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Research Paper

Physical Activity Cognitive Function Comparison: Gym-Goers Vs. Non-Goers

Brunda Kumari M.[1]*, Ms. Deena Dixon[2]

ABSTRACT

This study aimed to comprehensively assess the cognitive functioning of gym goers and non-goers, focusing on domains such as mental speed, attention, visuo-constructional ability, learning and memory. Sixty-one participants, comprising 30 gym goers and 31 non-goers were recruited using snowball sampling. Cognitive assessments were conducted using NIMHANS Neuropsychological Battery, including digit symbol substitution for mental speed, digit vigilance test for attention, complex figure test for visuo-constructional ability, learning and memory. Statistical analyses were performed using SPSS software. Results demonstrated that gym goers exhibited significantly superior performance to non-goers across various cognitive domains. There was no significant difference in visuo-constructional ability among the groups. These results contribute to the growing body of knowledge about the connections among physical activity and cognitive functioning, implications of these findings highlight how important it is to get out of sedentary lifestyle as potential sources of deficits in cognitive functions and indulge in a more active lifestyle. By focusing on these interconnected factors, future interventions and lifestyle changes may be able to improve cognitive functions and overall health and wellbeing.

Keywords: *Cognitive function, Physical activity, Gym-goers, Non-goers, Attention, Speed, Visuo-constructional ability, Learning, Memory*

In India, going to the gym is growing in popularity as people realize the advantages of physical and mental well-being that comes with exercise. Physical activity (PA) has been essential to our species' existence for the majority of its history, it has altered our physiology during the course of evolution. But the effects of a sedentary lifestyle on health are only now becoming apparent. It is known that certain lifestyle choices can cause epigenetic changes that alter the expression of genes and the structure of chromatin, potentially leading to heritable metabolic effects. Numerous studies have demonstrated that PA can at least partially counteract the negative consequences of a sedentary lifestyle. Engagement in physical activity represents a well-established method to elicit health-beneficial effects (Lollgen H, Bockenhoff, 2009).

[1]MSc. Clinical Psychology Student, Kristu Jayanti College Autonomous, Bangalore, India
[2]Assistant Professor, Kristu Jayanti College Autonomous, Bangalore, India
*Corresponding Author

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Over the years, the potential impact of PA on brain morphology and function has evolved as another focus of research. According to data from animal experiments, chronic exercise promotes synaptic plasticity, angiogenesis, and neurogenesis, evidence suggests the occurrence of training-induced cerebral adaptations that may help to prevent or delay cognitive decline and neurodegenerative diseases; (Vaynman S, Gomez-Pinilla F, 2016, Liu PZ, Nusslock R, 2018). Researchers discovered that PA activities have psychological benefits, gym-goers had lower rates of anxiety and despair, exhibited better levels of self-efficacy and self-esteem compared to non-goers (Biddle,2013, Sani et al., 2016). Studies have also suggested that gym-goers may have distinct brain connections for instance, robust white matter pathways in the frontal lobe, a part of the brain linked to working memory, attention, and processing speed (Voss et al.,2010). It can also help prevent the aging of the brain and degenerative diseases. Above all, PA strengthens the age-old tenet of "mens sana in corpore sano," or a sound mind in a sound body, by enhancing cognitive functions, having analgesic and antidepressant effects, and even eliciting a sense of wellbeing (Di Liegro CM et al., 2019).

The association between PA and cognitive functions has been explained by a variety of methods. Physiological mechanisms and learning/developmental mechanisms are the two main groups into which these systems fall. According to the learning/developmental mechanisms, physical activity and mobility offer learning opportunities that support and may even be essential for healthy cognitive growth. Physical alterations in the body brought on by exercise are the basis for the physiological mechanisms, which include altered arousal levels, altered cerebral blood flow, altered brain neurotransmitters, and structural modifications in the central nervous system. Studies suggest that there's a chance that exercise improves blood flow to the brain, causes our heart rates to rise and our blood vessels to widen, increasing the amount of blood that reaches the brain, stimulates the synthesis of brain-derived neurotrophic factor (BDNF), induces functional and structural changes in the nervous system, affect neurotransmitter systems, for example by increasing levels of serotonin, noradrenaline and acetylcholine (Lafenetre et al., 2011; Vaynman et al., 2004, Lista and Sorrentino, 2010). These factors all play important roles in inducing neuroplasticity.

There is a growing body of research that suggests that physical activity may have a positive impact on cognitive function. However, more research is needed to better understand the relationship between physical activity and cognitive function among healthy young adults, studies have been mostly done on older adults or children with psychiatric and neurodevelopmental disorders. There are a number of researches on gym goers and their self-esteem, motivation, eating disorders, BMI, nutritional aspects, supplement intake and so on. There are intervention studies on cognitive functions and gym-goers, systematic review studies are carried out, although there is no study testing the cognitive functions of healthy gym-goers. This study will help us to find the difference in cognitive functions among gym-goers and on-goers, the results can be a wake-up call to all the individuals to engage themselves in exercise of any type and care for their physical and mental health. Regardless of their goals for physical activity, research indicates that all kinds of gym goers may gain from enhanced cognitive performance. This study does not establish a causal link between exercise and specific outcomes; rather, they demonstrate a relationship between exercise and cognitive function.

