Available online at: http://journal.iepa.ir

Iranian Journal of Learning and Memory, 2019, 2 (5), 67-77

Comparing the Effects of Physical, Cognitive and Combined Rehabilitation on the Improvement of Working Memory and Cognitive Flexibility of the Elderly

Amir Dana*, Ph.D.
Department of Physical Education, Tabriz Branch, Islamic Azad University, Tabriz, Iran

Abstract

The present study aimed to compare the effects of physical, cognitive and combined rehabilitation on improving working memory and cognitive flexibility of the elderly living in the nursing home. This quasi-experimental study was carried out with a pretest-posttest design in four groups with the control group. The statistical population consisted of all elderly residents of a nursing home in Tehran. 48 people were selected randomly and divided into four groups (three experimental groups and one control group). For the experimental groups, intervention programs, including physical, cognitive, and combined rehabilitation, were conducted in three sessions of one hour each week for two months. The data were collected using a working memory capacity scale and a cognitive flexibility inventory (CFI). Data was analyzed using a one-way analysis of covariance (ANCOVA) and Bonferroni post hoc test using SPSS software version 22. The results showed that all three types of rehabilitation programs have a significant effect on improving the working memory and cognitive flexibility of the elderly (P <0.001). Also, the mean of the groups in the pre-test and post-test stages showed that among the three programs, the combined rehabilitation program had more efficacy in improving the working memory and cognitive flexibility of the elderly and there was no difference between the two types of physical and cognitive rehabilitation programs (P> 0.001) According to the findings, combined rehabilitation programs can be effective in improving the working memory and cognitive flexibility due to the focus on both physical and cognitive aspects.

Keywords: Cognitive rehabilitation, elderly, flexibility, memory, physical rehabilitation

Introduction

Aging is a part of biological process and a period of human life that is associated with certain physical, psychological and social changes that occur to individuals of this period. Along with population growth, the population of elderly people in Iran has also increased dramatically so that by the year 2026, Iran's aging population is expected to account for 11% of the country's total population (Bayatlou, Salavati & Akhbari, 2011; Carroll, Slattum & Cox, 2005) The old age period is considered to start at the age of 65 (Kline, 1990) and in some sources, this period is considered to be 60 years (Moatamedi, 2017). Considering the increasing number of elderly people in the community as well as its increasing trend in the coming years, it is necessary to pay attention to their physical and mental health. Therefore, recognizing the issues of successful aging is one of the challenges facing the elderly and the community. Structurally, as age increases continuously, the number of brain neurons decreases and no replacement occurs (Moore, Mitchell, Bibeau & Bartholomew, 2011). Accordingly, during this period of life, a significant reduction occurs in the cognitive function of the elderly, and the cognitive deficit is one of the most common problems of aging, which has a very wide range (Wang & Blazer, 2015). Studies show that about 5% of people aged 65 years and older have clear cognitive deficits (Farooqui & Farooqui, 2015). One of the cognitive domains affected by aging is working memory (Baeler & Snomen, 1993; Bull, 2008). Working memory is a mental system, which is responsible for temporary data storage and processing to carry out a series of complex assignments such as understanding, reasoning, and learning (Carretti, Cornoldi, De Beni & Palladino, 2004). Working memory includes a central executor and a few subsystems (Demon & Hart,

* **Corresponding Author**
Email: amirdana@iaut.ac.ir

Received: 01/13/2019
Accepted: 05/06/2019

2007). The visual-spatial sector is involved in preserving and manipulating visual-spatial information. The review circuit is responsible for the maintaining and reviewing the verbal information, and another component, called temporary storage, is a limited systematical event that provides temporary storage of information from two sub-systems of working memory (phonetic circuit and visual-spatial sector) and long-term memory and coordinates them coherently. Studies in this area show that working memory in the elderly is declining (Bull, 2008; Cool, 2006; McQuail et al., 2018). These studies have shown that if this memory is not strengthened, and if middle-aged and elderly people do not receive the necessary training to strengthen it, the problems with working memory may increase and their life would become difficult (Bull, 2008; Cool, 2006; McQuail et al., 2018). Therefore, paying attention to working memory and the presentation of new and effective methods for promoting it seems necessary for the elderly.

