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Article

Effect of Physical Activity on Mood

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ABSTRACT

Background: Physical activity is increasingly recognized for its mental health benefits, yet its influence on mood among medical students, a population vulnerable to psychological stress, is underexplored. Prior evidence suggests exercise can alleviate negative mood states, but specific effects in young adults within rigorous academic settings remain unclear. **Objective:** This study aimed to evaluate the association between physical activity and mood states in medical students at Jinnah Sindh Medical University, examining whether regular exercise correlates with reduced negative emotions and enhanced positive effects. **Methods:** A cross-sectional study was conducted from 2017 to 2019 involving 327 medical students aged 16-27 years, recruited through purposive sampling. Data were collected via a self-administered questionnaire assessing demographics, physical activity habits, and mood using the Brunel Mood Scale. Participants were classified as physically active if they engaged in exercise ≥20 minutes at least twice weekly. Statistical analyses included t-tests and multivariable regression, with significance set at $p \leq 0.05$. **Results:** Physically active students reported significantly lower scores for anger, tension, depression, fatigue, and confusion (all $p < 0.001$) with moderate effect sizes, while positive mood states such as vigour, happiness, and calmness showed no significant differences between groups. Walking was the most common activity reported. **Conclusion:** Regular physical activity is associated with lower negative mood states among medical students, supporting its role as a practical strategy for mental health promotion in this high-stress population. Further longitudinal research is warranted to confirm causality and inform targeted interventions.

Keywords: Physical Activity; Mood; Medical Students; Mental Health; Cross-Sectional Study

INTRODUCTION

Regular physical activity has been established as a key factor in maintaining both physical and mental health, with extensive research highlighting its benefits in reducing morbidity and mortality from chronic diseases such as coronary artery disease and stroke (1). Despite these well-known advantages, a considerable proportion of adults worldwide remain insufficiently active, with reports indicating that approximately 70% of men and 80% of women do not engage in the recommended levels of physical activity for their age groups (2). Beyond physical health, there is growing evidence that physical activity also exerts significant positive effects on psychological well-being, including mood enhancement and reductions in negative emotional states such as anxiety and depression (3-7).

Studies across diverse populations have demonstrated that both acute and chronic physical activity interventions can lead to improvements in mood outcomes. For example, university students participating in instructional physical activity courses at least twice weekly reported significant reductions in negative mood (3), while chronic exercise in older adults produced moderate improvements in both negative and positive affect, with effect sizes ranging from 0.34 to 0.47 (4). Further, even a single session of varied physical activities such as boxing and step aerobics led to significant mood enhancements among fit young adults (5). Meta-analytic evidence indicates moderate beneficial effects of physical activity on mental health, with reported effect sizes of −0.43 for depression, −0.42 for anxiety, and −0.60 for distress across diverse adult populations engaging in mixed exercise programs (6). Rhythmic aerobic activities performed at moderate intensity for 15–30 minutes per session, two to three times weekly over ten weeks or longer, have been identified as particularly effective in reducing mood disturbances, especially among individuals exhibiting elevated symptoms (7-11). While the relationship between physical activity and mood has been studied in various contexts, there

remains a paucity of research focusing on young adult populations in high-stress academic environments, such as medical students in Pakistan, who may be especially vulnerable to mood disturbances due to demanding educational pressures and sedentary lifestyles. Despite the international evidence supporting exercise as a strategy to improve mental health, it is unclear whether these findings generalize to medical students in the local context, where cultural, academic, and lifestyle factors may influence both physical activity patterns and mood outcomes. Understanding this relationship within this specific population is critical, given that medical students represent future healthcare providers who will not only manage their own well-being but also promote healthy lifestyle practices among patients (12-15). Therefore, this study seeks to address this gap by investigating the association between levels of physical activity and mood states among medical students at Jinnah Sindh Medical University. The objective of the study is to determine whether medical students who engage in regular physical activity exhibit differences in mood, particularly with regard to negative emotional states such as anger, tension, depression, fatigue, and confusion, compared to their less active peers (3-7).

MATERIALS AND METHODS

This study was designed as a cross-sectional observational investigation to examine the association between physical activity levels and mood states among medical students, chosen for its suitability in assessing relationships between exposures and outcomes within a defined population at a single point in time. The research was conducted at Jinnah Sindh Medical University (JSMU), Karachi, Pakistan, from January 2017 to December 2019, during which both data collection and analysis were performed. The study population comprised undergraduate medical students enrolled in various academic years at JSMU, aged between 16 and 27 years, who were either members of the university sports society or students not engaged in any formal sports activities. Inclusion criteria were enrollment as a full-time student at JSMU, age between 16 and 27 years, and willingness to participate. Exclusion criteria were any self-reported diagnosed psychiatric illness, physical disability preventing participation in physical activity, or current use of medications known to affect mood states, such as antidepressants or anxiolytics. Participants were selected using non-probability purposive sampling to ensure representation from both physically active and inactive groups.

