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European Journal of Experimental Biology, 2013, 3(2):353-362

ISSN: 2248 –9215
CODEN (USA): EJEBAU

The effects of physical and mental activity on the memory in 50-70 year-old-women with mild cognitive impairment

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ABSTRACT

The world is aging. The increase of lifetime and the number of elderly people cause some concerns about the future and inevitable problems which will exist for this particular period of time. Now the scientists and experts of Aging, Geriatrics and other sciences are trying to find ways to prevent diseases, delay aging and successful aging experience. It is expected that each of 10 people over 60 suffers Alzheimer and this rate reaches 4in people over than 85. Alzheimer is a progressive disease, which reaches more advanced stages in case of non-intervention. Some methods include physical and mental activities have shown that they can be effective in preventing and eliminating disease progression. The objective of this study is also verifying the effect of physical and mental activities on the memory function level of the 50-70 year-old-women who are affected by memory impairment. 32 female subjects (mean age 61/1 ± 6/5) with MCI = 0.5 (mild cognitive impairment), illiterate, healthy (Based on the medical view for participation in physical activities) and without regular physical and mental activities in Tehran elderly nursing home were selected. The randomly practices intervening: the first group: education of reading and writing, the second group: physical activities and in the third group; education of reading and writing and physical activities. Also the fourth group (control) participated in the research without any activities. (Each group consisted of eight persons). Duration of intervening was three months, three sessions per week and each session was held for 60 minutes. The combined exercise group attended in each class for 30 minutes. For the diagnosis of dementia, the Clinical Dementia Rating (CDR) was used. Also in order to control the depression level before and after implementation of the plan; the Geriatric Dementia Scale (GDS) was done. To evaluate the datum paired t-test and the ANCOVA analysis method and the Bonferroni post hoc were used. The results indicated that all three intervening methods in the mental, physical and combined methods have had significant effect on the memory impairment in increasing the memory level of the 50-70 year-old-women with MCI and the highest effects existed in the physical activities group and the less effect existed in the combined activities group. Being affected for subscales in all three groups was the memory subscale. In this consideration, no changes were observed in the depression level and the level of depression has not interfered in the function level of the participators. In this study, interventional procedures including physical and mental and combined activities have caused an improvement in the memory of 50-70-year-old women with mild cognitive impairment. So doing the physical and mental performance in patients with less cognitive impairment is effective.

Keywords: Alzheimer, Clinical Dementia Rating, Mental Activity, Mild Cognitive Impairment, Physical Activity.

INTRODUCTION

The past century has been the rise of human life. In the last 100 years, the average of human life expectancy in developed countries has been increased by 30 years. The average of life expectancy for Iranians also was added by 10 years during the decade 1986 to 1996[1]. According to the latest data in the Iranian elderly population (65 years and older) in 2006, this population from 5 million persons will reach 26 million persons in 2049[2]. The increase of lifetime is associated with aging problems and specific diseases. Therefore, methods to prevent delay and treat the complications and consequences will be the long-term goals from different perspectives in the world.

One of the major problems of this period is disease of dementia. The most common type of dementia is the Alzheimer disease. Symptoms of Alzheimer disease include loss of memory, judging, and reasoning, and cognitive decline, sleep disorders, mood and personality changes [1].

Since the problems of memory cause pains and suffering in the patients and their families and paying much inevitable costs for this disease, make us to verify and review the methods which can reduce such diseases and problems for the patients. Although a precise estimate does not exist in Iran and developing countries in this field, but according to a study in the developed countries, the cost of care and treatment of Alzheimer disease over a lifetime could be about $ 174.000 and the cost of keeping patients in hospital has been estimated as $ 19.000 (World Alzheimer Society in 2006) and the more the disease be advanced, the costs will be more. Therefore, using different techniques in attempt to stop the progression of disease, eliminate the progression of Alzheimer and prolong the gap of mild to severe Alzheimer is necessary.

If these activities to be effective, a big economic load could be removed from the family and the government and as a result a feeling of happiness and reduction of depression will occur for the patient and those who are around him/her.

