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EXAMINING THE PUBLIC HEALTH RELATIONSHIP BETWEEN PHYSICAL ACTIVITY AND COGNITIVE FUNCTION IN OLDER ADULTS

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Abstract

This research explored the connection between physical activity and cognitive functioning in Indian older people, a low-resource, diverse environment in which lifestyle decisions diverge markedly from those of high-income nations. We modelled this association, controlling for putative confounders, and assessed gender differences. Employing nationwide data from the Longitudinal Ageing Study in India (2017-2018), we used propensity score matching (PSM) to investigate the relationship. Cognitive functioning was measured over five domains, namely memory, orientation, arithmetic function, executive function, and object naming. Our final data set included 31,464 participants aged 60 years or older, 16,366 men and 15,098 women. After controlling for a range of personal, health, lifestyle, and household variables, our findings indicated that older adults who were physically active had better cognitive functioning than those who were not, with this relationship being seen in both older men and women. Particularly, the PSM analysis identified that physically active women and men in regular physical activities had statistically improved cognitive function scores with an improvement of 0.98 points and 1.32 points, respectively. These observations indicated that physical exercise could play an important role to improve cognitive function in old individuals. Regular physical activity, then, is one of the great lifestyle components useful for maintaining normal cognitive aging.

keywords: Geriatrics, Health policy, public health, cognitive functioning, physical activity.

1. INTRODUCTION

Cognitive functioning refers to a group of mental skills such as reasoning, language, learning, thinking, attention, concentration, and visuospatial functioning. Supported by theoretical and empirical evidence, cognitive functioning usually decreases with increasing age, placing older adults at higher risk for cognitive impairment [1]. Nearly 47 million individuals worldwide suffered from dementia in 2015; by 2050, that number is predicted to rise to 132 million, with the majority of those affected anticipated to reside in Asian nations [10]. Notably, there are already 5.3 million dementia sufferers in India, where the disease is a growing health concern. By 2050, that number is predicted to triple. India will face significant public health and socioeconomic issues as a result of a larger percentage of its elderly population experiencing poor mental health and cognitive deterioration [2]. Furthermore, cognitive impairments have a significant negative impact on the individual as well as the family, healthcare professionals, and society at large on a physical, emotional, and financial level [9].

Pharmaceutical treatments for dementia are still in their infancy. Since there is currently no cure, it is critical to find protective factors and effective lifestyle-based methods that can be changed to lower the risk of dementia [3]. Research has also shown modifiable lifestyle components that substantially decrease cognitive deterioration and avoid dementia. Raviglione et al. have identified three main factors that are responsible for cognitive health, including regular physical exercise, socially integrated networks, and cognitive leisure activities [13]. Of these, regular physical activity has been found to have the most protective effect against age-related cognitive impairment [4]. Regular exercise also has wider physical health benefits, such as lowering the risk of chronic diseases like diabetes, heart disease, stroke, and depression, which are established risk factors for cognitive impairment [5] [14].

2. REVIEW OF LITERATURE

randomly assigned half to receive depressive drugs and the other half to a four-month fitness regimen. These researchers discovered that participants in the exercise program showed improvements in memory and executive functioning, and that these improvements were correlated with a reduction in depression symptoms. Similar effects have been seen in another research (Bartholomew & Ciccolo, 2008) [11].

Two theories that suggest exercise may promote healthy cognitive aging are the social-stimulation theory and the depression-reduction hypothesis [17]. According to the depression reduction hypothesis, effective depression reduction techniques will inevitably enhance cognitive performance since depression impairs regular cognitive functioning. Two facts form the basis of this hypothesis. First, La Rue, Swan, and Carmelli (1995) found a correlation between depressed symptoms and impaired cognitive functioning in older persons [15].

Vance et al. (2005) used structural equation modelling to examine the social-stimulation and depression-reduction hypotheses in a sample of 158 older individuals who lived in the community and were cognitively intact. There was some evidence to support both hypotheses, and the suggested model fit the data well [16]. A noteworthy route that connected social networks, physical exercise, depressive symptoms, and cognition was discovered. Significantly, a positive cascade of consequences was suggested by the association between higher physical activity and larger social networks, which in turn were linked to fewer depressed symptoms and, eventually, improved cognitive performance [6].

