perceived Stress Scale 10 (PSS-10) and the Modified Mini-mental State Examination (3MS), respectively. The BMI was calculated using Quetelet's index. Pulmonary function was measured using a computerised spirometer. The mean PSS-10 score for exercising students (11.36±3.67) was significantly lower compared to non- exercising students (20.71±4.61). The 3MS score of exercisers (97.33±1.73) was significantly higher compared to non-exercisers (94.02±1.40). The mean values of pulmonary functions namely Forced Expiratory Volume 1 (FEV1) (3.43±0.71 L), Forced Vital Capacity (FVC) (3.88±0.76 L), and FEV1/FVC (87.94±2.73%) in exercisers, were significantly better than the values for non-exercisers: FEV1 (3.00±0.67 L), FVC (3.48±0.71 L), and FEV1/FVC (85.86±2.75%). The mean BMI of exercisers (21.45±1.43 kg/m2) was significantly lower than that of non-exercisers (23.03±1.35 kg/m2).

In present study, the mean PSS-10 score in Group I was significantly lower (11.6 ± 2.3) compared to Group II (19.2 ± 2.3). This aligns with previous study indicating that regular exercise contributes to stress reduction through physiological mechanisms such as modulation of cortisol levels and increased endorphin production.[14] Exercise has also been found to improve emotional resilience and reduce symptoms of anxiety and depression among medical students, who are often exposed to high academic pressure.[15]

We found that the Modified Mini-Mental State Examination (3MS) scores indicate that cognitive performance was higher in the exercising group (98.2 ± 1.5) than in the non-exercising group (95.4 ± 10.4). This supports findings from other studies that suggest aerobic exercise enhances cognitive function, particularly executive function, attention, and memory.[16] Physical activity is believed to stimulate neuroplasticity, increase cerebral blood flow, and elevate brain-derived neurotrophic factor (BDNF) levels, which collectively enhance cognitive abilities.[17]

The Body Mass Index (BMI) of students in Group I was lower (21.8 ± 1.2 kg/m²) compared to Group II (23.4 ± 8.2 kg/m²). This is consistent with the well-established role of physical activity in maintaining a healthy weight by improving energy expenditure and metabolic rate.[18] Although the difference was at the threshold of significance (p = 0.05), it highlights the potential of even moderate physical activity in regulating body composition among young adults.

Forced Vital Capacity (FVC) was higher in Group I (3.9 ± 1.1 L) compared to Group II (3.5 ± 0.5 L), and Forced Expiratory Volume in 1 second (FEV_1) was also higher in the exercising group (3.4 ± 1.9 L) than in the non-exercising group (3.0 ± 0.8 L). In terms of pulmonary function**,** both Forced Vital Capacity (FVC) and Forced Expiratory Volume in 1 second (FEV_1) were significantly higher in the exercising group. This aligns with previous study indicating that regular aerobic activity has been shown to improve lung capacity and efficiency by strengthening respiratory muscles and enhancing alveolar ventilation.[19] These results mirror those from previous cross-sectional studies showing superior lung function parameters in physically active individuals.[20]

DOI: 10.69605/ijlbpr_14.2.2025.213

Pathan SS et al.[21] studied 10,975 men and women aged 47-70 years (23% African-Americans) enrolled in the Atherosclerosis Risk in Communities Study. In analysis adjusted for lifestyles, APOE genotype, and cardiovascular risk factors, impaired lung function was associated with worse cognitive function at baseline. No association was found between lung function and cognitive decline over time. Impaired lung function at baseline was associated with higher risk of dementia hospitalization during follow-up, particularly amongst younger individuals. The hazard ratios (95% confidence intervals) of dementia hospitalization were 1.6 (0.9, 2.8) and 2.1 (1.2, 3.7) comparing the lowest with the highest quartile of forced expiratory volume in 1 s and forced vital capacity, respectively. Presence of a restrictive ventilatory pattern, but not of an obstructive pattern, was associated with reduced cognitive scores and higher dementia risk.

Abdulghani HM et al.[22] in their study the prevalence of stress was measured and compared with the five study variables, such as gender, academic year, academic grades, regularity to course attendance, and perceived physical problems. The response rate among the study subjects was 87% (n=892). The total prevalence of stress was 63%, and the prevalence of severe stress was 25%. The prevalence of stress was higher ($p<0.5$) among females (75.7%) than among males (57%) (odds ratio=2.3, chi2=27.2, $p<0.0001$). The stress significantly decreased as the year of study increased, except for the final year. The study variables, including being female ($p<0.0001$), year of study ($p<0.001$), and presence of perceived physical problems ($p<0.0001$), were found as independent significant risk factors for the outcome variables of stress. Students' grade point average (academic score) or regularity to attend classes was not significantly associated with the stress level. The prevalence of stress was higher during the initial three years of study and among the female students. Physical problems are associated with high stress levels.

LIMITATIONS OF THE STUDY

- Sample size was relatively small and limited to one institution, which may affect the generalizability of results.
- Self-reported data on exercise habits may introduce reporting bias.
- The cross-sectional design does not establish causal relationships.
- Environmental factors, dietary habits, and academic stress levels, which may influence stress and cognition, were not controlled.

CONCLUSION

The current cross-sectional study demonstrates that regular physical exercise among medical students is associated with multiple health benefits. Students who engaged in regular exercise (Group I) exhibited significantly lower perceived stress levels, better cognitive performance, healthier body mass index, and improved lung function (as indicated by higher FVC and FEV_1 values) compared to their non-exercising counterparts (Group II). These findings underscore the importance of incorporating regular physical activity into the daily routines of medical students to promote overall mental, physical, and respiratory well-being. Encouraging exercise habits early in medical training may not only enhance academic performance but also foster long-term healthy lifestyle practices in future healthcare professionals.

