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PHYSICAL ACTIVITY AND COGNITIVE DEFICITS AMONG UNIVERSITY STUDENTS IN PAKISTAN

Original Research

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ABSTRACT

Background: Physical activity is widely recognized as a protective factor against cognitive decline, with extensive international evidence linking exercise to improved memory, attention, and executive functioning. However, in Pakistan, research exploring the relationship between physical activity and cognitive outcomes remains scarce, particularly among university students, who represent a critical population for future societal development. Understanding this relationship within the local context is essential to inform culturally relevant health and education strategies.

Objective: The objective of this study was to examine the relationship between physical activity and cognitive deficits among Pakistani university students aged 20–30 years, with a focus on gender and educational level differences.

Methods: A cross-sectional correlational design was employed, and purposive sampling was used to recruit 384 university students, all of whom were citizens and residents of Pakistan. Physical activity was measured using the International Physical Activity Questionnaire–Short Form (IPAQ-SF; 7 items), while cognitive deficits were assessed using the Cognitive Assessment Questionnaire (CAQ; 25 items). Ethical approval was obtained, and informed consent was secured from all participants. Data were analyzed using SPSS version 26, with descriptive statistics, Pearson's correlation, regression analysis, and independent-samples t tests applied to test the study hypotheses.

Results: The mean age of participants was 23.42 years (SD = 3.11), with 202 enrolled at the bachelor's level (53%) and 182 at the master's level (47%). The sample included 195 men (51%) and 189 women (49%). Physical activity had a mean score of 28.82 (SD = 14.07), while cognitive deficits had a mean score of 65.45 (SD = 24.49). Correlational analysis revealed a significant negative association between physical activity and cognitive deficits ($r = –0.42$, $p < .05$). Regression analysis confirmed that physical activity significantly predicted cognitive deficits ($B = –0.73$, $\beta = –0.42$, $p < .001$), explaining 17% of the variance. Group comparisons showed that women reported lower physical activity ($M = 27.75$, $SD = 14.29$) and higher cognitive deficits ($M = 67.01$, $SD = 24.43$) compared to men ($M = 29.92$, $SD = 13.79$; $M = 63.85$, $SD = 24.51$), though differences were not statistically significant ($p > .05$). Similarly, bachelor's students reported higher physical activity ($M = 29.33$, $SD = 13.39$) and cognitive deficits ($M = 67.34$, $SD = 23.34$) compared to master's students ($M = 28.24$, $SD = 14.81$; $M = 63.36$, $SD = 25.60$), without statistical significance ($p > .05$).

Conclusion: The study demonstrated that higher levels of physical activity were significantly associated with lower cognitive deficits among Pakistani university students. These findings highlight the importance of promoting physical activity as a protective factor for cognitive health and academic performance, and they call for gender-sensitive and culturally adapted interventions to encourage participation in physical activity.

Keywords: Cognition, Cognitive Dysfunction, Exercise, Mental Health, Pakistan, Students, Universities.

INTRODUCTION

Physical activity encompasses all forms of bodily movement that engage skeletal muscles and require energy expenditure beyond resting levels, ranging from daily activities such as walking, gardening, and yoga to structured exercises like running and swimming (1,2). Alongside its well-recognized role in promoting physical health, increasing attention has been directed towards its potential influence on brain health and cognitive functioning. Cognitive function refers to a spectrum of processes that include perceiving, processing, and responding to information, as well as decision-making and problem-solving (3,4). When impairments occur across these domains, they are broadly categorized as cognitive deficits, which may manifest as forgetfulness, poor attention, reduced executive functioning, or difficulties performing routine tasks. These deficits are more commonly observed in advancing age due to neurobiological changes, but they can also impact younger populations (5-7). Over the past two decades, growing evidence has highlighted a negative association between physical activity and cognitive decline. Studies suggest that regular engagement in physical activity supports healthier cognitive aging, mitigates age-related decline, and enhances specific domains such as memory, executive function, and processing speed. For instance, reviews and systematic analyses across different populations consistently indicate that habitual physical activity contributes to improved or maintained cognitive function, particularly in older adults, with some evidence pointing to a dose–response effect (8-11). Similarly, research involving younger and middle-aged adults has demonstrated benefits of both acute and long-term physical activity interventions, improving attention, flexibility, and working memory (12). In children and adolescents, sports participation has also been linked with cognitive and emotional development, though the effects of specific sports remain underexplored (13).