The Alzheimer develops from the weak memory impairment to moderate and then advanced one during the time. There is no cure for this disease. Despite of this issue, some of the medications are able to influence the procedure of the disease and to be a controller for the disease too.

The dynamic and challenging environment, social relationships and mental and physical activities are important factors in maintaining memory. According to the scientific researches which have been done in this field, the effects of these factors on memory are due to the increase of partial blood flow and production of new nervous cells [3, 4, 5, 6, 7 and 8].

An infrastructure change in the field of physical activities effects on the nervous cells, production of new cells (Neurogenesis) which was followed with doubts during the decade 1960, but after some years the existence of the new cells in Olfactory Bulb and Dentate Gyrus were confirmed in human and animals hippocampus and this idea was confirmed that the brain of mammals are able to produce new cells3. This increase during the lifetime even during the elderly era occurs through the increase of Glya cells and production of dendrite branching.

Kramer and colleagues in 2006 showed that even relatively short-term aerobic training (6 months) prevents the brain volume from the process of aging. In this study, the gray section of the brain of active persons in the upper frontal temporal was increase [5]. Some research also concluded that aerobic and resistance exercises improve brain function and structure.

Also the studies have indicated that physical activities in humans cause an increase for recognition and memory [9, 10], delay the reduction of the memory relevant to age [11, 12] and a delay in the start of nervous system destruction [13, 14]. Curtin, the famous physiologist, in the study of more than 200 research works on the effects of exercise in the elderly concluded that old age and weakness occurs so quicker for all those who do not exercise and the nervous system of elderly athletes is more active than the Non-athletes elderly [15].

In the effect of exercise on mental and cognitive memory of Valenzuela and Sachdev in 2009, in the meta-analysis of 54 research projects, showed that the cognitive training is a good exercise to avoid dementia; and the experimental group with an average of more than 3 months of cognitive training indicated an extraordinary and strong effect that even lasted for two years [16].

The lack of researches in the field of comparison of different methods affecting on the memory in Iran made the researchers to verify and compare the effects of aerobic, mental and combined activities on the level of memory

function. Generally the question is that after detecting the persons who suffer from complain about their own memory, is this possible to avoid the speed of dementia? Is this possible that we cause the stability of nervous system by physical, mental and combined methods even for a bit? Is this possible that dementia associated to aging to be prevented and the Alzheimer to be delayed for a time? Is this possible to prescribe physical and mental activities to reach long-term aging and the successful experience? Which methods of physical, mental and combined activities are more effective on memory?

MATERIALS AND METHODS

Participants

From the 250 elderly women aged 50 to 70 years old resided in the nursing house of Qods city in Tehran, the questionnaires relevant to personal information were completed; all the persons who were fine physically and mentally, uneducated and without regular exercises and mental activities were selected. Some of the participants got out of the plan due to the lack of their tendency to take part in the plan and they were taken to another center. Eventually 32 elderly (mean age: 61/1±6/5) participated in the project. All individuals based on the confirmation of doctor, were physically able to perform all phases of the project.

Instruments

Test scores of Clinical Dementia Rating Persian version (CDR-P) and Geriatric Depression Scale (GDS) before and after the project were provided. The information relevant to CDR test was received based on the interviews from participants and their accompaniers (councilor and the authority of nursing center) and the information relevant to depression test was obtained from the participants as questions and answers.

CDR-P has a high acceptable validity based on the comment of the neurologists and psychologists, and the initial reliability was 73% and the stability coefficient was 89 % [17]. The test included 75 questions in six subscales of memory, time and place orientation, judgment and problem solving, community affairs, home and recreation and personal affairs. CDR scores in the memory function is the reverse. In other words the decreasing or increasing scores on the subscale or total score, showed improvement and loss of memory, respectively.

Geriatric depression sale includes 15 questions (either yes or no options) and with a validity of 0.9 and Cronbach's coefficient 0.9 and split-half coefficient of 0.89[18].