In addition to working memory, one of the other cognitive domains that decrease with aging and in the elderly is the cognitive flexibility (Entezari, Shamsipour Dehkordi & Sahaf, 2018). The concept of cognitive flexibility is the ability to change cognitive sets in order to adapt to changing environments and it can adjust individual's thinking and behavior in response to changing environmental conditions (Dennis & Vander Wal, 2010). People who do not have good cognitive flexibility tend to rumination when they feel sad (Davis & Nolen-Hoeksema, 2000). An aging period is associated with cognitive dysfunction, comorbidities, and reduced cognitive function, which can affect the physical ability of individuals (Lange et al., 2014). The aging period is particularly associated with the risk of increased cognitive deficits. In normal aging, many effects of age on cognitive functions have consequences such as slowness in processing speed, reduced efficiency in controlling inhibition and reduced functionality associated with work memory and event memory (Clarys, Bugaiska, Tapia & Alexia Baudouin, 2009; Lange et al., 2014). Based on this concept, reducing the cortical volume of the prefrontal cortex causes the loss of executive functions and, consequently, the loss of memory (strategic memory processing) (Lange et al., 2014). Therefore, cognitive flexibility, as well as other cognitive functions including working memory, decreases with aging period, which in turn affects the quality of the life of elderly and requires attention and interventions (Entezari et al., 2018).

One of the most important ways to improve cognitive function during the aging period is rehabilitation programs, which in fact acts as reinforcement mechanisms to remove cognitive and mental defects. One of the training programs in this area is the Physical Rehab Program. In this exercise, an individual attempt to perform a motor skill using an organ or the whole body, and according to Adams, this performance affects the memory (Karaminoori, 2004). Physical activity and motor exercises have been shown to improve the secretion of neurotransmitters affecting the information processing in the brain; for example, significant improvement has been observed in the secretion of acetylcholine, dopamine and serotonin during the time of physical activity. These transmitters play an essential role in cognitive functions, and disruption of their secretion leads to a failure in cognitive function (Brown et al., 1992). The results of studies in this area have shown that physical training programs can enhance the cognitive functions of the elderly. For example, the results of the study of Entezari et al. (2018) showed that elderly people with high physical activity have a better cognitive flexibility. The results of the study by Ruscheweyh et al. (2011) suggest that physical activity for the elderly at any level can reduce the memory problems of the elderly and enhance their memory performance, and this relationship is mediated by the increase of the gray matter of the prefrontal cortex and neurobiology factors.

Another type of exercise is a cognitive rehabilitation program. Cognitive rehabilitation refers to a set of interventions or strategies that empower individuals and their families and aims at adapting, controlling and reducing cognitive deficits (Zare & Sharifi, 2017). Cognitive rehabilitation is applied in various fields, including pathological repair, cognitive function optimization, compensated loss of cognitive function and replacement of healthy cognitive function and its effectiveness has been investigated in groups such as elderly and children. The results of research in this field have shown that the memory and attention rehabilitation program has a significant effect on decreasing memory deficits in the elderly with dementia and this method, as one of the new therapeutic approaches, can be effective on the memory status of the elderly patients and improve their life quality (Amini et al., 2010).

Atri Ebrahimpour et al. (2013) also studied the effect of computer cognitive rehabilitation on active memory function, attention, language ability, visual-spatial ability, and fluency of speech in elderly people. The results showed that computer cognitive rehabilitation program has an impact on cognitive function (active memory, attention, visual-spatial ability, language ability, and fluency). Therefore, based on these results, computer cognitive empowerment can be important in preventing cognitive deficits of the elderly.

Another program that can influence the cognitive function of the elderly is combined rehabilitation programs, which include physical rehabilitation and cognitive rehabilitation. Although research has been conducted on the effects of rehabilitation programs on cognitive function improvement (Cortese et al., 2015), there was no study on the combination of rehabilitation programs and whether they can affect cognitive functioning of the elderly. Therefore, it seems that the use of a combined program, in which both types of physical activity and cognitive practice exist, can affect the cognitive function of individuals (Cortese et al., 2015).

