ORIGINAL ARTICLE

THE EFFECTS OF MULTICOMPONENT EXERCISE ON MILD COGNITIVE IMPAIRMENT IN ELDERLY POPULATION: A RANDOMIZED CONTROL TRIAL

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ABSTRACT

Objective: To determine the effectiveness of multicomponent exercise on mild cognitive impairment in older adults.

Materials and Methods: This randomized control trial was conducted at the Department of Rehabilitation at Pakistan Railway General Hospital, Rawalpindi. Fifty-eight older persons with mild cognition impairment were allocated randomly into 2 groups. The participants of the experimental group (n=29) performed multicomponent exercises two times a week for 55-60 minutes. In the control group (n=29), participants performed 20 minutes of treadmill walking thrice a week. Both groups performed these exercises for 6 weeks. Pre and post assessment was carried out at baseline and after 6 weeks of intervention for the following test: Mini-mental state examination (MMSE), Montreal Cognitive Assessment (MoCA), Trail-making test A (TMT-A) and Trail making test-B (TMT-B). Data was analyzed using SPSS 21.

Results: The mean age of study participants was 62.74±7.4 years. Within-group analysis for MMSE, MoCA, TMT-A, and TMT-B significantly improved ($p < 0.05$) in the experimental group in comparison to the control group. Between-group analysis showed that all parameters were significantly improved ($P < 0.05$) at post-intervention assessment.

Conclusion: Multicomponent exercise training was found to be effective in the elderly with mild cognitive impairment. A combination of exercise can enhance cognitive function, help in the prevention of the decline in cognitive function, and reduce the risk for dementia.

Keywords: Mild Cognitive Impairment, Cognition, Trail Making Test, Dementia

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INTRODUCTION

Mild cognitive impairment is a major concern rapidly affecting elderly persons in developing countries. MCI prevalence reported in individuals older than 65 years is about 10% to 20%. Pakistan is among the 7th densely populated countries, where the number of older persons above 60 years is increasing. It is projected that by 2050 number of the people above 60 years of age will be more than 27 million. [1] The estimated prevalence of people with dementia in South Asia is 2% and approximately 2 million cases of dementia are in Pakistan. This increased number of dementia among older persons is causing economic and social burdens in Pakistan. [2]

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Peterson et al. were the first to describe mild cognitive impairment (MCI) as an intermediate stage between normal aging to dementia. It is an impairment of cognition above that which is observed with age-related cognitive decline. Clinical symptoms include memory and language problems, poor attention, disorientation, and motor impairments. [3] It is reported that 5% to 15% of persons affected with MCI progress to dementia if left untreated. Therefore, early identification and control of MCI subjects may help decrease cases of dementia. [4]

Currently, there is no effective pharmacological treatment for improving cognitive function in MCI patients. However symptomatic benefits are achieved along with numerous side effects of medications. Efforts are made to for interventions that help in decreasing the cognitive decline in older adults. Nonpharmacological interventions like diet, lifestyle modification, cognitive/ brain training games, and moderate physical exercise (aerobic, resistance training) have shown promising effects in improving cognitive function in MCI. [5] Several exercise-mediated mechanisms are reported that help in preserving cognition in elder persons. It is observed that physical exercise

improves the blood supply of the brain, and enhances the brain's neural plasticity, thereby increasing the release of protective neurotrophic factors to improve cognition. [6] A recent systemic review has reported that exercise plays a worthy part in the prevention of cognitive decline and enhances the quality of life of individuals diagnosed with cognitive impairment. Exercise improves the levels of growth factors like brain-derived neurotrophic factor, and inflammatory cytokines, decreasing oxidative stress enzymes and thus increasing cerebral blood flow. [7]

Multicomponent exercise programs include a comprehensive training approach to the combination of aerobic, cognitive, resistance, balance, and coordination exercises with a purpose to improve the physical function of elder persons and help in reversing frailty in the geriatric population. This combination of different exercises helps to potentially improve physical and cognitive functions simultaneously as well as maintains overall health of an individual. The advantages of multicomponent exercise are very familiar regarding physical fitness in elder persons, however, evidence related to improvements in cognitive function as a result of multicomponent exercise is less consistent. [8] Literature shows that aerobic, balance, and resistance training in combination helps to improve cardiovascular fitness, and physical and cognitive functions, which are important for the independent functioning of an individual. Moreover, balance problems are a significant concern in persons with MCI and the balance exercise component of this extensive program helps to reduce the risk of falls in these individuals [9]. To the best of our knowledge, no study has been conducted in Pakistan to investigate the effects of multicomponent exercise on cognition among elderly persons with MCI. Therefore, the purpose of the study was to find out the effectiveness of multicomponent exercise on mild cognitive impairment in older adults.

