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WALKING ACTIVITY AND AQUATIC EXERCISE ON MEMORY OF IRANIAN RETIRED MALE TEACHERS

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Abstract
The purpose of the present study was to examine the effect of eight weeks of walking and exercising in water with different intensities on memory of elderly men. The population included 60 to 75 years old men who were living in Kahrizak Foundation, out of whom 50 people were selected as the research sample. To implement the intervention, two training protocols of walking and exercising in water with low (30-40%) and moderate (40-60%) intensities were used in eighteen 45-min sessions. Personal information questionnaire and Wexler Memory Test were also used for matching and selecting the participants in the research groups; after the training intervention, Wexler Memory Test was re-used for studying memory condition of the participants. Two-way covariance analysis method was applied while analyzing the data. In this method, training type and intensity were considered the first and second factors, respectively. Moreover, age was considered the covariance variable to control for the participants' age. Results of two-way covariance showed that walking and exercising in water had a positive effect on memory of elderly men while training intensity did not have any significant effect on their memory. Bonfroni post-hoc test demonstrated no significant difference between various types of training intensity in each type of exercise and no significant difference was observed between different types of aerobic exercises with special intensity. Generally, these results showed that aerobic exercises had a significantly positive effect on memory of elderly men, which may be independent from type and intensity of aerobic activities.

Keywords: *Memory, Retired Male Teachers, Aerobic exercises, Training type, Training intensity*

Introduction

Memory is one of the most important issues in the field of health, especially during aging period (1). Decline of information processing system continues throughout adulthood years and various aspects of this system are affected with increasing age and reaching the old age (4). Researchers believe that aging process in brain tissue is accompanied by decrease in the number of neurons and cellular density, which may result in decreased performance capacity of brain and, as a result, structure and function of hippocampus; consequently, evident changes in memory power may be observed during aging years (2).

It seems that there are different ways which will decrease brain's aging speed and memory at older ages, one of which is doing continuous exercises and physical activities. Studies on humans and animals have shown that exercise will postpone aging process and increase life time (12), improve brain function (including increased synaptic plasticity, learning and memory) (13), increase hippocampus' electrical activities (due to changing activity of neuron and neurotransmitter) (16), and help to cure diseases caused by aging (17). Thus, regular physical activities are one of the most important factors for maintaining body and mental health among the elderly so that these activities have been developed by a group of experts from more than 150 national organizations in the USA as one of 15 priorities for behavior changing in order to achieve health (14).

Research results suggest that increased regular physical activity is related with some health factors including improving cognitive functions so that physical activity can play an important role in

ISSN 1512-1801

maintaining cognitive functions, especially in aging period in which people face loss of some cognitive abilities (15). Although physical activity and exercises are among the techniques for preventing, postponing or curing aging-caused problems and their positive effect on improving health and life quality of the elderly have been proved (7), statistics shows that significant percent of the elderly do not participate in regular physical activities (21).

In addition, several studies have specifically demonstrated that regular physical activity can improve memory and brain health (28.9 and 27). Research results in this field have suggested that the number of brain neurons, particularly hippocampus, increase due to physical activity (17). Electrophysiological studies have also shown that long-term physical movements (such as running or walking) increase electrical activity of hippocampus due to changes in activities of neurons and neurotransmitters (16). For example, results of the study by Keramer, M. et al. (2006) showed that long-term aerobic exercises prevent dementia in the elderly (20). Miranda, G. Dik et al. (2003) studied the relationship between rate of physical activity with medium intensity in early years of life and memory operation in the aging period; the results obtained by these researchers indicated that physical activity in early years of life may postpone memory loss in aging period (23). Weinberg, R.S et al. (1995) demonstrated that water exercises and aerobic exercises produce positive changes in temperament and mental health compared with anaerobic physical exercises (31). Nevertheless, Blumenthal, J.A. et al. (1991) showed no difference in cognitive function between active and inactive elderly groups. These authors attributed the results to the type of training which was given to the elderly and its different intensities (11).

In spite of the mentioned studies in this section and other researches in this field, the difference in impact(s) of low and moderate training intensities on memory is not evidently known. However, recent studies have shown that every type of energy consumption during exercises in aging period helps improve cognitive and physical functions, which rejects the previous belief that training with specific intensity are effective (29 and 24). In addition, recent cross-sectional studies on groups of elderly have acknowledged that general activity level may be more important than training intensity for improving memory function in the elderly (22).