This research findings could lead to the development of innovative strategies for enhancing cognitive function and promoting cognitive health, with implications for preventing and

treating cognitive decline across all age groups. By comparing the cognitive functions of gym-goers and non-gym-goers, particularly in non-Western contexts, this research addresses a critical gap in the literature and highlights the importance of physical activity for cognitive well-being, potentially impacting public health initiatives worldwide.

METHOD

Aim

To compare the cognitive functioning of gym-goers and non-goers.

Objectives

- To assess the cognitive domain of mental speed using digit symbol substitution test.
- To assess the domain of attention using the digit vigilance test.
- To assess the domain of visuo-constructional ability using complex figure test (copy)
- To assess the domain of learning and memory using complex figure test (immediate and delayed recall).
- To compare the domain scores of gym-goers and non-goers.

Hypothesis

- H01: There is no significant difference between the mental speed of gym-goers and non-goers.
- H02: There is no significant difference between the sustained attention of gym-goers and non-goers.
- H03: There is no significant difference between the visuo-constructional ability of gym-goers and non-goers.
- H04: There is no significant difference between the learning and memory of gym-goers and non-goers.

Sample

This study recruited 61 participants (30 gym-goers and 31 non-goers; 43 males and 18 females) for the assessments after the screening of 100 people using the snowball sampling method. The sample included only gym-goers consistently going to the gym for a minimum of 1-year, 3 times per week. The study's exclusion criteria include individuals with a history of head injury, psychology students, those who regularly indulge in board games, engage in regular sports/workout routines, have diagnosed psychiatric disorders, have a history of hospitalization within the past 15 days, do not take supplements, or have chronic/acute medical conditions.

Inclusion criteria:

- Gym-goers include individuals aged 18 to 29 who are in a consistent use of the gym.
- Non-goers include individuals aged 18 to 29 who have never engaged in physical activity and never been to the gym.

Tools

- A Google form was used to recruit the participants who fulfilled the inclusion and exclusion criteria.
- NIMHANS Neuropsychological Battery was used to assess the level of cognitive functioning of the participants.
- Digit Symbol Substitution Test (DST) was used to assess mental speed
- Digit Vigilance Test (DVT) was used to asses sustained attention

- Complex Figure Test- copy (CFTC) was used to asses visuo-constructional ability
- Complex Figure Test- immediate recall (CFTI) was used to assess learning and, Complex Figure Test- delayed recall (CFTD) for assessing memory.

Design

This study employed ex post facto quasi-experimental study design. The independent variable was physical activity (gym going) and how it impacts the different neuropsychological functioning. The descriptive statistics were computed using the SPSS software.

RESULTS AND DISCUSSION

The study used SPSS, AMOS 26.0 programs for data analysis. A Shapiro–Wilk test showed a significant departure from normality for the variables. The data was not normally distributed so a non-parametric test was used, and Mann–Whitney (U) test was applied to compare results between gym-goers and non-goers.

Table: 1 Mann Whitney U test comparisons based on cognitive domains of the gym-goers and non-goers and Z-value of Mann Whitney U test

	Group	N	Mean Rank	Mann Whitney U	Z	p
DST	Gym	30	46.50	.000	-6.733	.000
	Non-Gym	31	16.00			
	Total	61				
DVT	Gym	30	45.47	31.000	-6.289	.000
	Non-Gym	31	17.00			
	Total	61				
CFTC	Gym	30	31.77	442.000	-.538	.590
	Non-Gym	31	30.26			
	Total	61				
CFTI	Gym	30	40.97	166.000	-4.336	.000
	Non-Gym	31	21.35			
	Total	61				
CFTD	Gym	30	39.23	218.000	-3.583	.000
	Non-Gym	31	23.03			
	Total	61				

Mann–Whitney U test indicated that gym-goers demonstrated significantly higher mean rank scores for DST ($U = .000$, $Z = -6.733$, $p < 0.05$), DVT ($U = 31.000$, $Z = -6.289$, $p < 0.05$), CFTC ($U = 442.000$, $Z = -.538$, $p > 0.05$), CFTI ($U = 166.000$, $Z = -4.336$, $p < 0.05$), and CFTD ($U = 218.000$, $Z = -3.583$, $p < 0.05$), than non-goers.

Mann–Whitney U test indicated that there is a significant difference in mental speed ($p<0.05$), sustained attention ($p<0.05$), learning and memory ($p<0.05$) between gym-goers and non-goers. Surprisingly the test indicated no significant differences in visuo-constructional ability ($p>0.05$) between the groups.

DISCUSSION

This study was carried out to understand the cognitive implications of physical activity among gym-goers and non-goers. This study employed a comparative assessment of cognitive profiles of (30 gym-goers and 31 non-goers). Participants who qualified as gym-

goers for the study were assessed for mental speed, sustained attention, visuo-constructional ability, learning and memory and were compared to the non-gym-goers.