Several theoretical models provide mechanistic insights into these associations. The Neuroplasticity Theory emphasizes the role of exercise in fostering neuronal growth, strengthening synaptic connectivity, and enhancing neurotransmitter activity, all of which benefit learning and memory (14). The Cardiovascular Fitness Hypothesis posits that physical activity improves cerebral perfusion and oxygenation, thereby optimizing brain performance (15). Meanwhile, the Cognitive Reserve Theory suggests that sustained physical activity builds a protective cognitive buffer, enabling individuals to better withstand aging or pathological stressors (16). Collectively, these perspectives underscore the multidimensional pathways through which physical activity may influence cognition. Despite robust international evidence, research in the Pakistani context remains limited and somewhat inconsistent. While some studies have reported significant links between physical activity and cognitive or non-cognitive skills among university students, others found negligible associations, suggesting that cultural and contextual factors may shape these outcomes (17,18). This knowledge gap highlights the importance of localized studies that consider cultural, social, and lifestyle determinants, as findings from Western or regional literature may not fully capture the unique experiences of Pakistani populations. In light of these considerations, the present study seeks to examine the relationship between physical activity and cognitive deficits among Pakistani university students aged 18 years and above. By addressing this gap, the study aims to provide culturally relevant insights into whether physical activity contributes to cognitive health within this population and to inform future interventions promoting both physical and mental well-being.

METHODS

The study employed a cross-sectional correlational research design to investigate the association between physical activity and cognitive deficits among university students in Pakistan. A purposive sampling strategy was used to recruit 384 participants, all of whom were Pakistani citizens and residents between the ages of 20 and 30 years. Individuals with a prior diagnosis of neurocognitive or neurodegenerative disorders were excluded to minimize potential confounding effects. This inclusion and exclusion framework ensured that the sample represented a healthy young adult population suitable for examining the study objectives. Data collection involved the administration of two standardized instruments. Physical activity was assessed using the International Physical Activity Questionnaire–Short Form (IPAQ-SF), which consists of seven items rated on a seven-point Likert scale ranging from 1 (never) to 7 (very often). Item 5 is reverse scored, and higher cumulative scores reflect greater levels of physical activity. The IPAQ-SF has demonstrated acceptable internal consistency, with a Cronbach's alpha coefficient of 0.80 (9). Cognitive deficits were measured using the Cognitive Assessment Questionnaire (CAQ), developed by Broadbent and colleagues. This instrument comprises 25 items rated on a five-point Likert scale ranging from 0 (never) to 4 (very often). Higher scores correspond to greater levels of cognitive impairment. The CAQ has been widely validated, with Cronbach's alpha values reported between 0.88 and 0.93, indicating strong reliability (12).

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Prior to data collection, ethical approval was obtained from Institutional Review Board (IRB) of the relevant institute in accordance with the American Psychological Association (APA) 7th edition ethical guidelines. Participants were recruited from diverse academic institutions, including schools, colleges, and universities. Each participant was provided with an information sheet and a written informed consent form, which emphasized voluntary participation, anonymity, confidentiality of responses, and the right to withdraw at any stage without negative repercussions. Following consent, participants completed a brief demographic questionnaire along with the study instruments. The entire process required approximately 25 minutes. Data were coded and entered into IBM SPSS Statistics version 26 for analysis. Descriptive statistics were computed to summarize demographic variables and scale scores, while correlational analyses were performed to assess the relationship between physical activity and cognitive deficits. Additional inferential tests such as regression analysis and group comparisons were planned to examine predictive associations and differences between subgroups where applicable. Statistical significance was set at $p < 0.05$.

RESULTS

The study included 384 participants with a mean age of 23.42 years (SD = 3.11). Slightly more than half of the respondents were enrolled in bachelor's programs (n = 202, 53%), while the remaining were master's students (n = 182, 47%). Gender distribution was nearly equal, with 195 men (51%) and 189 women (49%). The analysis revealed that physical activity was significantly and negatively correlated with cognitive deficits ($r = –0.42$, $p < .05$). The mean score for physical activity was 28.82 (SD = 14.07), whereas the mean score for cognitive deficits was 65.45 (SD = 24.49). Regression analysis demonstrated that physical activity significantly predicted cognitive deficits, with higher physical activity scores associated with lower cognitive deficits ($B = –0.73$, $\beta = –0.42$, $p < .001$). The model accounted for 17% of the variance in cognitive deficits ($R^2 = 0.17$), and the overall model fit was statistically significant ($F = 81.62$, $p < .001$). The 95% confidence interval for the regression coefficient ranged from –0.88 to –0.57. Further subgroup analyses were conducted by gender and educational level. Women reported lower physical activity scores (M = 27.75, SD = 14.29) compared to men (M = 29.92, SD = 13.79), whereas women reported higher cognitive deficits (M = 67.01, SD = 24.43) compared to men (M = 63.85, SD = 24.51). However, these differences were not statistically significant ($p > .05$). Similarly, bachelor's students reported slightly higher levels of physical activity (M = 29.33, SD = 13.39) and cognitive deficits (M = 67.34, SD = 23.34) than master's students (M = 28.24, SD = 14.81; M = 63.36, SD = 25.60, respectively). These differences were also not statistically significant ($p > .05$). Overall, the results suggested that physical activity was significantly associated with reduced cognitive deficits in young adults, and regression modeling confirmed its predictive role. However, no statistically significant differences were observed when comparing groups by gender or educational level.