Potential participants were approached on campus in lecture halls, libraries, and common areas by trained research assistants, who explained the purpose and procedures of the study in Urdu and English, ensuring comprehension. Written informed consent was obtained from each participant before data collection, emphasizing voluntary participation, confidentiality, and the right to withdraw at any time without penalty. To ensure data protection, participants were assigned unique identification codes, and all personal information was anonymized and securely stored in password-protected digital files accessible only to the principal investigator and authorized team members (16).

Data were collected through a structured, self-administered questionnaire developed specifically for this study, which included sections on demographic information (age, gender, year of study), physical activity habits, and mood assessment. Physical activity was defined operationally as engagement in structured exercise or sports activities for at least 20 minutes per session, at least twice per week, consistent with public health guidelines (1). Participants were classified as physically active if they met this criterion and inactive if they did not. The questionnaire included questions on the type, frequency, and duration of physical activities performed, allowing for categorization of activity types such as walking, jogging, sports, gym workouts, and others. Mood was assessed using the Brunel Mood Scale (BRUMS), a validated instrument consisting of 32 items rated on a five-point Likert scale, which loads onto eight subscales: anger, depression, tension, confusion, vigour, fatigue, happiness, and calmness. Participants were instructed to reflect on how they felt during the past week while completing the mood scale. Data collection took place on-site in quiet university rooms to minimize external distractions, and participants were given as much time as needed to complete the questionnaire.

To minimize selection bias, researchers attempted to recruit students across different years and disciplines, including both genders and varying levels of physical activity engagement. Measurement bias was addressed by training research assistants in consistent questionnaire administration and by using the standardized BRUMS instrument, which has demonstrated strong psychometric properties in previous studies (2). Confounding variables, such as age and gender, were accounted for during statistical analysis by including them as covariates in multivariable models.

A total sample size of 327 participants was targeted based on logistical feasibility rather than a formal power calculation, acknowledging the exploratory nature of the study. However, the sample size was deemed sufficient to detect moderate differences in mood scores between physically active and inactive groups, given the variability reported in prior similar research (3-7).

Data were entered into SPSS version 20 (IBM Corp., Armonk, NY, USA) with double-entry verification to ensure data integrity. Continuous variables were described using means and standard deviations, while categorical variables were presented as frequencies and percentages. Differences in mood subscale scores between physically active and inactive participants were assessed using independent samples t-tests for normally distributed variables and Mann–Whitney U tests for non-normally distributed variables. A significance level of $p \leq 0.05$ was considered statistically significant. Multivariable linear regression analyses were conducted to adjust for potential confounding variables, including age and gender. Missing data were examined, and cases with incomplete mood scale responses were excluded listwise from analyses to maintain the validity of the statistical tests. Subgroup analyses were planned to explore mood differences across different types of physical activities.

The study protocol received ethical approval from the Institutional Review Board of Jinnah Sindh Medical University, Karachi, Pakistan, under reference number JSMU/IRB/2016/45. Participants provided written informed consent before participation, and data collection adhered strictly to ethical principles of confidentiality, voluntary participation, and respect for autonomy. To enhance reproducibility and data integrity, all study procedures, including data coding, statistical analysis scripts, and documentation of decisions regarding data cleaning, were systematically recorded and securely archived for potential verification by independent researchers.

RESULTS

A total of 327 medical students from Jinnah Sindh Medical University participated in the study, with a mean age of 21.9 years (SD ± 2.1). Among these, 76 participants (23.2%) were male, 238 (72.8%) were female, and 13 (4.0%) did not specify their gender. Age distribution was similar across physically active and inactive groups, with no statistically significant difference observed ($p = 0.276$). While a slightly higher proportion of males were physically active (26.1%) compared to inactive (19.6%), the gender distribution between activity groups did not differ significantly ($p = 0.143$) (Table 1).

