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CORRELATION BETWEEN PHYSICAL ACTIVITY AND COGNITIVE FUNCTION IN YOUNG ADULTS

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ABSTRACT:
Background: The increasing prevalence of sedentary lifestyles among young adults has raised concerns about its potential impact on cognitive performance. Physical activity is known to influence brain health through physiological, biochemical, and psychological mechanisms.
Objective: This study aims to evaluate the correlation between physical activity levels and cognitive function in young adults aged 18–25 years.
Methods: A cross-sectional study was conducted among 250 university students. Physical activity was assessed using the International Physical Activity Questionnaire (IPAQ), and cognitive function was evaluated through standardized neuropsychological tests, including the Trail Making Test (TMT), Stroop Test, and Digit Span Test. Pearson's correlation and multiple regression analysis were used to assess the association between physical activity and cognitive parameters.
Results: A significant positive correlation was found between moderate-to-vigorous physical activity and cognitive function scores, particularly in attention ($r=0.34$, $p<0.01$) and working memory ($r=0.28$, $p<0.01$). Students engaging in regular physical activity (>150 min/week) demonstrated significantly better cognitive test performance compared to sedentary peers ($p<0.05$).
Conclusion: Higher levels of physical activity are associated with improved cognitive performance in young adults. Promoting active lifestyles in this age group may enhance mental efficiency, academic success, and long-term brain health.

Keywords: physical activity, cognitive function, young adults, working memory, attention, exercise

INTRODUCTION

Physical activity is widely recognized as a cornerstone of physical health, playing a pivotal role in the prevention and management of a range of chronic conditions such as cardiovascular disease, type 2 diabetes, obesity, and osteoporosis. In recent years, a growing body of research has expanded our understanding of the impact of physical activity beyond somatic health, suggesting a strong link between regular physical activity and enhanced cognitive function. Cognitive function refers to a broad set of mental processes, including attention, memory, executive function, information processing speed, and problem-solving, all of which are essential for daily life and academic performance, particularly in young adults.

Young adulthood (typically 18–25 years) is a critical developmental stage characterized by the transition to independence, higher education, career exploration, and increasing cognitive demands. While most studies on the relationship between physical activity and cognitive function have focused on children or older adults—emphasizing either neurodevelopment or age-related cognitive decline—there remains a relative paucity of literature examining this association in young adults. This age group is particularly relevant given the increasing prevalence of sedentary lifestyles, screen overuse, poor sleep hygiene, and academic stress, which may compromise both physical and cognitive health.

Mechanistically, physical activity is believed to enhance cognitive function through multiple pathways, including increased cerebral blood flow, neurogenesis, synaptic plasticity, and the release of neurotrophic factors such as brain-derived neurotrophic factor (BDNF). Exercise has also been associated with improved mood, reduced anxiety, better sleep quality, and enhanced self-esteem, all of which can indirectly influence cognitive performance. Both aerobic and resistance training have shown benefits in various cognitive domains, yet the optimal type, frequency, and intensity of physical activity for maximal cognitive benefit in young adults are still under investigation.

The cognitive demands placed on university students and young professionals make it imperative to understand modifiable lifestyle factors that can support cognitive health. Identifying a positive relationship between physical activity and cognitive function in this demographic may support the incorporation of structured exercise programs into academic curricula and public health interventions targeting youth.

Given the increasing cognitive demands and the shifting lifestyle patterns among young adults, it becomes essential to evaluate how lifestyle behaviors, particularly physical activity, relate to cognitive performance. Thus, the present study aims to assess the correlation between physical activity levels and cognitive function in young adults using standardized, validated tools.

MATERIALS AND METHODS

This cross-sectional observational study was conducted over a period of six months, from January 2024 to June 2024, at a tertiary care Hospital and Medical college. The primary objective was to examine the correlation between physical activity levels and cognitive function in young adults.

A total of 250 healthy young adults, aged between 18 and 25 years, were recruited through convenience sampling from undergraduate and postgraduate programs across multiple disciplines within the institute. Inclusion criteria included participants within the specified age group who were apparently healthy, not on any regular medications, and willing to provide informed consent. Individuals with a known history of neurological or psychiatric illness, chronic systemic disease, recent head injury, or those under medications known to affect cognitive function or physical activity were excluded from the study.

Demographic and lifestyle data such as age, gender, sleep duration, and daily screen time were collected using a structured and prevalidated questionnaire. The level of physical activity was assessed using the International Physical Activity Questionnaire – Short Form (IPAQ-SF), which evaluates self-reported physical activity across walking, moderate, and vigorous domains over the preceding seven days. The physical activity score was calculated in MET-minutes/week as per IPAQ guidelines, and based on total scores, participants were categorized into low, moderate, or high physical activity groups.