Table 1: Demographic Characteristics (N=384)

Characteristics	Frequency	Percentage	Mean	Standard Deviation
Educational Level				
Bachelor	202	53		
Master	182	47		
Age			23.42	3.11
Gender				
Men	195	51		
Women	189	49		

Table 2: Correlational Analysis (N=384)

Variables	1	2	Mean	Standard Deviation
1.Physical activity	-	-.42*	28.82	14.07
2.Cognitive Deficits		-	65.45	24.49

Note. *$p<.05$

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Table 3: Regression Analysis (N=384)

Variables	B	SE	β	R^2	△ R^2	F	P	95% CI	
								LL	UL
				.42	.17	81.62			
Constant	86.49	2.59					.001	81.40	91.58
PA	-.73	.08	-.42				.001	-.88	-.57

Note. ****p<.001, PA= Physical Activity*

Table 4: Gender Difference between Study Variables (N=384)

	Women(n=195)		Men (n=189)				
Variables	*M*	*SD*	*M*	*SD*	*t* (382)	*P*	Cohen's d
Physical activity	27.75	14.29	29.92	13.79	-1.51	.13	0.15
Cognitive Deficits	67.01	24.43	63.85	24.51	1.29	.20	0.12

Note. *M*= Mean, *SD*= Standard Deviation

Table 5: Difference in Educational Level of Respondents between Study Variables (N=384)

	Bachelor (n=202)		Master (n=182)				
Variables	*M*	*SD*	*M*	*SD*	*t* (382)	*P*	Cohen's d
Physical Activity	29.33	13.39	28.24	14.81	.75	.45	0.07
Cognitive Deficits	67.34	23.34	63.36	25.60	1.58	.11	0.16

Note. *M*= Mean, *SD*= Standard Deviation

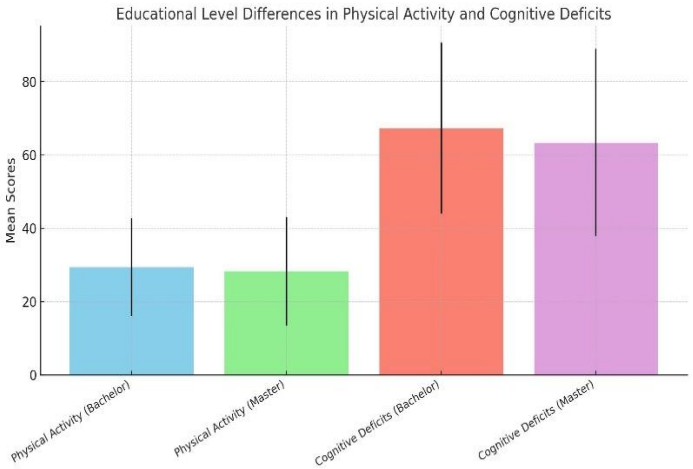

Figure 2 Educational Level Differences in Physical Activity and Cognitive Deficits

