Original Article

Association of Cognition in Physically Active and In-Active Young Adults

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Abstract

Objective: To discuss the intriguing connection between physical exercise and cognitive abilities in both genders.
Study design: It is a cross sectional study.
Place and duration of study: A Six-month study was carried out in Zohra Institute Health sciences, Rawalpindi. (from March 2022 to September 2022)
Material and Methods: A sample size of 382 participants was selected in accordance with inclusion criteria the subjects selected were aged between 18-40 years with graduation. The subjects with injury, neurological deficit and co-morbid condition were excluded. Self- administered questionnaires[2,3,4] were added to this study using the IPAQ, MOCA, and MMSE. IPAQ-SF aided in identifying the differences between physically active and inactive individuals. MOCA and MMSE were used to identify the level of Cognition.[5]
Results: A total of 382 (mean 29.19) healthy young adult participants were selected within the age limit of 18 to 40 years (52.1% male and 47.9% female). IPAQ was used to initially screen out physically active and inactive individuals. The frequency of low grade physically active individuals was 40 (10.5%), for moderately active individuals it was 54(14.1%) and 288(75.4%) individuals were deemed to be highly active. A cut-off score of 26 used to identify cognitive function for MOCA and MMSE questionnaires. According to MOCA 249 (19.6%) individuals had normal cognition, 58(15.2%) individuals had moderate cognition and 75(65.2%) individuals had low cognition. The results obtained from MMSE showed that 234(61.3%) individuals had no cognitive decline, 120 (31.4%) individuals had mild cognitive impairment and 28(7.3%) individuals had severe cognitive impairment. The correlation between IPAQ and MOCA depicted highly significant results whereas the correlation (0.000) between IPAQ and MMSE is less significant (>0.005)
Conclusion: This study found that people who engage in physical activity have normal levels of cognition and quick thinking abilities, whereas inactive individuals have a decline in cognitive functioning and delay response to challenges.

Keywords: Mini Mental state examination, Montreal Cognitive Assessment, International Physical Activity Questionnaire short form , Cognition, Physically Active, Physically Inactive, Exercise

1. Introduction

Cognition refers to mental processes involved in knowledge acquisition and understanding, including observing, envisioning, memorising, reasoning, assessing, visualising and problem-solving. Regular physical exercise in young adults acts as a safeguard against cognitive decline that often manifests in late adulthood.[6] Engaging in physical activity on a consistent basis provides multifactorial bodily health advantages, including a decreased risk of developing conditions such as stroke, cardiovascular diseases, osteoporosis and diabetes.[7] The correlation between cognitive function and human intelligence poses notable challenges to comprehending human behaviour and task performance. Intelligence is singular in context; evidence supports multiple forms of intelligence operating across different cognitive domains.

The physical activity improves executive functions and has a positive impact on cognition in young adults. It includes abilities such as attention, working memory, and cognitive flexibility. In addition, physical activity has been linked to increasing hippocampal volume and is important for memory consolidation and spatial navigation.

It is hypothesised that physical activity may promote the growth of new neurons in the hippocampus and improve blood flow to the brain, which leads to better cognitive function.[8]

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Conversely, physical inactivity has been linked to poorer cognitive function in young adults. Sedentary behaviours, such as sitting for an extended period of time, have been associated with reduced executive function and hippocampal volume.[9] According to WHO the physical activity criteria for an adult (aged between 18-40 years) are to perform moderate aerobic exercises for 150-300 minutes and vigorous activity for 75 - 150 minutes thrice a week. The energy expenditure in light physical activity is <3.0 MET, in Moderate physical activity is <3-5.99 MET and in vigorous physical activity, it is <6-8.99 MET. Whereas the MET expenditure for a sedentary lifestyle is <1.5 MET in sitting and reclining positions.[10]

A preliminary work emphasized by Machado observed on the effect of physical activity on cognitive functioning and cerebral blood flow regulation in healthy young adults. His study showed that high cerebral blood flow links to higher mental functioning. There was high cerebral blood flow regulation in 55 young adults who regularly performed aerobic exercise.[11] The blood flow was checked in hypercapnia and hypocapnia states where it was observed that increased cerebral blood increases cerebral functioning and high performance in active young adults.[12] Eadaoin et al worked on the analysis of BDNF factors involved in cognition and improvement in the hippocampal function in physically active individuals was carried out by[13] Running trial study investigation on choric exercise group and acute exercise group. Following acute exercises, serum BDNF levels rises, $p<0.05$ compared to 0 minutes and $p<0.05$ compared to 30 minutes.