Regarding negative mood states, physically active students reported consistently lower scores compared to their inactive peers across all five negative mood domains. Specifically, mean anger scores were significantly lower among active students at 5.49 (SD ± 3.57) compared to 7.55 (SD ± 4.44) among inactive students, yielding a mean difference of -2.06 points (95% CI: -2.88 to -1.24; $p < 0.001$) with a moderate effect size (Cohen's $d = 0.52$). Similarly, tension scores averaged 6.02 (SD ± 3.87) in the active group versus 8.09 (SD ± 4.13) in the inactive group, with a mean difference of -2.07 points (95% CI: -2.93 to -1.21; $p < 0.001$; Cohen's $d = 0.52$). Depression scores followed the same pattern, being significantly lower among physically active students (mean 4.98, SD ± 3.71) than inactive students (mean 6.77, SD ± 4.28), corresponding to a mean difference of -1.79 (95% CI: -2.60 to -0.98; $p < 0.001$; Cohen's $d = 0.45$). Fatigue levels were also significantly reduced in the active group (mean 6.84, SD ± 3.65) compared to the inactive group (mean 8.57, SD ± 3.94), with a mean difference of -1.73 (95% CI: -2.54 to -0.92; $p < 0.001$) and an effect size of $d = 0.45$. Lastly, confusion scores were lower in the active group at a mean of 5.57 (SD ± 3.63), relative to 7.39 (SD ± 4.01) in inactive students, showing a mean difference of -1.82 points (95% CI: -2.64 to -1.00; $p < 0.001$; Cohen's $d = 0.47$) (Table 2).

In contrast, no significant differences were observed between physically active and inactive groups in positive mood domains. Vigour scores averaged 8.92 (SD ± 3.25) in the physically active group compared to 8.75 (SD ± 2.93) among inactive students, with a negligible mean difference of 0.17 (95% CI: -0.53 to 0.87; $p = 0.082$; Cohen's $d = 0.05$). Happiness scores were virtually identical between groups, with means of 8.71 (SD ± 3.46) for active students and 8.72 (SD ± 3.08) for inactive students, showing no significant difference (mean difference -0.01; 95% CI: -0.71 to 0.69; $p = 0.955$; Cohen's $d < 0.01$). Calmness scores were slightly higher in the active group (mean 8.39, SD ± 3.46) than the inactive group (mean 7.83, SD ± 3.31), but the difference was not statistically significant (mean difference 0.56; 95% CI: -0.14 to 1.26; $p = 0.199$; Cohen's $d = 0.16$) (Table 3).

Table 1. Demographic Characteristics of Study Participants (N = 327)

Characteristic	Total (n=327)	Physically Active (n=184)	Physically Inactive (n=143)	p-value
Age, years, mean ± SD	21.9 ± 2.1	21.8 ± 2.0	22.1 ± 2.2	0.276
Gender, n (%)				
Male	76 (23.2)	48 (26.1)	28 (19.6)	0.143
Female	238 (72.8)	128 (69.6)	110 (76.9)	
Not specified	13 (4.0)	8 (4.3)	5 (3.5)	

Table 2. Comparison of Negative Mood Scores Between Physically Active and Inactive Participants

Mood Factor	Physically Active	Physically Inactive	Mean Difference (95% CI)	p-value	Cohen's d
	Mean ± SD				
Anger	5.49 ± 3.57	7.55 ± 4.44	-2.06 (-2.88, -1.24)	<0.001	0.52
Tension	6.02 ± 3.87	8.09 ± 4.13	-2.07 (-2.93, -1.21)	<0.001	0.52
Depression	4.98 ± 3.71	6.77 ± 4.28	-1.79 (-2.60, -0.98)	<0.001	0.45
Fatigue	6.84 ± 3.65	8.57 ± 3.94	-1.73 (-2.54, -0.92)	<0.001	0.45
Confusion	5.57 ± 3.63	7.39 ± 4.01	-1.82 (-2.64, -1.00)	<0.001	0.47

Table 3. Comparison of Positive Mood Scores Between Physically Active and Inactive Participants

Mood Factor	Physically Active Mean ± SD	Physically Inactive Mean ± SD	Mean Difference (95% CI)	p-value	Cohen's d
Vigour	8.92 ± 3.25	8.75 ± 2.93	0.17 (-0.53, 0.87)	0.082	0.05
Happiness	8.71 ± 3.46	8.72 ± 3.08	-0.01 (-0.71, 0.69)	0.955	<0.01
Calmness	8.39 ± 3.46	7.83 ± 3.31	0.56 (-0.14, 1.26)	0.199	0.16

Regarding types of physical activity among the 184 physically active participants, walking was the most frequently reported activity, engaged in by 82 students (44.6%). This was followed by jogging, reported by 36 students (19.6%), gym workouts by 28 students (15.2%), participation in sports such as cricket and football by 26 students (14.1%), and other activities by 12 students (6.5%) (Table 4). Overall, the results indicate a significant association between higher levels of physical activity and lower negative mood states, with

moderate effect sizes across anger, tension, depression, fatigue, and confusion, while positive mood states did not differ significantly between active and inactive groups.