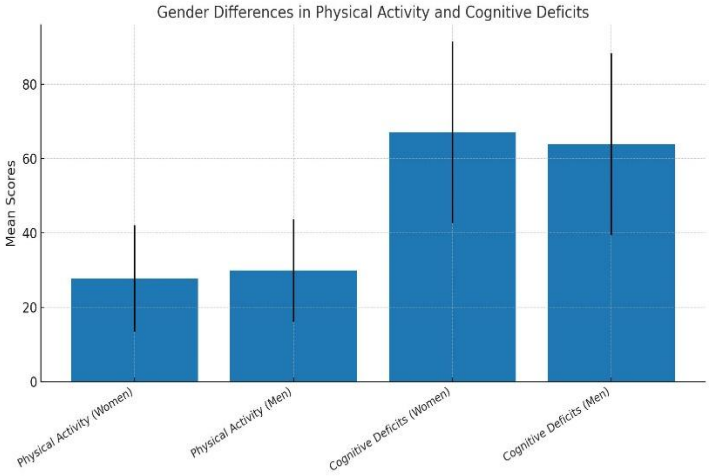

Figure 2 Gender Distribution in Physical Activity and Cognitive Deficits

DISCUSSION

The present study explored the association between physical activity and cognitive deficits among Pakistani university students, adding to the limited body of literature within this context. The findings demonstrated a significant negative correlation between physical activity and cognitive deficits, indicating that greater engagement in physical activity was linked to fewer cognitive impairments and, consequently, better cognitive performance. Regression analysis further established physical activity as a significant predictor of cognitive deficits, explaining 17% of the variance. These results aligned with global evidence suggesting that physical activity supports neurocognitive processes through mechanisms such as improved cerebral blood flow, enhanced neuroplasticity, and reduced stress-

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related impairments (17,18). The study's findings were in line with prior reviews and meta-analyses reporting positive effects of physical activity on executive functioning, memory, and processing speed. Consistency across these studies strengthens the argument that engagement in regular physical activity contributes to cognitive resilience (19,20). However, the present results also highlighted the contextual differences in Pakistan, where lifestyle factors and cultural constraints may influence participation in physical activity, particularly among female students. The observation that women scored lower in physical activity but higher in cognitive deficits compared to men, though not statistically significant, reflected broader gender-related disparities in opportunities for exercise (21). These outcomes underscored the importance of considering cultural and social determinants when designing interventions aimed at enhancing student health. Similarly, the comparison between bachelor's and master's students revealed only minor differences in physical activity and cognitive deficits, suggesting that age or academic level did not exert a substantial influence within this sample. It is possible that shared academic pressures, irregular sleep routines, and stress-related factors across both groups contributed to the lack of significant differences (22). These findings support the argument that, beyond demographic factors, lifestyle and psychosocial variables may play a critical role in shaping the relationship between physical activity and cognition.

A major strength of this study was its focus on university students in Pakistan, a population for which little empirical data exist despite the importance of cognitive functioning for academic achievement and professional development. The use of standardized, psychometrically validated tools such as the IPAQ-SF and CAQ enhanced the reliability of measurement. The relatively balanced sample across gender and educational levels also provided a more representative perspective on this age group. Nevertheless, certain limitations must be acknowledged. The cross-sectional design restricted the ability to infer causality, and self-reported measures introduced potential recall and social desirability biases. Moreover, relevant confounders such as dietary patterns, sleep quality, and psychological stress were not measured, which may have influenced the observed outcomes. The recruitment strategy was also limited to purposive sampling, potentially restricting the generalizability of the findings. Additionally, although the study referenced cultural and contextual influences in its rationale, these variables were not directly examined through statistical moderation or mediation, which represented a missed opportunity to address the research objective more comprehensively. Future research should employ longitudinal or experimental designs to establish causal pathways between physical activity and cognitive performance (23). Incorporating objective methods, such as actigraphy or fitness trackers, could yield more accurate assessments of physical activity levels. Broader samples that include not only university students but also adolescents and older adults could provide a more comprehensive understanding of developmental and cultural influences. Intervention-based approaches would further clarify whether structured exercise programs can reliably enhance cognitive outcomes in different population subgroups. The implications of these findings are relevant for public health policy and higher education. Promoting physical activity within university settings has the potential to improve not only cognitive outcomes but also general well-being and academic achievement. The observed gender disparities highlighted the necessity of culturally sensitive programs that provide safe and equitable opportunities for women to engage in physical activity. Embedding physical activity promotion into institutional policies and health campaigns could serve as a preventive strategy to protect cognitive health and optimize student performance in academic and professional domains.

CONCLUSION

The study concluded that physical activity played a meaningful role in reducing cognitive deficits among university students in Pakistan, underscoring its importance for maintaining cognitive health in young adults. By highlighting the inverse relationship between these two variables, the research emphasized that promoting regular physical activity may serve as a practical strategy to enhance cognitive performance and overall well-being in academic settings. The findings further pointed to the need for culturally sensitive and inclusive interventions, particularly to address gender-related barriers that limit participation in physical activity. This work contributes to the growing evidence that integrating physical activity into daily routines is not only vital for physical health but also critical for supporting mental sharpness and academic success.

AUTHOR CONTRIBUTION

Author	Contribution
Muhammad Sajjad Shahid*	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Maryam Amin Awan	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Rafia Tuz Zahra	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Sehrish Naseem	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published

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