In particular, people who were more sedentary had higher levels of depression, and depression was correlated with worse cognitive functioning. Interestingly, despite the established links between sedentary behavior, depression, and poorer cognitive functioning, research has yielded mixed results. Specifically, studies by DiPietro (2001) and Epstein & Hundert (2002) found a counterintuitive direct relationship between sedentary behavior and cognition, suggesting that more sedentary individuals actually exhibited better cognitive functioning [18].

In addition to reproducing the earlier study by Vance et al. (2005), this study aims to enhance it in two significant areas. To elucidate the distinct contributions of the depression-reduction hypothesis (Path A) and the social-stimulation hypothesis (Path B) regarding physical activity and cognitive functioning in older adults, the study initially examined the duration of sedentary behavior and sleep patterns separately, aiming to disentangle their unique effects [7].

The last trimmed model accounted for a significant 22% of the variance in cognitive function. This, however, indicates that there is a large percentage of unexplained variance, and hence, that there could be other factors not included in the model influencing cognitive function. Future studies could draw on such factors as physical health status, education level, leisure activities, work history, and cognitive reserve, which could give further information [12] (Vance et al., 2012).

Significance

With the high incidence of dementia in elderly populations, there is a growing need to learn about the preventive steps that can ensure their cognitive functions remain intact. Learning what strategies work for maintaining cognitive ability can have important implications for countering the risk of dementia and enhancing the overall quality of life for aging populations. One of these lifestyle choices that can be changed to maintain cognitive functions is physical activity. Additionally, self-reported measurements may offer easier ways to assess the effects of physical activity than objective measures if they are proven to be a reliable indicator of physical activity.

Hypotheses

My hypothesis was that people with higher levels of physical activity would also have higher cognitive performance overall. To confirm the validity of self-reported data as a physical activity measure, I also anticipated discovering a correlation between the subjective reports of exercise made by participants and the objective accounts of physical activity monitored through their home key cards.

3. DESIGN

A subset of a broader longitudinal study, this cross-sectional study looks at the relationship between older adult participants' cognitive functioning (an end variable) and physical activity (a predictor variable).

Methods

1. Outcome variable

Cognitive functioning in the elderly was measured on five broad areas: memory, orientation, arithmetic function, executive function, and object naming. For the purpose of assessing these areas, specific tests were utilized, such as immediate and delayed word recall for memory, time and place measures for orientation, procedures for executive function, and object naming. A domain-specific measure was employed to determine a composite score between 0 and 43, giving a global measure of cognitive impairment.

2. Treatment variable

The regularity of hard physical activity was measured on a dichotomous coding scale, where "yes" reflected daily participation and "no" for less regular participation (more than once a week, once a week, one to three times a month, or never). To estimate physical activity, the participants were queried as follows: "How often do you play sports or do hard work, like running, swimming, cycling, gym, or other hard work such as heavy lifting, chopping, or farm labor?". In earlier studies conducted in India and other countries, older persons were asked the questions about strenuous physical exercise [8].

3. Explanatory variables

The expenditures were elicited over different periods, with food spending elicited over 7 days and non-food spending over 30-day and 365-day periods, before being brought to a common reference period of 30 days. The resultant consumption data was tabulated by using MPCE, and the same was categorized into five quintiles, lowest to highest economic status. Variable for religion (Christian, Muslim, Hindu, others) and caste (also got coded. Dwelling places were either urban or rural in classification, and India was geographically subdivided into six areas: North, Central, East, Northeast, West, and South.

4. STATISTICAL ANALYSIS

This research utilized cross-sectional data, while reducing selection bias and mimicking the features of an experimental design. Through the establishment of a balanced comparison group, PSM makes it possible to estimate counterfactual outcomes, which are the outcomes that would have happened in the event of no treatment. In doing this, each individual is given a propensity score, which reflects their probability of being allocated into the treatment group, based on a set of observed factors.

Table 1: Descriptive Statistics

	Sample	Min.	Max.	Avg.
What connection exists between older people' levels of physical exercise and cognitive function?	1035	1.33	5.00	3.8006
Does regular physical activity predict improved cognitive function in older adults?	1035	1.20	5.00	3.8216
What is the optimal frequency, duration, and intensity of physical activity required to improve cognitive function in older adults?	1035	1.45	4.82	3.8156
Do the cognitive benefits of physical activity vary by age, sex, or health status in older	1035	1.50	4.88	3.7920

