

Effect of aerobic exercise on cognition in elderly persons with mild cognitive impairment

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Objective: To determine the effect of aerobic exercise on cognition in elderly persons with mild cognitive impairment.

Methodology: This randomized controlled trial was conducted at Physiotherapy Rehabilitation center of NCS University, Swabi Campus after approval from university. The inclusion criterion was age group between 60 to 70 years, MMSE 18 – 23, able to walk independently without use of assistive device. Subjects were excluded who could not participate because of musculoskeletal disorders, had current medical condition for which exercise is contraindicated, had cardiac and respiratory disorders. A total of 60 patients was selected and were randomly divided into experimental, and control group using sealed envelope technique. Treatment intervention for the experimental group was moderate intensity aerobic exercise program i.e., walking and control group received active range of motion exercises and stretching 5 days/week for 6 weeks. MMSE, MoCA, Trail making Test

A and B were used as outcome measure for both groups. Assessment was done at baseline and after 6 weeks of intervention.

Results: Of the 75 patients assessed, 60 (80%) were included; of them there were 30 (50%) in each of the two groups. Overall, mean age was 62.49 ± 1.82 ; there were 35 (56.5%) males and 24 (38.7%) females. Intra-group analysis showed significant improvement in outcomes measures MMSE, MoCA, TMT-A and B after six weeks of intervention in aerobic training group ($p < 0.05$). Inter-group analysis showed significant differences in scores of neurocognitive measures ($p < 0.05$) after six weeks of training.

Conclusion: Aerobic exercise showed improvement in neurocognitive domains of elderly persons with mild cognitive impairment after 6 weeks of intervention.

Keywords: Aerobic exercise, aging, cognition, elderly, mild cognitive impairment.

INTRODUCTION

Pakistan is ranked as sixth most densely populated country with 7% of its population above the age of 60 years. It is predicted that by 2050, this number will increase up to 27 million.¹ In coming thirty years, prevalence of 26% rise is estimated in Pakistan of persons with dementia.² Mild cognitive impairment (MCI) is considered as a pre-dementia stage. This clinical condition can lead to Alzheimer and Dementia, if not prevented. Early detection can control the cases of dementia. MCI is associated with various risk factors such as age, gender, smoking, diabetes, hypertension, cerebrovascular accident and low physical activity.^{3,4}

Presently, there is no effective pharmacologic treatment for prevention of cognitive decline. However, several studies suggest that lifestyle modification and engaging in regular physical activity can help in improving cognitive function.^{5,6} Previous studies have showed that aerobic exercise improves executive functions of cognition.⁷ Some studies have also shown that there are no improvements in cognitive function with exercise

training of different types like strength training, Tai-chi programs, multicomponent programs.⁸ Age related cognitive impairments are a major concern among elderly persons.⁹ American Academy of Neurology (AAN) recently updated practice guidelines for the treatment of MCI imply that exercise is a viable non-pharmacological technique to improve cognitive performance in patients with MCI.¹⁰

Findings of four systematic reviews support exercise as a promising therapy option and cover a variety of exercise modes in their reviews, ranging from multicomponent exercises to tai chi.^{11,13} Twelve months of stretching or aerobic exercise training in people with aMCI resulted in improved executive and memory functioning.¹⁴ Combining aerobic exercise and cognitive training may have a synergistic effect on cognition by strengthening separate brain functions in a complimentary manner.^{15,16} This study aimed to investigate the effects of aerobic exercise on cognition among elderly with mild cognitive impairment.

METHODOLOGY

This randomized control trial was conducted at Physiotherapy Rehabilitation Center of NCS University Swabi Campus from February to July 2019. The study protocol was approved by ethics review committee of the University. A written informed consent was taken from all participants. Sixty elderly subjects of both genders participated in study. Sample size was calculated by Open epi tool. The inclusion criteria were age group between 60 to 70 years, MMSE 18 – 23, able to walk independently without use of assistive device. Subjects were excluded who could not participate because of musculoskeletal disorders, had current medical condition for which exercise is contraindicated, had cardiac and respiratory disorders. Participants were randomized using sealed envelope technique into experimental (n = 30) and control (n = 30).

Participants of experimental group performed 40 – 50 minutes/day aerobic program, 5 days a week for 6 weeks. It included 10-minute warm up, followed by 20 – 30 minutes aerobic walk and cool down of 10 minutes.¹⁷ Warm up and cool down included stretching and active range of motion exercises for lower limb and trunk muscles. Participants walked on treadmill at a constant pace with zero inclination such that 11 to 14 (RPE)

Borg's rating of perceived exertion is maintained. Participants of control group performed gentle active range of motion exercises and stretching exercises to large muscle groups of lower limb and trunk muscles for 5 – 7 cycles of 10 repetitions for 20 mins for 5 days/week and training was continued for 6 weeks also advised to carry out their activities of daily living.

Assessment was done at baseline and after 6 weeks using MMSE, MoCA, Trail making test A and B. There was one drop out in experimental group due to low back pain.