MATERIALS AND METHODS

A randomized control trial was conducted at the Department of Rehabilitation at Pakistan Railway General Hospital, Rawalpindi from January 2019 to June 2019. The current study was approved by the Internal Review Board (IRB) of Riphah College of Rehabilitation Sciences (Riphah/RCRS/REC/00450). The clinical trial registry number of the study is (NCT03938051) registered under the U.S National Library of Medicine. After taking informed consent the benefits and risks involved in the study were described to the participants. The sample size calculated through the open-epi tool was 58 participants. [10] The study included both male and female participants of age >55 years with MMSE scores 18- 23 (mild cognitive impairment). We have excluded those participants who had a history of neurodegenerative disease /stroke, current medical condition, arterial disease history in the past year, and oncologic patients with active treatment with chemotherapy. By the sealed envelope. 58 older adults were randomly allocated into two groups: an experimental group (n=29) and a control group (n=29). The sample was raised using a convenience sampling technique. The assessment was carried out at the baseline and after 6 weeks of intervention for the following test: Mini-mental state examination (MMSE), Montreal Cognitive Assessment (MoCA), Trail-making test A (TMT-A) and Trail making test-B (TMT-B).

The participants of the experimental group performed multicomponent exercises twice weekly, 55-60 minutes for 6 weeks. A whole exercise program was designed to include progressions and variations. Each session included (aerobics, strength, balance, coordination, agility, reaction time, flexibility, and warm-down). Aerobic includes multi-directional movements. Strength training targets all major upper and lower body and core muscle groups. Balance Training involves both dynamic and static balance. For coordination and agility line drills were performed. Reaction time includes flat-foot drumming and walking with bouncing the ball. The session was completed by performing static stretches on the floor. The detail of the intervention is given in Table 1. The participants of the control group performed treadmill walk thrice a week; 20 minutes for 6 weeks. Participants walked with zero inclination at a steady constant pace at the rate of 5 to 7 points on the ten-point Borg scale.

Statistical analyses were done with SPSS 21. Descriptive statistics were used for qualitative and quantitative variables and data was presented as frequencies, percentages, mean, and standard deviation. Shapiro-Wilk test and normality curve were used to check the data normality. The p-value of the Shapiro-Wilk test for all variables measures was greater than 0.05 therefore, parametric tests were used. To examine the difference between the two groups, an independent samples t-test, however, for the difference between the same group at two different time points, the paired-sample t-test was carried out. $P<0.05$ was considered significant.

RESULTS

Among 145 patients assessed, 58 were included according to the inclusion criteria. The participants were randomly divided into experimental groups (n=29) and control groups (n=29). There were four dropouts from the experimental group and three dropouts from the control group. The analysis included fifty-one participants. Detail of the participants assessed and analyzed is given in Figure-1.

The mean age was 62.74±7.4 years. Among them, 26 (50.98%) male participants and 25 (49.01%) were female participants. The mean age in the experimental group was 64.520±6.25 years, 12 male and 13 female. Whereas, in the control group the mean age was 63.961±6.33 years with 14 male and 12 female partic-

ipants. Within group analysis of the experimental group showed a statistically significant difference ($p<0.05$) between pre and post-treatment values for neuropsychological tests i.e. MMSE (p-value 0.002), MoCA (p-value 0.001), TMT-A (p-value 0.001), TMT-B (p-value 0.033). Whereas group analysis of the control group showed a non-significant difference ($p>0.05$) between pre and post-treatment values for neurological tests i.e. MMSE (p-value 0.067), MoCA (p-value 0.231), TMT-A (p-value 0.064), TMT-B (p-value 0.416). (Table 2). Pre-treatment comparison between the two groups showed no significant difference ($p>0.05$). However, post-treatment between-group comparison showed a significant difference with a p-value of < 0.05.i.e MMSE (experimental group 24.36±2.03 vs control group 20.50±2.14, p=0.004), MoCA (experimental group 23.72±3.04 vs control group 19.13±2.17, p=0.006), TMT-A (experimental group 98.94±69.55 vs control group 100.115±69.13, p=0.005), TMT-B (experimental group 246.200±131.19 vs control group 248.269±115.60, p=0.037) (Table 3).