Procedure

The current research is a Quasi-experimental study. The control variables included: age, sex, level of brain function, level of education, level of physical and mental activities and economic and social status. The persons were randomly selected and according to the same distribution of different ages divided into four groups: (each group consisted of eight persons) and they were put in the exercise groups randomly. The program in the first group: mental activity (teaching to read and write), the second group: Physical activities (doing rhythmic aerobic exercise), and the third group: A combined method (physical plus mental activities) and the fourth group (control) were without any activity.

The plan duration included three months, three days per week and each session was 60 minutes. The persons in the combined group were present in the each class of mental and physical exercises class for thirty minutes.

Statistical Analysis

All the variances in the testing groups before analysis and description of results were indicated with Leven test. To analyze the level of effects of physical, mental and combined activities on the CDR-P (total score) and its six sub factors (inter-difference), the paired t-method is used. To consider the difference of groups (intra-differences) the ANCOVA test and the Bonferroni post hoc test are used. All statistical methods were calculated in the alpha level 0.05 respectively.

RESULTS

The effect of age ($F= 1.10$ and $P= 0.52$) and depression level ($F= 0.76$ and $P= 0.52$) the participants were not in the meaningful group. Therefore age and depression are not considered as covariate variables ($P> 0.05$). Also in the consideration of the change in level of depression, the results showed that there is no significantly differences in depression among the participants before and after the intervention ($t= -0.65$ and $P> 0.05$). This means that depression is not effective in changing the level of memory function.

In the consideration of the effect of physical activities on CDR-P, the results showed that the physical activity has a significant impact on CDR-P (t= 6.45 and P< 0.05) (Table 1).

Also, the effect of physical activity on the six sub factors of CDR-P is positive and significant (Table 1).

Table 1: A comparison to the average of memory function scores for the participants, before and after physical activities

Subscales	Before		After		t	P
	Average	Standard deviation	Average	Standard deviation		
Memory	0.62	0.23	0.18	0.25	7.00	0.0001
Orientation	0.31	0.37	0.06	0.17	2.64	0.033
Judgment and Problem Solving	0.75	0.26	0.06	0.17	5.22	0.001
Social Affairs	0.56	0.32	0.31	0.25	2.64	0.033
Home Affairs and Recreation	0.56	0.41	0.18	0.37	3.00	0.020
Personal Affairs	0.00	0.00	0.00	0.00	...	...
CDR-P(total score)	0.46	0.20	0.12	0.09	6.45	0.001

The highest level of positive effects is the physical activity on most sub factor of memory (t= 7.00) and lowest on the social affairs sub factor and orientation of women (t=2.64).

In the evaluation of the effect on mental activities on memory, the results showed that the mental activities have a significant and positive impact on the memory function level (t= 9.00 and P< 0.05) (Table 2).

Table 2: A comparison to the average of memory function scores for the participants, before and after mental activities

Subscales	Before		After		t	P
	Average	Standard deviation	Average	Standard deviation		
Memory	0.81	0.37	0.31	0.25	5.29	0.001
Orientation	0.68	0.25	0.37	0.23	3.41	0.011
Judgment and Problem Solving	0.87	0.23	0.31	0.37	4.96	0.002
Social Affairs	0.62	0.35	0.18	0.37	2.96	0.021
Home Affairs and Recreation	0.68	0.25	0.25	0.37	3.86	0.006
Personal Affairs	0.00	0.00	0.00	0.00	...	...
CDR-P(total score)	0.61	0.13	0.23	0.18	9.00	0.001

In the consideration of the effect of mental activity on the six sub factors of CDR-P, results in Table 2 indicate a positive impact on reducing mental activity scores. The most positive effect of mental activity on memory sub factor (t=5.29) and the lowest impact on sub factor has been observed as the social affairs (t-2.96).

In the consideration of the effect of the combined activities on memory, the results showed that a combination of activities has significant impact on memory function (t=7.51 and P<0.05) (Table 3).