Statistical Analysis: The SPSS version 24 was used for the statistical analyses. $p < 0.05$ was considered significant.

RESULTS

Of the 75 patients assessed, 60 (80%) were included and, of them, there were 30 (50%) in each of the two groups. Overall, mean age was 62.49 ± 1.82 ; there were 35 (56.5%) males and 24 (38.7%) females. Mean and standard deviation of MMSE at baseline experimental and control group were 20.28 ± 1.06 and 20.87 ± 1.19 ($p = 0.039$).

Table 1: Inter-group analysis of test variables.

Variable	Group (n = 59)	Pre-intervention Mean $\pm$ SD	P-value	Post-intervention Mean $\pm$ SD	P-value
MMSE	Experimental (n = 29)	20.28 ± 1.06	0.039	21.69 ± 1.10	0.046*
	Control (n = 30)	20.87 ± 1.19		21.03 ± 1.18	
MoCA	Experimental (n = 29)	21.17 ± 1.39	0.908	24.07 ± 1.60	0.003*
	Control (n = 30)	21.13 ± 1.63		21.07 ± 1.23	
TMT-A	Experimental (n = 29)	1.57 ± 0.28	0.008	1.21 ± 0.32	0.001*
	Control (n = 30)	1.74 ± 0.30		1.70 ± 0.42	
TMT-B	Experimental (n = 29)	4.59 ± 0.63	0.601	2.97 ± 0.61	0.002*
	Control (n = 30)	4.66 ± 0.64		4.52 ± 0.65	

Mean and standard deviation of TMT-B at baseline for experimental 4.59 ± 0.63 and control group 4.66 ± 0.64 ($p = 0.008$), after intervention mean and SD of experimental group was 2.97 ± 0.61 and for control group was 4.52 ± 0.65 ($p = 0.001$), significant difference in TMT-B scores $p < 0.05$ after 6 weeks of intervention (Table 1). Intra group analysis of neurocognitive measures MMSE, MoCA, TMT-A and TMT-B showed significant improvement ($p < 0.05$) in experimental group after 6 weeks of intervention (Table 2).

DISCUSSION

The current study showed that after 6 weeks of training with aerobic exercises in MCI subjects had significant improvements in cognitive

functions as compared to stretching and active range of motion exercises. Ten Brinke et al in a 6-month trial on MCI women found that aerobic training group showed significantly increased left hippocampal volume.¹⁸ Cammisuli et al proposed that aerobic exercise enhance cognition in MCI patients.¹⁹ Stern et al found marked effect of aerobic exercise on executive functions as people ages, also proposed that it may helpful in minimizing age related cognitive decline.²⁰ Sacco et al reported that regular aerobic exercise increased cognitive performance and improvement in the execution of the cognitive tasks during exercise training added additional benefits for MCI patients.²¹

The present study also found that experimental group showed improvement in neurocognitive measures MMSE, MoCA, TMT- A and B ($p < 0.05$) after 6 weeks of intervention with aerobic exercise. Zheng et al in their meta-analysis of eleven trials concluded that aerobic exercise significantly improved global cognitive ability MMSE, MoCA scores.²² Another meta-analysis done by Groot et al found overall positive effect of moderate-intensity exercise the cognitive function in patients with MCI, additionally they highlighted the beneficial effect of aerobic exercise on cognition and delay the onset of AD.²³ Song and Yu observed marked improved in cognitive functions as well as on health related quality of life scales in intervention group while training with aerobic exercise.²⁴

This study has several limitations among them this study was done on single city of Pakistan by convenient sampling technique, which has limited the generalizability of findings. Secondly, the duration was short as intervention program was limited to 6 weeks. Therefore, it is recommended that further studies with longer duration of exercise intervention should be conducted in other cities of Pakistan.

CONCLUSION

Encouraging participants to perform 20 – 30 min of moderate aerobic exercises has shown beneficial effects. Benefits of Aerobic exercises showed marked improvement on cognitive functions in older adults with mild cognitive impairment after 6 weeks of treatment.

Table 2: Intra-group analysis of test variables.

Variable	Group (n=59)	Median ± IQ Pre-Post	Z-value	P-value
MMSE	Experimental (n = 29)	20 (1.00)	-4.367	0.002
		22 (1.50)		
	Control (n = 30)	21 (1.00)	-1.890	0.059
		21 (1.00)		
MoCA	Experimental (n = 29)	21 (2.00)	-4.739	0.005
		24 (2.00)		
	Control (n = 30)	20 (3.00)	-0.055	0.956
		22 (2.00)		
TMT-A	Experimental (n = 29)	1.45 (0.20)	-4.705	0.003
		1.15 (0.23)		
	Control (n = 30)	1.65 (0.65)	-1.052	0.293
		1.72 (0.67)		
TMT-B	Experimental (n = 29)	4.65 (0.93)	-4.706	0.001
		3.10 (0.95)		
	Control (n = 30)	4.55 (1.05)	-3.525	0.003
		4.35 (0.98)		

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