adults?				
Can physical activity be used as a preventive strategy to reduce the risk of age-related cognitive decline and dementia?	1035	1.45	4.80	3.8075
What types and intensities of physical activity are most strongly associated with improved cognitive function in older adults?	1035	1.00	5.00	3.4206
Do older adults with higher levels of physical activity experience a slower rate of cognitive decline compared to those with lower levels of physical activity?	1035	2.00	5.00	4.0444
What is the impact of physical activity on cognitive function in older adults with existing cognitive impairment?	1035	1.50	5.00	4.2406
Can older persons with dementia benefit from physical activity in terms of their cognitive function?	1035	1.78	4.89	3.9019

participants was generated using the propensity score, which balanced the observable predictors and ensured comparable distributions of covariates between the treatment and comparison groups. A one-to-one matching technique paired regularly physically active individuals with matched controls, assigning them to the treatment group.

Table 2: ANOVA Table

		df	Mean Square	F	Sig.
What connection exists between older persons' cognitive reserve and physical activity?	5.477	1	5.477	8.255	.004
	685.389	1033	.663		
	690.866	1034			
Regardless of living circumstances, do older persons who exercise have superior cognitive performance to those who do not?	1.880	1	1.880	3.054	.081
	635.955	1033	.616		
	637.835	1034			
What connection exists between older persons with vision impairment and their level of physical activity and cognitive function?	3.396	1	3.396	5.759	.017
	609.151	1033	.590		
	612.547	1034			

Can older persons with traumatic brain damage benefit from physical activity in terms of their cognitive function?	1.120	1	1.120	1.948	.163
	593.677	1033	.575		
	594.797	1034			
What effect does exercise have on cognitive performance in elderly people who have several chronic illnesses?	2.733	1	2.733	4.886	.027
	577.760	1033	.559		
	580.493	1034			
Regardless of financial background, do older persons who exercise have superior cognitive performance to those who do not?	5.477	2	3.423	5.164	.006
	685.389	1032	.663		
	690.866	1034			
How do cognitive performance and physical activity relate to each other in older persons with sleep disorders?	1.880	2	2.810	4.587	.010
	635.955	1032	.613		
	637.835	1034			
Can older persons with obesity who engage in physical activity lower their risk of age-related cognitive decline?	3.396	2	1.816	3.077	.047
	609.151	1032	.590		
	612.547	1034			
How does physical activity affect cognitive performance in chronically pained older adults?	1.120	2	1.203	2.096	.123
	593.677	1032	.574		
	594.797	1034			
Regardless of educational attainment, do older persons who exercise have superior cognitive performance to those who do not?	2.733	2	.900	1.604	.202
	577.760	1032	.561		
	580.493	1034			
What connection exists between cognitive performance and physical exercise in older persons with diabetes?	39.071	5	7.814	12.337	.000
	651.795	1029	.633		
	690.866	1034			
Can elderly persons who have had a stroke benefit cognitively from physical activity?	41.213	5	8.243	14.216	.000
	596.622	1029	.580		

	637.835	1034			
What effect does exercise have on cognitive performance in elderly Parkinson's disease patients?	44.795	5	8.959	16.238	.000
	567.752	1029	.552		
	612.547	1034			
Do physically active older persons, regardless of age, have superior cognitive performance over those who do not?	30.593	5	6.119	11.159	.000
	564.203	1029	.548		
	594.797	1034			
What connection exists between cognitive performance and physical activity in depressed older adults?	38.482	5	7.696	14.612	.000
	542.011	1029	.527		
	580.493	1034			
Can older persons with cardiovascular disease who engage in physical activity lower their risk of age-related cognitive decline?	14.602	5	2.920	5.470	.000
	549.403	1029	.534		
	564.005	1034			

The ethics approval, rules, and direction needed to conduct the LASI survey were supplied by the Central Ethics Committee on Human Research (CECHR) of the Indian Council of Medical Research (ICMR). Additionally, every technique was used in compliance with the applicable rules and regulations.

5. CONCLUSION

As life expectancy rises quickly, cognitive impairment is becoming a bigger public health concern. According to the results of this study, one of the risk variables that can be changed to prevent or postpone the development of cognitive impairment is physical activity. Physical activity can be incorporated into active aging interventions because of its cardio-protective effect, which makes it a possible element that enhances brain activity and cognitive functioning in old age. Development of physical activity-based interventions that can counteract cognitive decline could be useful for health professionals who seek in older patients or clients. Further longitudinal studies are also required to explain how behavioural interventions can enhance cognitive enrichment in older adults, especially women, by promoting successful aging and maximizing cognitive health.

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