Table 3: A comparison to the average of memory function scores for the participants, before and after combined activities

Subscales	Before		After		t	P
	Average	Standard deviation	Average	Standard deviation		
Memory	0.68	0.25	0.18	0.25	5.29	0.001
Orientation	0.56	0.17	0.31	0.25	2.56	0.033
Judgment and Problem Solving	0.75	0.26	0.31	0.37	2.96	0.021
Social Affairs	0.68	0.37	0.25	0.26	7.00	0.000
Home Affairs and Recreation	0.75	0.37	0.43	0.32	2.37	0.049
Personal Affairs	0.00	0.00	0.00	0.00	...	...
CDR-P(total score)	0.57	0.13	0.25	0.17	7.51	0.001

Also the effect of combined activities on the six sub factors was positive and significant. The highest level of positive effects of combined activities has been for the social affairs sub factor (t=7.00 and P< 0.05) and the lowest impact has been on the home and recreation affairs (t=2.37 and P<0.05).

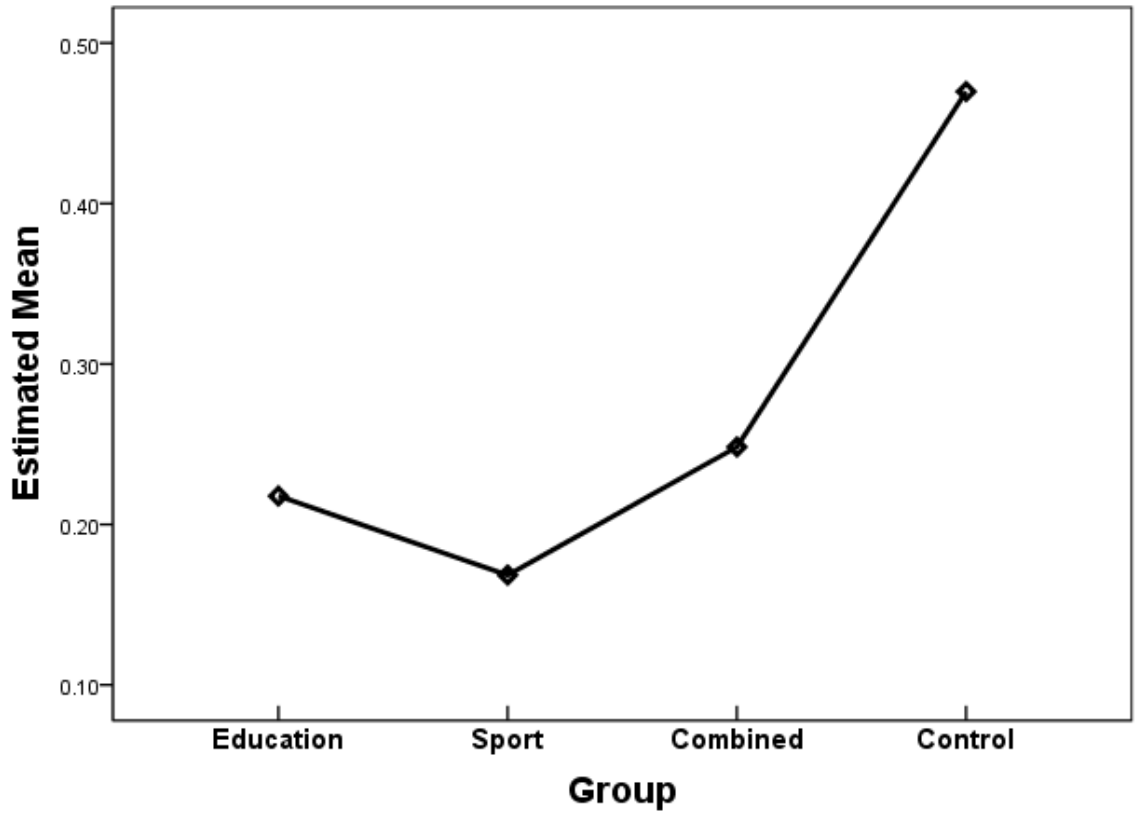
In comparison the effect of groups on the CDR-P and sub factors was analyzed by using ANCOVA method, the pre-test score (before of intervention) in each subscale as a covariate variable used. After confirming the existence of differences between groups (α =0.5), Bonferroni post hoc test showed the highest level in the physical activity group and lowest in the combined exercise group (table 4) (Graph 1).