Therefore, the aging period is associated with a significant reduction in cognitive abilities such as work memory and cognitive flexibility, and the decrease in cognitive abilities has negative effects on the lives of the elderly and their families and, in fact, the community, in which the decreased life quality and increased costs are the consequences. Although, research has been conducted on the effect of rehabilitation programs on cognitive function of the elderly, there is no study on the effect of these interventions on working memory and cognitive flexibility as two applicable variables in elderly life. By using these programs and examining their effects, the underlying purpose of this study is to find innovative interventions that can serve as reinforcement and enhancement mechanisms for improving cognitive deficits and cognitive functioning of the elderly, specifically their working memory and cognitive flexibility. Accordingly, in this study, the effect of three methods of physical, cognitive, and combined (physical-cognitive) rehabilitation on the working memory and cognitive flexibility of the elderly was compared to determine which one of these interventions is effective on the cognitive ability (working memory and cognitive flexibility) of the elderly and which treatment is better than the others. The aim of this study was to compare the effect of physical, cognitive and combined rehabilitation on the improvement of the working memory and cognitive flexibility of the elderly.

Method

The research method was quasi-experimental with a pretest-posttest design with four groups.

Participants

The statistical population includes all the elderly in the age range of 60 to 75 in the nursing home of Tehran, Iran, in 2017. Considering that one of the methods for determining the sample size is the type of research method and the minimum sample size in this method was considered 12 people for each group, therefore 48 elderly people were selected by non-probability convenience sampling method and were randomly assigned to 4 groups of 12 after obtaining informed consent and written consent for participation in the study. For random assignment of individuals in groups, the coding method and random selection of codes were used. Each person was given a code and then, the researcher assigned four groups and randomly considered one of the codes respectively for each group and this process continued until the last person was selected. Inclusion criteria included the age range of 60-75, minimum educational level of middle school for implementing the programs, lack of illness and physical disabilities or lack of co-operation in other rehabilitation programs, and exit criteria included having mental and neuro-cognitive deterioration, having a history of cardiovascular disease and taking medications that affect psychological and cognitive characteristics. After taking the pre-test from both groups, the experimental groups participated in the physical, cognitive and combined rehabilitation programs (described below) three sessions a week for two months (a total of 24 sessions). The control group received no intervention and placed in the waiting list. After the sessions were completed, a post-test was taken from each of the four groups during one session. The total study time lasted 6 months and treatment sessions were conducted in January and February, 2017.

Instruments

The following instruments were used to collect research data:

Working Capacity Measurement Scale

This test was made to measure the working memory capacity by Daneman and Carpenter in 1980. This test has 27 questions divided into six sections from the two sentences section to seven sentences section. The main characteristic of this test is the simultaneous measurement of the two parts of the working memory (processing and storage) while doing a mental activity. In this test, the participants are asked to listen carefully at each stage to a string of different and difficult sentences that are read to them, then they have to do two mental activities (processing and storage) simultaneously in the following order: A. Define the meaning of the sentences correctly. B) Remember the last word expressed in the sentences (Mojtaba Zadeh, 2006). In this test, the value of all single sentences is the same, and each correct answer is given one score, and the wrong answers or unanswered points do not count. Therefore, each participant gained two score points for each successive answer for each sentence, one for the processing that is obtained for the correct definition of the read sentences, and the other for the storage that is obtained for the correct writing of the last word they heard. In general, since the number of sentences in this test is 27 and the value of the sentences are the same, the score of each participant is calculated from 27 for both processing and storage, and the working memory score of each participant is also achieved from the mean of the sum of the two scores (processing and storage), which is written as percentages. Regarding the validity of this test, a correlation coefficient of 0.88 was obtained in a preliminary study of Asadzadeh (2009) conducted on 84 students of the Faculty of Psychology and Educational Sciences in Allameh Tabataba'i University, Iran. For the reliability of this test, Mojtaba Zadeh (2006) has obtained 0.87 through Kuder-Richardson's method in his research. Asadzadeh (2009) has also reported its reliability as 0.85 by the split-half method. The reliability of the questionnaire in the sample group in the present study was 0.84 using Cronbach alpha.