Our findings revealed a significant difference between the performance of gym-goers and non-goers. Gym-goers performed better on processing speed, sustained attention, learning and memory compared to the non-exercising group. Suggesting that physical activity positively impacts mental speed, sustained attention and has been associated with enhanced learning abilities and improved memory consolidation and retrieval.

The present findings are in accordance with previous evidence demonstrating an association between PA and cognitive performance, showing that increased PA levels may be related with better cognitive functioning, promoting attention, processing speed and memory (Bherer,2013, Chang YK,2012, Erickson, K. I., et al.,2011). Some studies suggest high-intensity interval training (HIIT) might be particularly effective to improve mental speed (Brown et al., 2012). Luque-Casado and collaborators (2013) reported the first direct evidence of a selective association between aerobic fitness and sustained attention in young adults, another study suggests that coordinated exercise could enable more robust improvements in sustained attention (Chou CC et al.,2023). Findings from previous studies suggests that aerobic exercise, and fifteen minutes of walk at moderate intensity before encoding improves learning and memory functions in young adults (Sng E,2018, Blomstrand, P., et al.,2021)

Contradictorily there was no significant difference in the performance of visuo-constructional ability between the groups. Suggesting that engaging in physical exercise at the gym may not have a direct impact on visuo-constructional abilities compared to other cognitive functions assessed in this study. A study investigated the impact of music-based physical training on motor skills and cognitive performance, including visuo-constructive abilities. The results showed visual-constructive skills remained stable after the intervention, except for verbal fluency and recall, which significantly improved after the dance program which compliments the present findings indicating that physical exercise did not have a significantly direct impact on visuo-constructional ability (Prinz, 2021).

There are various possible mechanisms underlying the positive association between physical activity and various cognitive domains. In addition to neurophysiological changes, exercise is well-known to promote neurogenesis, the growth of new brain cells, particularly in the hippocampus, a region crucial for learning and memory (Erikson et al., 2011), studies have shown that regular aerobic exercise can boost the size of the hippocampus. Additionally, physical activity improves blood flow to the brain, delivering essential oxygen and nutrients that optimize brain function (McMorris et al., 2018). This improved vascular health might contribute to faster information processing, attention, learning and memory. Research indicates that exercise can enhance memory retention by increasing levels of brain-derived neurotrophic factor (BDNF), promoting synaptogenesis, and supporting the survival of nerve cells.

The present study finding, along with existing research findings, becomes evident that engaging in regular physical activity, such as going to the gym, can lead to significant differences in mental speed, sustained attention, learning, and memory compared to individuals who do not participate in such activities. These results underscore the importance of physical activity in promoting cognitive functions and overall brain health.

CONCLUSION

The purpose of our research was to compare cognitive functions among gym-goers and non-goers. The assessment of cognitive domains has revealed that gym goers performed better on mental speed, sustained attention, learning and memory. Although the performance on visuo-constructional ability did not show a significant difference among the groups. The findings were confirmed by the results of Mann–Whitney (U) analysis, results showed gym-goers had significantly higher scores on all the cognitive domains. Suggesting that there is a significant difference between mental speed, sustained attention, learning and memory among the groups. Surprisingly, this research indicated no significant differences in visuo-constructional ability. Our research modestly contributed to the previous research in the field, implying that there is an association between PA and cognitive functions.

Implications

- Develop exercise programs for cognitive health: The findings support the use of physical activity as an intervention to improve cognitive function. Future research could inform the development of targeted exercise programs for different age groups and cognitive needs.
- Public health recommendations: The study reinforces the importance of physical activity for overall health, not just physical but also mental well-being. These findings could be used to strengthen public health recommendations to encourage regular exercise.

Limitations of the study

The small sample size restricts the study's generalizability, and reliance on self-reported data raises concerns about accuracy due to potential social desirability bias, memory recall issues, and failure to account for unreported comorbidities. Additionally, the limited cognitive assessment may miss crucial functions impacted by exercise, and the cross-sectional design can't establish causality between gym attendance and cognitive improvement. This type of study only captures a snapshot in time. It can't determine if gym attendance causes better cognitive function, or if people with naturally better cognition are more likely to join a gym.

Recommendations

Further research on people who exercise occasionally or have been exercising in the past and assess their cognitive performance: assessing the impact of exercise patterns on cognitive performance. Increase participant numbers and utilize objective measures (trackers, records) for gym attendance and health habits to enhance generalizability and reduce reliance on self-reported data. Implement a longitudinal study design to follow participants over time and determine if consistent gym attendance truly leads to improved cognitive function. Employ a wider range of cognitive tests to capture the full impact of exercise on various brain functions. Consider kinds of physical activity and its impact on cognitive functions.

Ethical considerations

Informed consent was taken from the participants as the first step, participants were provided with the clear instructions for the tests. Confidentiality was maintained, data collected is strictly in a protected document and is used only for research purposes. Since deception was used in the study, the participants were not informed about the actual purpose of the study before the assessments were conducted, each participant was debriefed about the experiment and its actual purpose after the completion of the experiment.

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Conflict of Interest

The author declared no conflict of interest.

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