Table 4: A comparison of post CDR between groups

groups	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
education	.218a	.048	.118	.317
sport	.168a	.049	.068	.269
education+sport	.248a	.047	.152	.345
control	.470a	.049	.369	.571
a. Covariates appearing in the model are evaluated at the following values: age = 61.1875, preq7 = .5703.				

In other words the methods of physical activities have the highest effects on prevention of memory loss.

Graph 1: the level of effects of physical, mental and combined activities on memory function level



DISCUSSION

Based on the theoretical foundations, some methods of intervention can improve memory function. The expanded and increasing researches in the world in the field of influence of physical activity on the memory are running. The overall objective of this study was to assess the effect of physical, mental and combined activities (physical and mental) on memory function in women with the age of 70-50 years old who suffered memory impairment.

Physical activity and memory

In the consideration of the effect of physical activities on memory, the results of the current research indicated that the physical activities has a positive effect on the memory function of the 50-70 years old women with mild cognitive impairment and the highest effects are on the memory and the ability of solving problems sub factors. Some researches are contrary to this study [19, 20, and 21]. Wang and colleagues (2003) based on their three-year study believes that the regular physical activity does not improve memory, and yet does not reduce risk of dementia [19]. Blumenthal and Madden (1988) despite the increased level of physical fitness of participants in the resistance exercise for 12 weeks; they did not report significantly relationship between memory and the physical activities [20]. It seems the contrast of results is due to this issue that in these two researches that the effect of physical activities have been verified and reviewed on the healthy human bodies, but the current research these activities have been

examined on the persons with mild cognitive impairments. Broe and colleagues (1998) [21] also used the questionnaire method and after event method, but the current research is semi-experimental and it has been done in a nursing house, so the level of memory function, type of exercise, environmental factors and…have been under control, while in the after-event researches many of the factors are not under the control of the researchers. Also the current study has been done by using questionnaire and with open, half-open and several-option questions have been designed for the questionnaire and in the questionnaire method, such possibilities do not exist. On the other side, the questionnaire method has a generality orientation [22, 23].

Despite these researches, some other researches have the same idea of this research regarding the effect of physical activities on the memory function; Such studies of Rachel Cooper (2011)[24], Lautenschlager et al (2003)[14], Rovio et al (2007)[9], Ghanaei et al (2007)[25], Eric Larson et al (2006)[11], Ho et al (2001)[26], Lee et al. (1991)[27] and the Sanna et al (2009)[28].

Rashel Cooper (2011) indicated that the weaker physical power has a relation with the low cognitive level and he concluded that the physical characteristics can foresee the health for the elderly [24].

Nicolas Lautenschlager et al (2003) considered the effect of physical activity (24 weeks) on the reduction of cognitive decline in adults at risk (with risk factors for dementia) and they concluded that the physical activity improves cognition. The study of Rovio et al (2007) also confirms the increase of cognition and memory improvement after physical exercises [14].

Even in the consideration of individuals without dementia, the relationship of physical activity to prevent the occurrence of dementia and Alzheimer has been indicated as a positive effect. Eric Larson and colleagues (2006) in a longitudinal study of persons without cognitive impairment believe that regular exercise is associated with delayed onset of dementia and Alzheimer. Lindsay and colleagues (2001) also confirmed these results [10].

People with limited physical activity, are at high risk of developing Alzheimer disease [27]. With at least two days activity in leisure time among the 65 years old and older people, and significant and positive correlation has been found to delay Alzheimer disease [8].

Based on the comment of Yoshitake et al (1995) physical activities in the 65-year-old people and older persons is a factor to avoid Alzheimer disease [29]. Weuve et al (2004)[30], Laurine and colleagues(2001)[12] and Van Praag et al(2005)[10] also believe that the physical activities cause a delay for memory reduction relevant to age. According to these results, even the least of physical activities during the midlife and elderly era can improve the memory.

One common method of aerobic exercise in middle-aged and adults is walking. Researchers from the perspective of cognitive function and they thought that walking is so necessary and walking is one of the factors which is associated with reduced dementia [13, 9, 31].