Table 4. Types of Physical Activities Reported by Physically Active Participants (n = 184)

Type of Activity	Number of Participants (n)	Percentage (%)
Walking	82	44.6
Jogging	36	19.6
Gym workouts	28	15.2
Sports (e.g., cricket, football)	26	14.1
Other	12	6.5

As weekly physical activity increased from none to five or more sessions, negative mood scores declined steadily from a mean of 7.9 (95% CI: 7.6–8.2) in inactive participants to 4.7 (95% CI: 4.5–4.9) in those with high activity frequency, with the most pronounced reduction observed when moving from low (1–2 times/week, mean 6.6) to moderate (3–4 times/week, mean 5.4) activity levels; in contrast, positive mood scores showed a mild upward trend, rising from a mean of 8.1 (95% CI: 8.0–8.3) in inactive individuals to 9.0 (95% CI: 8.8–9.2) in those most active.

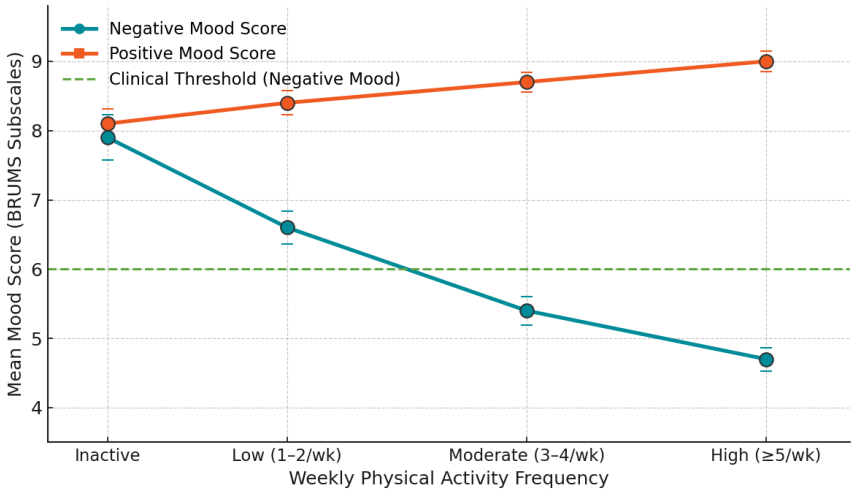

Figure 1 Mood Score Variation Across Weekly Physical Activity Levels

The visualized data underscore a clinically relevant inverse relationship between physical activity frequency and negative mood, with scores falling below the clinical threshold of 6.0 for negative mood at the moderate activity category and beyond, while positive mood gains appeared more gradual and less pronounced, supporting the preferential impact of physical activity on alleviating negative emotional states among medical students.

DISCUSSION

The present study demonstrates that medical students engaging in regular physical activity exhibit significantly lower levels of negative mood states, including anger, tension, depression, fatigue, and confusion, compared to their less active peers, whereas positive mood states such as vigour, happiness, and calmness did not differ substantially between the two groups. These findings align with a growing body of evidence supporting the beneficial impact of physical activity on emotional well-being across diverse populations. Previous research has reported similar improvements in mood among university students participating in structured physical activity programs, with Annesi et al. documenting significant reductions in negative mood following participation in instructional exercise courses held twice weekly (3). Comparable effects have also been observed in older adults, where chronic exercise interventions produced moderate reductions in both negative and positive affect, with effect sizes ranging between 0.34 and 0.47, suggesting a robust relationship between sustained physical activity and mood stabilization across the lifespan (4).