Due to the expansion of health and medical facilities and improvement of living conditions in recent decades, global population of the elderly is increasing. According to reports of World Health Organization, there are 10 elderly people with age of 65 years old or more against each newborn child in underdeveloped countries and it is estimated that this figure will reach 15 people in 2020. In this regard, statistics showed that the elderly composed 17% of the world population in 2006. It has been also predicted that this figure may reach 21.1% (i.e. around one-fifth of world population) by 2050. This matter highlights the necessity for paying attention to this age group (19).

Considering the mentioned issues, it is found out that most studies on memory have not dealt with differences in various training intensities and types. In most of these studies, there is just one aerobic or resistance exercise with low or moderate intensity. Most of the research about effects of regular physical activities on memory has been implemented on animal models, which can be hardly generalized to the elderly; thus, considering the elderly and their problems in the field of brain health, especially memory, is more than necessary.

Walking and exercising in water are two different types of aerobic activities; walking has high falling risk while exercising in water removes the falling risk (17). Considering that falling risk increases during aging period, it is important to select type of physical activity. Therefore, one of objectives in this study was to compare effects of both activities in order to select the sport activity which can be appropriate for the conditions of the aging period. So, the present study aimed to investigate effect of two aerobic exercises (walking and exercising in water) and compare effects of different intensities of both of these exercises on memory of the elderly.

Research Method

The present research design was of quasi-experimental type with applied purposes. Statistical population of the research included elderly men from 60 to 75 years old who were selected from

ISSN 1512-1801

Kahrizak Sanitarium. Convenience sampling was used for selecting the sample. Several criteria were also considered for selecting the participants; 1) their age must be above 60, 2) they can walk without any auxiliary tools, 3) they should not have any background of cardiac-pulmonary diseases (final confirmation by a physician only), 4) they should be able to participate in training programs, and 5) they should almost equally do mental games or solve puzzles. The sample size was determined based on previous studies' results using G Power (Power and Sample Size Determination) software for every 10-people group (5 groups) (significance level of 0.95 and statistical power of 0.80). Therefore, 50 people were selected from among the elderly in Kahrizak Sanitarium; they voluntarily participated in this study after getting familiar with the process and method of holding training programs and tests and obtaining their written consent.

In this research, Wechsler's Test was used for measuring memory. This test included seven subtests of 1) general memory, 2) orientation, 3) mind control, 4) logical memory, 5) forward and backward digit repetition, 6) visual memory, 7) associations learning. Memory utilization score was obtained by summing these subtests. In a research, Sarrami (2005) studied validation of Wechsler Memory Test in the population of Tehran and confirmed reliability and validity of the test (5). It is necessary to mention that the test was first implemented before the interventions in order to homogenize the studied groups and then it was given to the participants again at the end of the interventions as a post test.

In addition, in this study, Polar clock rate was used to measure heart rate of the participants. This tool was also used to control training intensity. Polar clock rate specifies the number of heart rate in a given period with the determined intensity (3).

Finally, personal information questionnaire was used to evaluate selection criteria and control confounding variables. This researcher-made questionnaire investigated reviewed age, education level, type of possible disease, type of consumed drug, marital status and so on as self-reporting.

Methods

The participants were divided to five groups so as to examine effect of aerobic training on memory of the elderly. These five groups included aerobic training group of low-intensity walking, aerobic training group of moderate-intensity walking, low-intensity training in water, moderate-intensity training in water and control group.

Groups 1 to 4 performed aerobic training with specified intensities for 8 weeks, three 45-min sessions per week. To do the training, first, the participants' heart rate was recorded; then, their heart rate was fixed within a pre-specified range under the influence of training and physical movements. Accordingly, the first group conducted warm-up exercises and walking until reaching the range of 30 to 40% of maximum heart rate; also, the second group performed warm-up exercises, fast walking with appropriately moderate intensity for the elderly and climbing up the stairs to reach the range of 40 to 60% of maximum heart rate. Group of training in water with low intensity (third group) conducted forward walking, side walking, slow in-situ running and hugging knees until pain range to bring the heart rate to 30 to 40% of maximum heart rate. Finally, training of the fourth group (group of exercise in water with moderate intensity), which was carried out in the range of 40 to 60% of maximum heart rate, included forward walking, backward walking, side walking, spatial walking, trunk rotation, step up, opening body in water, hopping in water, hugging knees until pain range, abdomen movement in water within their ability, in-situ running and mobile running (17).

Statistical indexes of mean and standard deviation were used to statistically describe the data. To investigate the effect of training on the dependent variable (memory of the elderly) and to compare pairs of the groups, two-way covariance analysis (ANCOVA) and Bonfroni Test were used, respectively. All the statistical analyses of this study were done in SPSS 16.