Cognitive Flexibility Inventory (CFI)

This tool was created in 2010 by Dennis and Vander Wal, which has 20 questions and is used to measure a kind of cognitive flexibility that is needed to help a person succeed in a challenge and replace inefficient thoughts with more efficient thoughts. Scoring is based on a 7-point Likert scale. This scale measures the level of perception of control, the perception of multiple solutions, and perception of individual justifications. The concurrent validity of this questionnaire with the Beck Depression Inventory is -0.39, and with the flexibility of Martin and Robin is 0.75. Also, its reliability is 0.91 using Cronbach Alpha. In Iran, Share et al. obtained 0.71 validity for the total scale and achieved 0.90 reliability using Cronbach Alpha (Fazeli et al., 2014). The reliability of the questionnaire in the present study was 0.79 with Cronbach alpha method.

Procedure

In order to conduct the research, after coordinating with the officials and supervisors of the nursing home of Tehran, a number of elderly people were selected conveniently after the screening process according to the terms of entering and exiting criteria of the research. After obtaining written consent for participation in the research, participations were presented about the research and the purpose of its implementation in a meeting session. Participants were randomly assigned (through codes assigned to each individual) into physical, cognitive, combined and control groups (12 in each group). Then, all four groups took the pretest and after three weekly sessions for two months, all the groups were given the post-test. To remove the effects of treatment expectations and to observe ethics in the research, a session was arranged for the control group after taking the post-test. The meeting did not have any effect on the result of the study, since it was after the completion of the main sessions.

Physical Rehabilitation Program: The present study included aerobic exercises using a treadmill. Depending on the type of program that is continuously increasing the aerobics, the intensity of the initial training and resting points were determined based on the performance of the participants during the first session of the exercise. Then, on a weekly basis, by observing the overload principle, the intensity and duration of the exercises were increased based on the individual differences of the sample individuals. The program was conducted in a two-month, three-weekly session (24 sessions) with 40 to 80 percent THRmax. The target heart rate was calculated by the Karvonen formula in the present study.

Resting heart rate % + A ×(resting heart rate - maximum heart rate in exercise test) = target heart rate (THR).

Table 1.
Aerobic Exercise Program in Each Session

Row	Movements	Time (minutes)	Intensity
1	Stretching	3	……………..
2	warm-up exercises	1	low speed treadmill
3	Starting exercises	7 stages of 1-1-2-3-1-1-1 minutes	40-80 % THR
4	Continuing exercises	7 stages of 1-1-2-3-1-1-1 minutes	40-80 % THR
5	Cool down exercises	3	low speed treadmill
6	Rest between using each exercise	3-5	Depends on the time that the participant reached the level of resting heart rate

Cognitive Rehabilitation Program: Cognitive Rehabilitation Program includes a set of cognitive techniques and exercises that have been implemented using the Captain's Log computer software. Programs can be designed and delivered with this software that can be in accordance with the capabilities of each person. Captain's Log has advanced settings and can be used to provide more challenges for individual capabilities at every stage of the training. In fact, the Captain's Log collection has 2,000 different assignments to enhance various cognitive functions. The variables that can be practiced and upgraded in this software include as many types of precision and focus (selectivity, focused precision, continuous precision, decomposed precision and shifting precision), active memory, immediate memory and short-term visual and auditory memory, visual and auditory processing speed, visual and auditory perception, sensory and motor coordination, improving hand and eye coordination, visual processing and movement control, problem solving skills, executive function, reaction speed, rational reasoning, inductive and deductive reasoning, improving the control of momentum, mental integration, visual and auditory categories and sorting (arranging) and spatial intelligence. This program also conducted in three sessions per week for eight weeks. In each session, subcategories of precision and focus, short-term memory, visual-auditory perception, logical reasoning, and mental integrity were used and this program was implemented in the form of cognitive exercises on the participants. This software has been used in scientific research as a cognitive rehabilitation tool (Cortese et al., 2015).