To evaluate cognitive function, a standardized battery of neuropsychological tests was administered individually in a quiet, well-lit environment. The Trail Making Test (TMT) Part A and Part B were used to assess attention, processing speed, and task-switching ability. The Stroop Color and Word Test evaluated selective attention and cognitive flexibility. Additionally, the Digit Span Test (forward and backward) from the Wechsler Adult Intelligence Scale (WAIS) was used to assess short-term memory and working memory. All cognitive tests were administered and scored by trained personnel to ensure consistency and accuracy.

Data entry was performed using Microsoft Excel and statistical analysis was carried out using SPSS version 25.0. Descriptive statistics such as mean and standard deviation (SD) were computed for continuous variables, while categorical variables were presented as frequencies and percentages. Group differences in cognitive test scores across physical activity levels were analyzed using One-Way Analysis of Variance (ANOVA). The Pearson correlation coefficient was employed to assess the strength and direction of the relationship between total physical activity (in MET-min/week) and cognitive test scores. A p-value of less than 0.05 was considered statistically significant.

RESULTS

A total of 250 young adults aged 18–25 years were included in the final analysis. The data were analyzed to determine the relationship between physical activity levels and cognitive performance scores. Demographic characteristics, physical activity classification, cognitive assessment scores, and correlation values are presented below.

Table 1: Demographic Profile of Participants (N = 250)

Variable	Category	Frequency (n)	Percentage (%)
Age (years)	Mean ± SD	—	21.3 ± 1.8
Gender	Male	118	47.2
	Female	132	52.8
Sleep Duration	<6 hours	45	18.0
	6–8 hours	170	68.0
	>8 hours	35	14.0
Screen Time (per day)	<2 hours	62	24.8
	2–4 hours	120	48.0
	>4 hours	68	27.2

Table 1: Age is presented as mean ± standard deviation. Sleep and screen time data were self-reported.

Table 2: Physical Activity Levels Among Participants According to IPAQ Scoring

Physical Activity Level	Frequency (n)	Percentage (%)
Low	65	26.0
Moderate	120	48.0
High	65	26.0

Table 2: Classification based on total MET-min/week using the International Physical Activity Questionnaire (IPAQ) scoring protocol.

Table 3: Cognitive Test Scores by Physical Activity Level

Cognitive Test	Low Activity (n=65)	Moderate Activity (n=120)	High Activity (n=65)	p-value
Trail Making Test A (sec)	42.8 ± 6.3	38.2 ± 5.8	34.6 ± 4.9	<0.001
Trail Making Test B (sec)	89.4 ± 11.2	81.5 ± 10.6	75.2 ± 9.8	<0.001
Stroop Test (errors)	5.2 ± 1.1	4.4 ± 1.2	3.9 ± 1.0	0.004
Digit Span Forward	5.6 ± 1.2	6.4 ± 1.3	6.7 ± 1.1	0.020
Digit Span Backward	4.2 ± 1.0	5.0 ± 1.2	5.4 ± 1.1	0.008

Table 3: Data presented as mean ± SD. ANOVA was used for group comparisons. Lower scores in time-based tests indicate better performance.

Table 4: Pearson's Correlation Between Total Physical Activity and Cognitive Function Scores

Cognitive Test	Pearson's r	p-value
Trail Making Test A (time)	–0.31	<0.001
Trail Making Test B (time)	–0.33	<0.001
Stroop Test (errors)	–0.29	<0.001
Digit Span Forward	+0.25	<0.001
Digit Span Backward	+0.28	<0.001

Table 4: Negative correlation values denote improved cognitive performance with increased physical activity. All correlations are statistically significant.