Results

ISSN 1512-1801

Two-way covariance analysis (ANCOVA) was used to examine effect of aerobic exercise in water and walking with different intensities. In this analysis, three groups of aerobic exercise in water, walking and control group were considered the first independent variable (to investigate effect of intervention type), low and moderate intensities were considered second independent variable (to investigate effect of intervention intensity) and score difference of Wexler Memory test between post and pre tests was assumed to be the dependent variable. In addition, to control effect of age, this variable was considered the covariate variable.

Before doing the analysis, Leven's Test was used to study the assumed equality of dependent variable's error variance among the research groups. Lack of significance in this test meant equality of error variance of the dependent variable among the research groups. Test results showed that error variance of the dependent variable was equal for the research groups (F=0.92; sig=0.475) and ANCOVA method can be used in the research.

To describe the data, mean and standard deviation were used. Table 1 shows descriptive statistics related to the dependent variable (score difference of memory between pre and post tests) for the research groups.

Table 1: Descriptive statistics of a dependent variable for the research groups.

Intervention type	Intensity	Mean	Standard deviation	Number
Aerobic training in water	Low	20.50	74.7	10
	Moderate	20.00	3.09	10
	Total	20.25	23.9	20
Walking	Low	24.00	44.7	10
	Moderate	21.00	3.97	10
	Total	22.50	4.52	20
Control	Total	1.00	3.61	20

Dependent variable: Score difference of memory between pre and post tests

Results of two-way covariance analysis showed that effect of intervention type on memory of the elderly with high effect size (0.911) was significant while effect of intervention intensity as well as the interactional effect of intervention's type and intensity with negligible effect sizes (0.035 and 0.042, respectively) was not significant (see Table 2). In other words, results of the research demonstrated that aerobic exercises in water and walking affect memory of the elderly; but, their intensity and interaction of their type and intensity did not have any effects on memory.

Table 2: Results of two-way covariance analysis for studying effects of type and intensity of training on memory of the elderly

Source of changes (effects)	Sum of squares	Degree of freedom	Mean of squares	F	Significance	Effect size
Constant	124.48	1	124.48	11.77	0.001	0.182
Age (covariance variable)	322.14	1	322.14	730.4	0.000	0.365
Intervention type (first independent)	5711.18	2	2855.59	9270.0	0.000	0.911
Intervention intensity (second independent)	220.4	1	220.4	1.93	0.170	0.035

ISSN 1512-1801

Interaction of type and intensity	24.43	2	212.2	61.1	0.323	0.042
Error	560.36	53	10.57			

Dependent variable: Score difference of memory between pre and post test

Also, Table 2 shows that participants' age in this research, as covariance variable, influenced efficacy of training interventions on memory of the elderly. ANCOVA results in this study were also presented by controlling for the age effect.

Bonfroni post-hoc test was used to investigate significance of multiple comparisons in 3 groups of first independent variable (intervention type) including aerobic exercising in water, walking and control groups and two groups of second independent variables (intervention intensity) including low and moderate intensities. The results are presented in Table 3.

Table 3: Multiple comparisons of the research groups

Criterion group	Comparison group	Mean difference	Standard deviation	Significance
Aerobic exercise in water with low intensity	Aerobic exercise in water with moderate intensity	0.50	0.67	1.00
	Low intensity walking	3.50	0.82	0.065
	Moderate intensity walking	0.50	0.59	1.00
	Control	19.50	1.029	0.000
Aerobic exercise in water with moderate intensity	Low intensity walking	0.50	0.61	1.00
	Moderate intensity walking	1.00	0.78	1.00
	Control	19.00	1.028	0.000
Low intensity walking	Moderate intensity walking	3	0.66	0.083
	Control	23	1.12	0.000
Moderate intensity walking	Control	20	1.23	0.000

Balance method for multiple comparisons: Bonfroni

As shown in Table 3, there was no significant difference between groups of aerobic training in water and walking; however, the difference between these two groups and control one was significant. These results showed effects of each of the groups of aerobic exercise in water and walking on memory of the elderly. This table also showed that low and moderate intensity interventions were not significantly different from each other; i.e. interventions' intensity had no effect on memory of the elderly.