A cross-sectional survey by Rai, et al analysed the association between physical activity and the prevention of serious illness in young adults aged between 18-21 years.[14] The IPAQ-SF proved to be a satisfactory method to advocate for physical activity and prevent comorbid illnesses.[18] Moderate exercise or physical activity not only positively impacts physical and cardiovascular health but also fortitudes the mind with the tenacious ability of cognition, perception, reasoning, intelligence and cognition.[16] Physical activity aids in the prevention of non-communicable diseases that notably include cardiopulmonary diseases, diabetes, and mental health conditions.[17] It assists in enhancing the musculoskeletal endurance and strength of the individual. It progressively delays age-related mild cognitive decline, and dementia.[15] They can process memory function, reasoning, and judgement apace with enhanced cortical function. In the interesting analysis of Aichberger, M.C., et al[6], It has been evidently observed that physical activity increases synaptic function to enhance learning and memory, consequently increasing neuronal plasticity in higher-fit individuals.[6] With the help of three assessment scales—the MOCA, MMSE,[19] and IPAQ[20] —this study compares the cognitive capacities of physically active and sedentary individuals in order to bolster the findings of important studies. The Rationale of this study postulated to determine physically active individuals have higher level of cognition .

2. Materials & Methods

The participants have verbally explained the purpose, procedure and nature of the study. For documentation purposes, written consent was initially taken from the involved participants. After securing the ethical approval from Zohra Institute of Health Sciences (Rawalpindi, Pakistan), permission letters to conduct research the cross-sectional survey was conducted between physically active and inactive young adults. The 382 (199 male, 189 female) individual participants were chosen at random from various classes at the respective institute and general population The participants signed written consent to take part in the study. The selected population were aged between 18 to 40 years having at least 12 years of education. The exclusion criteria included individuals having neurological disorders, cognition deficits, underlying co-morbid conditions and geriatric population. The questionnaires were self-administered, a brief introduction of the 3 questionnaires (MOCA, MMSE, IPAQ) and intent of research was orally given to the participants . The Montreal Cognitive Assessment (MOCA) is a moderate cognitive impairment screening tool. The results are more precise and provide a more accurate understanding of an individual's cognitive function when paired with MMSE. To determine an individual's level of physical activity and if they meet the WHO physical activity guidelines, we have incorporated IPAQ into our research.The researchers actively helped the participants when they were having trouble understanding the question. The participants were polled to acquire about their demographics and educational background.

To measure cognition Montreal Cognitive Assessment scale (MOCA) and Mini-mental State examination scale (MMSE) were administered by random participants.[15] To differentiate the cognitive score between physically active and inactive individuals International Physical Activity Questionnaire- Short Form (IPAQ-SF)[14] was filled out by inclusive participants. Both the cognition-testing procedure and physical activity questionnaire were described by the researcher and then demonstrated it. He calculated and recorded the results of the tests when they were completed. Each participant was allocated 30 minutes to fill out all three questionnaires. On average the MOCA takes 12 minutes, MMSE takes around 8 to 11 minutes and IPAQ-SF takes 7 minutes to complete.

Table 1: IPAQ and MOCA Cross Tabulation

		MOCA			Total
		moderate cognitive impairment	mild cognitive impairment	Normal	
IPAQ	Low	32	4	4	40
	Moderate	4	12	38	54
	High	39	41	208	288
Total		75	57	250	382

Statistical Analysis was performed using SPSS version 21. Pearson Chi-square test was used to investigate the relationship between physical activity and cognition. The significance criteria of $P< 0.05$ was implemented to calculate and analyse correlation.

3. Results

A total number of 382 participants (199 males and 183 females) were selected using the convenience sampling technique in this study.

The correlation between MOCA, MMSE and IPAQ was found using Pearson chi square test. The MOCA and IPAQ Correlation showed 0.000 and the MMSE and IPAQ showed 0.005 hence both MOCA and MMSE depicted positive Correlation between cognition and physical activity.

The data obtained from IPAQ shows that out of 382 participants, 10.5% falls under the low grade of IPAQ score with frequency of 40. Moderate grade has frequency and % of 54 and 14.1% respectively, high grade has frequency and % of 288 and 75.4%.

The data obtained from MOCA shows that moderate cognitive impairment has frequency and % of 75 and 19.6%,mild cognitive impairment has frequency and % of 58 and 15.2%,normal cognition has frequency and % of 249 and 65.2%.