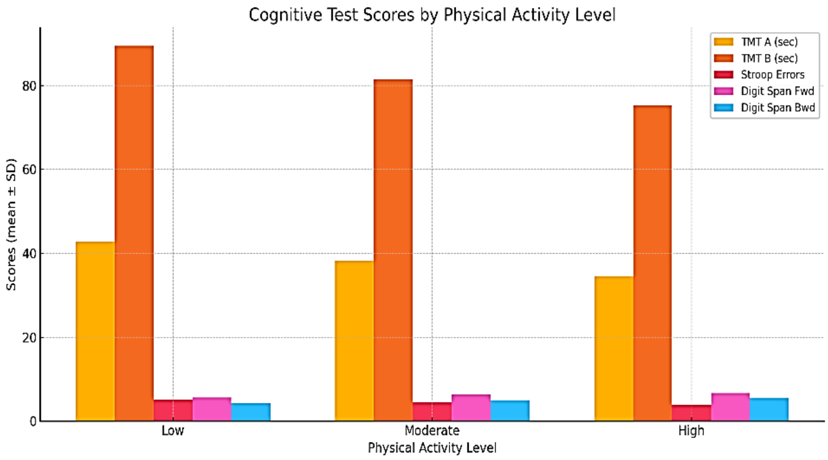

Figure 1: Cognitive Test Scores by Physical Activity Level-This bar graph displays the mean scores (± SD) of various cognitive tests—Trail Making Test A and B (in seconds), Stroop Test (number of errors), and Digit Span (Forward and Backward)—across three physical activity levels (Low, Moderate, High) as assessed by the IPAQ. Lower scores in TMT and Stroop indicate better performance, while higher Digit Span scores indicate enhanced working memory. A trend of improved cognitive function is observed with increasing levels of physical activity.

DISCUSSION

The current study explored the relationship between physical activity and cognitive function in young adults and found a significant positive correlation between higher physical activity levels and improved cognitive performance. Participants with moderate to high physical activity, as assessed by IPAQ-SF, performed significantly better on cognitive tasks assessing attention, working memory, executive functioning, and processing speed.

These findings are consistent with a broad spectrum of literature that links physical activity with cognitive enhancement. For instance, Erickson et al. (2011) demonstrated that aerobic exercise increased hippocampal volume in older adults and improved spatial memory, suggesting similar mechanisms may underlie cognitive gains in young adults as well [1]. In another study, Best (2010) found that physical activity improved executive function in young adults, particularly in tasks involving inhibition and cognitive flexibility [2].

Our study's results are also supported by Alves et al. (2014), who observed that university students engaging in higher levels of physical activity showed better working memory and attention control, as assessed by the Stroop and Digit Span tasks [3]. Furthermore, Loprinzi and Kane (2015) reported that even short-term moderate-intensity physical activity significantly improved information processing speed and accuracy among college students [4].

A meta-analysis by Lambourne and Tomporowski (2010) found that acute bouts of aerobic exercise had a small to moderate effect on cognitive performance, particularly for tasks administered shortly after the exercise session [5]. Similarly, Smith et al. (2010) concluded that both acute and chronic

physical activity interventions resulted in improvements in cognitive function in adults of all age groups, reinforcing the notion of physical activity as a universal cognitive enhancer [6].
Another key finding from our study is that even moderate physical activity was associated with cognitive benefits. This aligns with the World Health Organization (WHO) guidelines, which recommend at least 150 minutes of moderate-intensity aerobic physical activity per week for adults to achieve both physical and cognitive health benefits [7]. Supporting this, Esteban-Cornejo et al. (2015), in a study on young Spanish adults, found that those who met WHO-recommended activity levels had significantly better performance in executive function tests than their sedentary counterparts [8].
From a neurobiological perspective, regular physical activity is believed to exert cognitive benefits via enhanced cerebral perfusion, increased neurogenesis, improved synaptic plasticity, and elevated levels of brain-derived neurotrophic factor (BDNF)—a protein linked with learning and memory [9]. Knaepen et al. (2010) emphasized the role of BDNF and other neurotrophic factors as mediators of exercise-induced cognitive improvements [10].
However, not all studies present uniform findings. For example, Tomporowski et al. (2008) reported that while physical activity improved cognitive outcomes in children and older adults, the effects in young adults were smaller and varied depending on cognitive domain [11]. Additionally, Chang et al. (2012) noted that exercise intensity and timing relative to cognitive testing significantly influence outcomes, suggesting the need for more standardized protocols in future studies [12].

Strengths and Limitations

A key strength of this study is the use of validated tools (IPAQ-SF, TMT, Stroop Test, and Digit Span) and a homogenous population of young adults, minimizing age-related cognitive variability. However, the cross-sectional design limits causal inference. Physical activity was self-reported, which may introduce recall bias or inaccuracies. Future research should consider objective measurement tools, such as accelerometers or fitness trackers, and longitudinal or interventional designs to confirm the directionality of the observed associations.

Implications

Given the academic and occupational demands placed on young adults, promoting physical activity may serve as a simple, cost-effective strategy to enhance cognitive readiness and long-term brain health. Integration of regular exercise programs into educational institutions could contribute positively to students' academic performance and mental well-being.

CONCLUSION

This study reinforces the growing body of evidence suggesting a positive relationship between physical activity and cognitive performance in young adults. These findings highlight the potential of lifestyle-based interventions in enhancing cognitive functioning. Encouraging physical activity in university and community settings may offer not only physical health benefits but also improved cognitive capacity and academic outcomes.

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