Table No 1. Multicomponent exercise program

TYPE	PHASE 1 Time, intensity	PHASE 2 Time, intensity	PHASE 3 Time, intensity
Aerobic	10mins, 3-4/10RPE	15mins,4-5/ 10RPE	15mins,5-6/10RPE
Strength	15 mins, 2sets 6-8reps	10 mins, 3sets 6-8reps	10 mins,4sets 6-8reps
Balance	10mins	10mins	10mins
Coordination agility	10mins	10mins	10mins
Reaction time	5mins	7 mins	7 mins
Flexibility	10mins,3-4/10RPE Minimum 20 sec	8mins,3-4/10RPE Minimum 20 sec	8mins,3-4/10RPE Minimum 20 sec

Table No 2: Within-group analysis

Variable	Group (n=51)	Mean ± SD Pre and post	P value
MMSE	Experimental (n=25)	20.92±1.65	0.002*
		24.36±2.03	
	Control (n=26)	19.19±1.60	0.067
		20.50±2.14	
MoCA	Experimental (n=25)	18.12±3.28	0.001*
		23.72±3.04	
	Control (n=26)	18.53±2.30	0.231
		19.13±2.17	
TMT-A	Experimental (n=25)	136.72±107.64	0.001*
		98.94±69.55	
	Control (n=26)	102.15±67.10	0.064
		100.11±69.13	
TMT-B	Experimental (n=25)	289.16±130.62	0.033*
		246.200±131.19	
	Control (n=26)	247.34±111.56	0.416
		248.269±115.60	

Table No 3: Between-group analysis

Variable	Experimental group Mean± SD	Control group Mean± SD	P value
MMSE Pre	20.92±1.65	19.19±1.60	0.318
MMSE post	24.36±2.03	20.50±2.14	0.004*
MoCA Pre	18.12±3.28	18.53±2.30	0.460
MoCA Post	23.72±3.04	19.13±2.17	0.006*
TMT-A Pre	136.72±107.64	102.15±67.10	0.706
TMT-A Post	98.94±69.55	100.115±69.13	0.005*
TMT-B Pre	289.16±130.62	247.34±111.56	0.069
TMT-B Post	246.200±131.19	248.269±115.60	0.037*

DISCUSSION

The current study showed that multicomponent exercise training was effective in older adults with mild cognitive impairment. Takao Suzuki et al in their work concluded that a multicomponent exercise program provides beneficial cognitive effects for the elderly with aMCI. They further suggested that exercise benefits were evident for logical memory and general cognitive function. [11] Another RCT conducted by J. Thaiyanto, et al. on elderly women demonstrated that multicomponent exercise training that includes aerobic, resistance, and balance exercise showed beneficial effects in the exercised group $p<0.05$. [12] Another trial done by Takao Suzuki et al. found that improvements in cognitive performance were reported following multicomponent exercise in the treatment group with significant results in MMSE, logical memory, and letter verbal fluency test ($p< 0.05$). [13] In a review conducted by Mikel López Sáez de Asteasu and his colleagues also proposed that in older adults multicomponent exercises had positive effects on cognitive functions. [14] Patrick Eggenberger et al. in their trial proposed that in the elderly beneficial results were reported with multicomponent cognitive training programs. It also had positive effects which boost executive functions in older adults. [15] Betul Fatma Bilgin and Gozde Iyigun proposed MTT and MCT regimes found to be effective in improving cognitive as well as physical outcomes in persons with mild cognitive impairment. [16] The study conducted by Ma, C Y A et al. revealed beneficial effects of multi-component physical exercise program training and results in improvement of attention, executive function, and dual-task performance in elderly with MCI. [17] Navin Kaushalet et al. in their study concluded that multicomponent exercise had positive effects on cognitive functions in the elderly and also proposed that regular session could enhance their executive functioning, which improved their HR-QOL[18]. Qiao-hong Yang et al described improvements in cognitive performance, physical function, depression, and quality in MCI older adults with multicomponent exercise intervention in the East Asia region. [19] Another trial conducted to find the effects of multicomponent exercise training by Li L et al. on MCI showed significant improvement in MMSE and MoCA scores $p<0.05$ in the experimental group which supports our study findings. [20] In the latest review by Luis Carlos Venegas-Sanabria et proposes that beneficial effects on elderly with MCI or dementia were reported with multi-component physical exercise and hence effects on global cognition. [21]

The current study has a sample size was small. No long-term follow-up was conducted. Other parameters of strength, balance, fall, and quality of life were not addressed in this study. Furthermore, confounding factors such as the incidence of hypertension, diabetes, hypercholesterolemia, dyslipidemia, depressive and anxiety symptoms, and the use of medication were not identified. So future research should be conducted with different exercise intensities and combinations, longer duration, and follow-ups. Moreover, research should be carried out to find the effects on Dementia and Alzheimer's patients.

CONCLUSION

Multicomponent exercise programs that include aerobic, strength, balance, coordination, reaction time, and flexibility exercises have positive effects in the prevention of the decline in cognitive function and moreover, reduce the risk for dementia and AD.

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Authors Contribution:

Following authors have made substantial contributions to the manuscript as under

Authors	Conceived & designed the analysis	Collected the data	Contributed data or analysis tools	Performed the analysis	Wrote the paper	Other contribution
Khattak HG	✓	✓	✓	✓	✓	×
Arshad H	✓	×	✓	✓	✓	×
Aman S	×	×	✓	×	✓	✓
Amjad I	✓	×	✓	✓	×	✓

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Ethical Approval:

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