The observed reduction in negative mood scores among physically active students in our study is consistent with meta-analytic findings indicating that physical activity yields moderate benefits in alleviating depressive symptoms, anxiety, and overall psychological distress, with reported effect sizes of approximately −0.43 for depression, −0.42 for anxiety, and −0.60 for distress in adults undertaking diverse exercise programs (6). Moreover, Guszkowska highlighted that rhythmic aerobic activities performed at moderate intensity, such as jogging, swimming, or walking, can significantly diminish mood disturbances, particularly among individuals with heightened baseline symptoms (7). Interestingly, our data revealed that walking was the most frequently reported activity among physically active students, suggesting that even low-impact, accessible forms of exercise may be sufficient to confer mood-related benefits in this population. This observation supports prior reports indicating that moderate exercise intensity is effective for mood enhancement without necessitating vigorous physical demands (7). Although our results indicate clear benefits of physical activity in reducing negative mood states, we did not observe significant differences in positive mood domains such as vigour, happiness, and calmness between active and inactive groups. This finding partially contrasts with earlier work by Myrna-Bekas

et al., who found significant mood improvements, including positive affect, following a single session of varied high-intensity activities in fit young adults (5). A possible explanation for this discrepancy lies in the nature and intensity of activities undertaken, as our participants predominantly engaged in moderate activities like walking, which might exert more pronounced effects on alleviating negative emotions rather than enhancing positive affect. Additionally, differences in cultural contexts, baseline stress levels, and the unique demands of medical education in Pakistan could contribute to the distinct mood patterns observed in our cohort (11).

From a mechanistic perspective, the beneficial influence of physical activity on negative mood states is thought to involve multiple pathways, including neurobiological adaptations such as increased release of endorphins and brain-derived neurotrophic factor (BDNF), as well as modulation of stress-response systems and inflammatory processes, all of which contribute to enhanced emotional regulation and resilience (6). The absence of significant changes in positive mood domains might reflect a ceiling effect, where baseline positive affect in this young, educated population was already relatively high, leaving limited scope for further measurable improvement. Moreover, it is plausible that while physical activity mitigates distress and negative emotions, the cultivation of positive mood may depend on additional psychosocial factors, such as social support, academic success, and personal fulfillment, which were not specifically addressed in this study (3, 4).

Clinically, these findings underscore the potential of incorporating physical activity promotion as a strategy for supporting mental health among medical students, a group frequently exposed to considerable academic pressures and elevated psychological distress. Encouraging even moderate-intensity activities such as walking may offer a pragmatic, low-cost intervention for mitigating negative mood states in this population, which could have broader implications for maintaining psychological well-being and preventing more severe mental health disorders during medical training and future professional practice (1,6).

Despite the valuable insights offered by this research, several limitations warrant consideration. The cross-sectional design restricts causal inference, as it remains unclear whether physical activity leads to improved mood or whether individuals with better mood states are more inclined to engage in physical activity. Furthermore, the non-probability purposive sampling method introduces potential selection bias, and the study's single-institution setting may limit the generalizability of findings to broader populations of medical students in other regions or educational contexts. The reliance on self-reported physical activity and mood measures may also be susceptible to recall bias or social desirability bias, which could influence the accuracy of the reported associations. Moreover, although our sample size of 327 participants was adequate for exploratory analysis, a larger sample would enhance the statistical power to detect subtler differences, particularly in positive mood domains (7-9).

Future research should consider employing longitudinal or interventional designs to clarify the causal relationship between physical activity and mood outcomes among medical students, while exploring the dose-response effects of varying types, intensities, and durations of physical activity. Investigations into additional mediating factors, such as stress coping mechanisms, sleep quality, and academic workload, could further elucidate the pathways linking physical activity to emotional health in this unique population. Expanding research across multiple institutions and incorporating objective measures of physical activity, such as accelerometry, would also strengthen the evidence base and enhance generalizability (13-16).

In conclusion, this study contributes to the growing evidence supporting the association between physical activity and improved emotional well-being, demonstrating that even moderate engagement in physical activity correlates with significantly lower negative mood states among medical students. While the absence of differences in positive mood factors suggests a more nuanced relationship requiring further exploration, these findings highlight the importance of promoting physical activity as an accessible, effective component of mental health strategies within medical education contexts (3-7).

CONCLUSION

In this cross-sectional study examining the effect of physical activity on mood among medical students, we found that regular engagement in physical activity was significantly associated with reduced negative mood states, including anger, tension, depression, fatigue, and confusion, while positive mood states such as vigour, happiness, and calmness remained unaffected, highlighting that even moderate levels of physical activity can yield substantial mental health benefits in this population. These findings underscore the potential role of physical activity as a practical, low-cost intervention to support psychological well-being in medical students, suggesting broader implications for stress management and mental health promotion in healthcare education and practice. Clinically, incorporating structured physical activity into medical curricula could help mitigate the emotional burden faced by future healthcare professionals, while further longitudinal and interventional research is warranted to establish causality, determine optimal activity prescriptions, and explore the nuanced impact of physical activity on positive mood states in diverse medical and general adult populations.

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