Combined Rehabilitation Program: This program is a combination of the content of the Physical Rehabilitation Program and Cognitive Rehabilitation Program, carried out by performing aerobic exercises and then, performing cognitive exercises. Accordingly, the schedule for the aerobic training and practicing the skills related to the cognitive rehabilitation program (participation in computer games) was reduced to half, so that all three programs could have equal conditions.

To analyze the statistical data, one-way analysis of covariance (ANCOVA) and Bonferroni's post hoc test were used after the establishment of the hypotheses and the results were analyzed by SPSS-22 software.

Findings

The results showed that the mean age of the physical training group was 66.13 with a standard deviation of 2.14, the mean age of the cognitive training group was 67.56 with a standard deviation of 4.11, the mean age of the combined group was 65.12 with a standard deviation of 3.89, and the mean age of the control group was 64.19 with a standard deviation of 2.64. According to the marital status, 68.01were married and 31.09 were living alone in the physical training group, 0.65 were married and 0.35 were living alone in the cognitive training group, 63.20 were married and 36.58 were living alone in the combined group, and 64.15 were married and 35.85 were living alone in control group. Therefore, according to the demographic findings, the groups were similar.

Table 2 shows the mean and standard deviation of working memory and cognitive flexibility scores for individuals in control, physical, cognitive, and combined rehabilitation groups in two stages of measurement (pre-test and post-test).

Table 2.
Mean and Standard Deviation of Working Memory and Cognitive Flexibility in Two Stages of Measurement for Each Group

Group	Variable	Pre-test Mean	std.	Post-test Mean	std.
Control	Working memory	23.08	6.14	23.83	5.60
	Cognitive Flexibility	77.75	9.11	78.58	8.64
Physical rehabilitation	Working memory	21.75	5.84	24.67	5.17
	Cognitive Flexibility	76.92	10.98	80.75	9.69
Cognitive rehabilitation	Working memory	22.25	5.32	24.92	5.10
	Cognitive Flexibility	77.92	11.05	91.08	10.90
Combined rehabilitation	Working memory	22.17	5.70	26.83	4.68
	Cognitive Flexibility	76.50	11.10	92.58	9.05

As the results of Table 2 showed, the mean scores in the pre-test and post-test stages in the control group did not change significantly, but the scores of the working memory and cognitive flexibility of the experimental groups have increased from pretest to post-test. Also, all of the groups had similar scores based on their mean in the pre-test stage, but in the post-test stage, the mean of the groups has changed in all groups except for the control group.

One-way analysis of covariance (ANCOVA) was used to evaluate the effect of physical, cognitive and combined rehabilitation on improving the working memory and cognitive flexibility of the elderly. Prior to this test, the statistical hypotheses of the normal distribution of the scores were examined by using the Kolmogorov-Smirnov test and the homogeneity of variances was investigated by using Levine's test. With a non-violation of the above hypotheses, one-way analysis of covariance (ANCOVA) was used for Data analysis.

Table 3.
Results of One-Way Analysis of Covariance (ANCOVA) for Comparing Working Memory of Experimental and Control Groups

Source of changes	Sum of squares	df	Mean square	f value	sig.	effect size
Pre-test	1086.16	1	1086.16	564.36	0.001	0.929
Working memory	79.15	3	26.38	13.70	0.001	0.489
Error	82.75	43	1.92			
Total	1206.31	47				

Table 3 shows the results of one-way analysis of covariance (ANCOVA) for comparing the working memory scores in the experimental and control groups at the post-test stage. The F value obtained was 13.709 and its significance level was less than 0.001 (P <0.001). Therefore, the difference between the effectiveness of physical, cognitive and combined methods for improving the working memory of the elderly is confirmed. The effect size also indicates that the changes in working memory are as a result of the effect of the independent variable at the mean level.

Bonferroni's post hoc test was also used to examine the paired comparison of therapeutic methods to improve working memory.