Baker and colleagues (2010) verified the effect of different training methods on participants with memory impairment. These researchers examined two methods of aerobic and stretching exercises and after six months, they concluded that only the aerobic exercises cause cognitive increase [6]. So hereby Yonas Geda et al (2010) in the research done by Mayo Clinic Institute reviewed this issue that weather the physical activity is associated with the reduction of memory function decrease. The researchers compared healthy and low cognitive impairment people and concluded the result of light training (bowling, golf, dancing and walking) and severe training (strength training, singles tennis, racket ball and skiing) was without effect on memory but moderate training (aerobics exercises) has shown positive effects in increasing memory[32].

In the current research it was indicated that physical activities have effects on the level of memory function through sub factors of memory, judgment and problem solving. The lowest effects have been observed on the sub factors of social affairs and orientation.

Some of the researchers on the positive effect of physical training on total and subscales of memory disagree. Such as Sanna Start and colleagues (2009) indicated the effect of aerobic training on visual memory and not verbal memory [33]. Blomquist and Danner (1987) also showed the positive effect of aerobic fitness on some of the parts of the memory test but in the memory of words and Steinberg and Kotel did not see changes [34].

Regarding the procedure of the effect of physical activities on the memory, many discussions have been expressed and the substructure mechanisms of intervention are uncertainly, but it is assumed that by some changes in the body, these effects can occur.

Scientists examined many animal studies and reviewed the underlying mechanisms for mental and physical activity. They showed increased brain volume, insulin-like growth factor, Brain Derived NeurotrophiN Factor (BDNF), Angiogenesis, Neurogenesis, Synaptogensis and extra... Human research is limited because of ethical considerations. Colcombo et al (2006) investigated Synaptogenesis (increase of synapses and neurotransmitters) this effect on the brain of humans and concluded the significantly effect of aerobic exercise on brain gray matter volume[35]. Erickson and colleagues (2009) showed more accurately the changes in hippocampus volume and memory space has been created. But Colcombo et al (2003) in his previous research did not believe on the direct effect of exercise on the density of brain tissue and they state that aerobic exercises only prevents the occurrence of dementia[8]. Kramer and colleagues (2006) showed that even relatively short exercise prevents the loss of brain volume in aging and gray brain has increased in the upper frontal temporal [37].

Clark and et al (2009) indicated the production of new neurons after aerobic exercises in rats[38] and Van Praag et all (2000) indicated that the increase of physical activities caused the increase of brain formation on humans [10].

The other reviews in the field of Angiogenesis indicated the physical activates result to increase of blood capillaries and blood flow in the brain especially in the hippocampus. Bullitt et al (2008) studied the light and sever exercises in the adults and confirmed this idea that the more active persons have more accumulated capillaries and more number of capillaries in their brain [39]. Pereira et al (2007) using MRI concluded that the aerobic exercises for 12 weeks causes the preparedness of cardiovascular and the increase of blood volume of dentate gyrus, which the measurement scale for the cognition function[40].

The other important and effective factors are the Caspase-3 enzyme, Cox-2 and ß-Amyloid are reduced due to the physical activities and they have a positive effect on the level of memory function and cognition and they avoid the occurrence of Alzheimer[41]. Generally the researches indicated that physical activity cause a change in the nervous system of brain, the blood flow of brain and neurotransmitters which cause the prevention of dementia and the increase of brain formation.

Mental activity and Memory

This study showed that the mental activity of 70-50-year women with mild cognitive impairment has a significant and positive effect. The results of Willis et al (2006)[42] and Ball, Berg and Holmes (2002)[43] are the same too.

Valenzuela and Sachdev (2009) considered the meta-analysis of 54 studies and showed cognitive training is useful tool to avoid dementia and they have stated this kind of exercise causes a change in the nervous form [44]. Amini (2007) considered the effects of mental practice techniques and the rehabilitation of memory deficits in memory, attention and general cognitive function in patients so significant for dementia [45].