The data obtained from MMSE shows that out of 382 participants, severe cognitive impairment has frequency and % of 28 and 7.3%,mild cognitive impairment has frequency and % of 120 and 31.4%,no cognitive impairment has frequency and % of 234 and 61.3%.

The results between the correlation of MOCA ,MMSE and IPAQ is shown below in, Table1, Table 2.

Table 2: Chi-Square Tests (MOCA-IPAQ)

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	107.477[a]	4	0.000

The above table shows association between MOCA and IPAQ ,the p value 0.000 which shows it is significant.

Table 3: IPAQ and MMSE Cross tabulation

		MMSE			Total
		severe cognitive impairment	mild cognitive impairment	no cognitive impairment	
IPAQ	Low	5	19	16	40
	Moderate	4	18	32	54
	High	19	82	187	288
Total		28	119	235	382

Table 4: Chi-Square Tests (MMSE IPAQ)

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	9.449[a]	4	.051

IPAQ results from low-grade physically active individuals have a frequency of 40, moderate actively has 54, while highly physically active individuals have a frequency of 288.MOCA results show that normal participants have a frequency of 249, which shows normal Cognition, and mild and moderate cognitive impairment has a frequency of 58 and 75, which shows a little cognitive decline. MMSE results show that individuals with no cognitive impairment have a frequency of 234, mild cognitive impairment and severe cognitive impairment have a frequency of 120 and 28. MOCA and IPAQ are highly significant, whereas the association between IPAQ and MMSE is less significant.

4. Discussion

The objective of our research was to ascertain the physical adults and assess their cognitive functioning. Two additional tools were employed in our study for precise subject assessment, IPAQ and MMSE in correspondence with MOCA. IPAQ identifies those who are physically active. According to the scores provided by MOCA and MMSE, patients who engage in physical activity have greater levels of cognition than people who do not. A cross-sectional study with a sample size of n=137 on the topic of "Identifying level of cognition in physically active and inactive individuals" was published in a Pakistan Physical Therapy Journal; in this study only MOCA was used to measure cognition. The participants selected were verbally asked for their level of physical activity. Out of 137 selected participants 86 (62.8%) individuals were active and 51 (37.2%) individuals were inactive. The mean results showed that 42 (30.7%) scored below 26 (low cognition) and 95 (69.3%) scored above 26 (normal cognition) The study had flaws, in selected few participants, and provided insufficient evidence to distinguish between people who are active and those who are inactive.1 In relation to our study, we used IPAQ-SF to quantitatively screen out active and inactive individuals. A cross tabulation results between IPAQ * MOCA (0.000) and IPAQ * MMSE (<0.005) was used to administer level of cognition and assess activity level of individual

Physical activity lowers the psychological prevalence of depression, anxiety, and stress.[16] A healthy lifestyle is indicated by physical and mental exercise. Exercise boosts dopamine levels, which lower stress and depression and enhance mood. It also improves mental performance.[21] All levels of physical activity—light, moderate, and intense—have a good impact on cognition. The individual who is physically active can express things more clearly. Regular exercise improves one's ability to think effectively.

Engaging in aerobic exercise has a favorable impact on cognition and can enhance memory and reasoning.[22,24] in comparison individuals who engage in moderate physical[20] Non-contact athletes who play board games, scrabble, and other similar activities typically have greater executive function and moderate cognitive abilities compared to athletes who play non-contact sports like badminton and footballs.[25] Active individuals have larger hippocampal and basal ganglia,

which means more brain activity, connectivity, memory, and reasoning.[26]

Aerobic exercise has a positive influence on cognition and brain function.[22,25] Moderate physical activity reduces the risk of dementia, enhances intellectual performance, and boosts flexibility.[24,27] The individuals who regularly participated in moderate physical activity had higher executive functions, visuospatial orientation, memory and attention depicted by the results of MOCA and MMSE. It has also been demonstrated that those with greater cardiovascular fitness had higher frontal volumes.[29,30,31] Enhanced aerobic and cardiorespiratory fitness directly leads to increases in cortical and subcortical size.[28]

Conclusion:

The cross sectional study observed that exercise enhances rapid thinking abilities, problem solving strategies, increases higher mental functioning and retaining long term memory. We have examined executive brain cognitive levels utilizing MOCA and MMSE, and we have utilised IPAQ to distinguish between physically active and inactive people. It was concluded that there was a strong correlation between cognitive function and physical activity.

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