ACKNOWLEDGEMENT

Authors sincerely thank all the medical students who participated in this study, as well as the faculty and staff of the Department of Physiology for their valuable support. We are grateful to the institutional ethics committee and technical staff for their assistance. Special thanks to Dr.
(Prof.) Rita Kumari, Head of the Department, Department of Physiology, Nalanda Medical College & Hospital, Patna, for providing the necessary facilities and encouragement throughout the study.

REFERENCES

1. Johnson JD, Barnard DF, Kulp AC, Mehta DM. Neuroendocrine regulation of brain cytokines after psychological stress. J Endocr Soc. 2019;3(7):1302-20.
2. Childs E, de Wit H. Regular exercise is associated with emotional resilience to acute stress in healthy adults. Front Physiol [Internet]. 2014;5:161. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4013452/.
3. Mandolesi L, Polverino A, Montuori S, Foti F, Ferraioli G, Sorrentino P, et al. Effects of physical exercise on cognitive functioning and wellbeing: Biological and psychological benefits. Front Psychol [Internet]. 2018;9:509. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5934999/.
4. Coban D. Investigation of the relationship between smartphone addiction and overweight

DOI: 10.69605/ijlbpr_14.2.2025.213

on university students. Ann Med Res. 2019;26(10):2172-76.
5. Kesavachandran C, Bihari V, Mathur N. Can physical activity maintain normal grades of body mass index and body fat percentage? Int J Yoga. 2009;2(1):26-29.
6. Cournot M, Marquié JC, Ansiau D, Martinaud C, Fonds H, Ferrières J, et al. Relation between body mass index and cognitive function in healthy middleaged men and women. Neurology [Internet]. 2006; 67(7):1208-14. Available from: https://pubmed.ncbi.nlm.nih.gov/17030754/.
7. Chen Y, Liu X, Yan N, Jia W, Fan Y, Yan H, et al. Higher academic stress was associated with increased risk of overweight and obesity among college students in China. Int J Environ Res Public Health [Internet]. 2020;17(15):5559. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7432099/.
8. Cheng YJ, Macera CA, Addy CL, Sy FS, Wieland D, Blair SN. Effects of physical activity on exercise tests and respiratory function. Br J Sports Med [Internet]. 2003;37(6):521-28. Available from: https://bjsm.bmj.com/content/37/6/521
9. Fernandes J, Arida RM, Gomez-Pinilla F. Physical exercise as an epigenetic modulator of brain plasticity and cognition. Neurosci Biobehav Rev [Internet]. 2017;80:443-56. Available from: https://www.ncbi.nlm. nih.gov /pubmed/28666827.
10. Raj S. A study on physical activity and stress levels among undergraduate medical students. J Med Sci Clin Res. 2018;6(3):663-68.
11. Nemati Karimooy H, Hosseini M, Nemati M, Esmaily HO. Lifelong physical activity affects mini mental state exam scores in individuals over 55 years of age. J Bodyw Mov Ther. 2012;16(2):230-35.
12. Freidl W, Schmidt R, Stronegger WJ, Irmler A, Reinhart B, Koch M. Mini Mental State Examination: Influence of sociodemographic, environmental and behavioural factors, and vascular risk factors. J Clin Epidemiol. 1996;49(1):73-78
13. Anki Reddy RR, Bharath T, Vageesh V. Comparison of Cognitive Performance, Stress, Body Mass Index, and Lung Functions in Exercising and Non- Exercising Medical Students: A Cross-sectional Study. Journal of Clinical & Diagnostic Research. 2024 Aug 1;18(8).
14. Salmon P. Effects of physical exercise on anxiety, depression, and sensitivity to stress: a unifying theory. *Clin Psychol Rev*. 2001;21(1):33–61.
15. Bunevicius A, et al. Stress and mental health among medical students. *Med Educ*. 2005;39(7):722–8.
16. Hillman CH, et al. The effect of acute treadmill walking on cognitive control and academic achievement in preadolescent children. *Neuroscience*. 2009;159(3):1044–1054.
17. Cotman CW, Berchtold NC. Exercise: a behavioral intervention to enhance brain health and plasticity. *Trends Neurosci*. 2002;25(6):295–301.
18. Warburton DE, Nicol CW, Bredin SS. Health benefits of physical activity: the evidence. *CMAJ*. 2006;174(6):801–809.
19. Fleg JL, et al. Effects of exercise training on pulmonary function in healthy older adults. *Chest*. 1994;106(3):837–843.
20. Bye PT, et al. Pulmonary function and maximal exercise tolerance in humans. *Am Rev Respir Dis*. 1983;127(6 Pt 2):S90–S94.
21. Pathan SS, Gottesman RF, Mosley TH, Knopman DS, Sharrett AR, Alonso A. Association of lung function with cognitive decline and dementia: The Atherosclerosis Risk in Communities (ARIC) Study. Eur J Neurol. 2011;18(6):888-98.
22. Abdulghani HM, AlKanhal AA, Mahmoud ES, Ponnamperuma GG, Alfaris EA. Stress and its effects on medical students: A cross-sectional study at a college of medicine in Saudi Arabia. J Health Popul Nutr [Internet]. 2011;29(5):516-22.