Based on the longitudinal research of Gong and Sholman (2003), regular cognitive activities reduce the risk of dementia [19] and in the Siattel longitudinal research also some mentally challenging activities were shown in the study of cognitive function [46].

Researchers indicated that high education(a kind of cognitive activity) have much effect on prevention of occurrence and development of Alzheimer disease and the reason of this prevention is due to synapses complication and the increase of partial blood flow in the brain. As a result the regular activities are so effective for the health of neurons [47, 48]. Those groups of social activities [49] and the jobs which are accompanied with mental activities [50] can largely prevent the occurrence of Alzheimer disease.

It seems that the synaptic complexity and increase of local blood circulation into the brain is from the underlying changes of mental activities. Following the increase in blood volume, oxygen and food are available in the cells cause improve brain function. Other mechanism for the growth of hormone of insulin levels is due to mental activities which can be so useful to the memory. Low levels of this hormone are associated with cognitive impairment [51].

The reason of more effects of physical activities in comparison to mental activities is due to the level of memory function that in the physical changes (heartbeat, hormones secretions…) which is clear so quickly in the group of physical activities, while the mental changes due to the metal activities needs more time and that is why some of the

researchers believe that the occurrence of Alzheimer starts from childhood, so doing mental activities during the childhood could be considered as an advantage for preservation of memory which will last until the elderly and probably it could be as a mechanism which describes the relation of education and reduction of dementia[52]. In relation to the proposed acquisition of two languages in early childhood is recommended to maintain cognition and delayed dementia [53].

Combined Activities (Physical and Cognitive) and Memory

In the present study, the combined activities have a positive and significant effect on memory function through memory and social affairs sub factors. In this study the effect of distinct physical and mental activities had more effects in comparison to the combined activities. The results are not the same as the results of the researches of Oswald (2006) [54] and Fabre (2002)[55]. These researchers showed that a combination of physical exercise and mental exercise have more effects on cognitive functioning in comparison to the separated exercises. It seems the reason of difference for the current study to be illiterate participants in this study. Research participants of Oswald and Fabre were educated.

The group of combined activities in this study benefits from the mechanism of action of a combination of mental and physical activities, but it is followed with less memory function. The lower rate of improvement in the combined group in comparison to other groups is less time represented in each class. The time of combined group for each class was 30 minutes, while the other two groups had a time of 60 minutes completely for each relevant class which they attended in.

Cardiovascular fitness hypothesis

Base of Cardiovascular fitness hypothesis is the more increased cardiovascular fitness, the more increased cognitive function. In the present study the effect of all three methods of intervention are significant for the clinical dementia rating. In other words, aerobic, mental and combined activities (aerobic + mental) have increased the memory. The result indicates that the mental activities without the increase of cardiovascular fitness also causes an increase for cognitive function and only the physical activities such as aerobic are not effective for memory function. In the observed researches which have been done in this field, the combined activities which include the mental activities too are less under attentions.

Based on Liu-Ambrose research (2010), the combined aerobic and strength training than aerobic training had more effect on cognition [56]. In comparison to aerobic exercises in stretching and resistance exercises, Smiley Oyen (2008) concluded, despite an increase in maximum breathing capacity in both groups, only the aerobic group had improvement in cognitive function [57]. The meta-analysis of Etnier et al (2006) showed the lack of relationship between cardiovascular fitness and cognitive function [58]. In another study even the improvement of cognitive function due to resistance training has been shown [7]. According to the above text, the present study is a reason to reject cardiovascular fitness hypothesis which believes the increase of cardiovascular fitness causes an improvement for brain function.

CONCLUSION

According to the findings of present study, physical, mental and combined activities (physical and mental) cause an increase for the memory function of 50-70-year old women who suffered memory impairment and the effect of physical activities is more than the other two methods. The combined activities had the lowest level of effects and the major effects were observed for the memory sub factor. In other words we can expect by regular physical and mental activities in the elderly, we can prevent the development of Dementia and Alzheimer disease; and delay aging will be experienced. A review on the effects of physical and mental activities on memory is based on the substructure changes of nervous system and blood agents between healthy people and the people who suffer memory impairment is suggested.

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