Discussion and Conclusion

The present research was performed to examine effect of two aerobic exercises of walking and exercising in water with low and moderate intensities on memory of the elderly. Generally, the research results showed that memory of the elderly in four groups of walking and exercising in water with low and moderate intensities was accompanied by significant improvement compared with the control group. In addition, although these results suggested that aerobic exercises,

ISSN 1512-1801

regardless of their type and intensity, could improve memory of the elderly, they demonstrated that type and intensity of training do not have significant differences from and advantages over each other. In general, to explain these results, some studies which have demonstrated positive effect of adopting special lifestyles on general health of people in aging period should be referred to. One of these lifestyles is to get involved in regular aerobic physical activities with different intensities (10). In a meta-analytic research, Kramer et al. (2006) analyzed results of a research on over 55 year old people from 1966 to 2001. Results of the meta-analysis showed a significant relationship between aerobic activities and improvement of cognitive functions (20).

Hippocampus is a part of midbrain with a key role in certain aspects of learning and memory. Neuropsychological studies have shown that hippocampus synapses have a specific and flexible form called long-term potentiation (LTP), which can be related to memory performance in this area. Results of many studies have revealed that types of aerobic activities (8) with different intensities (27) can considerably influence flexibility of hippocampus synapses. Results of the present research were in line with these results and indicated significant effect of aerobic training (in land and water) with different intensities (low and medium) on memory improvement.

In a research by Miranda et al. (2003), the relationship between types of physical activities from low to moderate intensity was investigated in early years of life and memory performance and prevalence of Alzheimer's disease during the aging period. They reported that types of physical activities in early years of life might postpone memory decline in aging period. To explain these results which were consistent with those of this research, it can be noted that low intensity training leads to the release of a growth factor (brain-derived neurotrophic factor-BDNF). This growth factor can prevent Alzheimer's disease and make hippocampus cells resistant (14). Also, it seems that, training volume (regular and long-term exercises) which causes more blood perfusion in a longer period is the factor for more release of this factor, not training intensity (23).

Also, consistent with the results of the present research, Ralph et al. (2011) showed that aerobic exercises in water improved physical fitness, relaxation and social relations (26). Arab Ameri (2011) reported significant effect of key stage developments (KSD) and aerobic activities in water on memory of the elderly. To explain these results that were consistent with the results of this research, it can be mentioned that brain's memory-related structural changes depend more on the consumed energy of bodily activities than type of physical training because efficacy mechanism on brain structures (hippocampus) react to the rate of received blood (6).

Furthermore, results of this research were consistent with those of Partow et al. (2005) (24), Flown, F.N et al. (2009) (18) and Sadati et al. (2010) (28) in terms of the effect of physical training and activities on improving memory performance. In contrast, results of this research were not in line with those of Powel, R et al. (25) and Blumenthal, J. A. et al. (1991) (11). Powel, R et al. reported that cognitive functions of the elderly who had regular physical training were not different from the inactive ones. Blumenthal, J. A. et al. (1991) also found no difference in terms of cognitive functions between active and inactive elderly. To explain this inconsistency, effect of individual differences on results of the studies, due to ignoring pre test, difference in the type of measurement tools and implementation manner of training protocol, can be referred to.

As demonstrated by the results of this research, there was no significant difference between type and intensity of training. The results were consistent with those of Varela et al. (2011) (30) and Rescho et al. (2009) (27). Varela et al. (2011) conducted a research entitled "effect of two different intensities of aerobic training on the elderly with mild cognitive impairment" during three months and performed aerobic training with low (40% of maximum heart rate) and moderate (60% of maximum heart rate) intensity among 48 elderly people. After data analysis and confirming efficacy of training on preventing declined cognitive function in patients with mild cognitive impairment, no significant difference was found between the two groups which received training with different intensities. In explaining these findings, they mentioned that training intensity in aerobic training cannot be an effective factor for preventing declined cognitive function (30). In the research on the elderly by Rescho (2009), two types of aerobic training of walking with low intensity and

ISSN 1512-1801

gymnastic movements with moderate intensity were used to conclude that both low (40% of maximum heart rate) and moderate (60% of maximum heart rate) intensity aerobic activities had a significant effect on improving memory of the elderly and expanding neuronal area of hippocampus (27). This study was consistent with the present research that was performed using two aerobic training with low and moderate intensity; thus, it can be concluded that increasing rate of brain's necessary cells and BDNF was equal at low and moderate intensity.

Considering results of the present research and most of the performed studies in the field of physical activities and exercises of the elderly which show the efficacy of these activities on the improvement of memory, it is suggested for the elderly to select type and intensity of their aerobic exercises according to their taste, ability and motivation in order to improve their memory. Finally, improving memory as a cognitive issue is accompanied by this logic that adopting training programs as aerobic ones, regardless of their intensity and type, is very important.

One of the most important limitations of this study was lack of selection and random selection of the participants. In addition, this study had several administrative limitations, the most important of which were limitation of attention span and premature fatigue in the elderly.

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