Table 4.
Bonferroni's Post Hoc Test to Compare the Improvement of the Working Memory

Group	Group	mean difference	standard error	std.
Control	Physical rehabilitation	-1.84	0.573	0.015
	Cognitive rehabilitation	-1.66	0.570	0.033
	Combined rehabilitation	-3.65	0.571	0.001
Physical rehabilitation	Cognitive rehabilitation	0.18	0.567	1
	Combined rehabilitation	-1.80	0.567	0.016
Cognitive rehabilitation	Combined rehabilitation	-1.98	0.566	0.006

The results of Bonferroni's post hoc test showed that the scores of the control group are significantly different from the scores of all three rehabilitation programs (p <0.05). In other words, all three types of rehabilitation programs had a significant effect on improving the working memory of the elderly. Also, among the three rehabilitation programs, the combined rehabilitation program has more efficiency in improving the working memory of the elderly, and there is no significant difference between two types of physical and cognitive programs in improving working memory.

Table 5 shows the results of one-way analysis of covariance for comparing cognitive flexibility scores of the experimental and control groups at the post-test stage.

Table 5.
Results of One-Way Analysis of Covariance for Comparing Cognitive Flexibility of the Experimental and Control Groups

Source of changes	Sum of squares	df	Mean square	f value	sig.	effect size
Pre-test	700.24	1	700.24	570.77	0.001	0.930
Cognitive flexibility	63.58	2	21.19	17.27	0.001	0.547
Error	52.75	43	1.22			
Total	808	47				

The F value obtained was 17.27 and its significance level was less than 0.001 (P <0.001). Therefore, the difference between the effectiveness of physical, cognitive and combined methods for improving the cognitive flexibility of the elderly is confirmed. The effect size also indicates that the changes in cognitive flexibility are as a result of the effect of the independent variable above the mean.

Also, Bonferroni's post hoc test was used to compare the therapeutic approaches on improving cognitive flexibility.

Table 6.
Bonferroni's Post Hoc Test to Compare the Improvement of Cognitive Flexibility

Group	Group	mean difference	standard error	std.
Control	Physical rehabilitation	-1.88	0.453	0.001
	Cognitive rehabilitation	-1.35	0.452	0.027
	Combined rehabilitation	-3.21	0.452	0.001
Physical rehabilitation	Cognitive rehabilitation	0.52	0.454	1
	Combined rehabilitation	-1.33	0.453	0.031
Cognitive rehabilitation	Combined rehabilitation	-1.58	0.452	0.001

The results of Bonferroni's post hoc test showed that the scores of the control group are significantly different from the scores of all three rehabilitation programs (p <0.05). In other words, all three types of rehabilitation programs had a significant effect on improving the cognitive flexibility of the elderly. Also, among the three rehabilitation programs, the combined rehabilitation program has more efficiency in improving the cognitive flexibility of the elderly, and there is no significant difference between two types of physical and cognitive programs in improving cognitive flexibility.

Discussion and Conclusion

An aging period is associated with a decline in cognitive abilities. Therefore, the present study aimed to compare the effects of physical, cognitive and combined rehabilitation programs on improving working memory and cognitive flexibility of the elderly. The results of this study showed that all three types of rehabilitation programs have a significant effect on improving working memory and cognitive flexibility of the elderly. Also, the results showed that among these three programs, the combined rehabilitation program has more efficiency in improving working memory and cognitive flexibility of the elderly, and there was no difference between the two types of physical and cognitive programs.

Although, similar findings were not found in relation to the first finding on the effect of physical rehabilitation on working memory and cognitive flexibility, this finding is somehow consistent with previous research results (Stoeber & Damian, 2014; Randles et al., 2010; Danielle et al., 2006; Quested, 2014; Taranis & Meyer, 2010).

In explaining the results, it can be stated that increased physical activity of individuals can promote cognitive function and thus increase mental health. In other words, physical activity with an increase in the number of brain neurons is a factor in increasing the cognitive ability of the elderly. In the past, though it was thought that the number of brain neurons is declining over the lifetime, today studies show that physical activity can increase the number of neurons (Kee et al., 2007). Sports experts also believe that increased levels of physical activity in the elderly can increase the blood flow to the brain and increase the amount of oxygen available to the nerve cells (Moore et al., 2011), thereby reduces cognitive deficits and postpones it. However, in relation to effective mechanisms for improving memory, it is unclear which one of the compensatory processes (such as the interaction of different brain regions) or rehabilitation processes (such as strengthening existing networks) contribute to the improvement of the cognitive function of the elderly, but it seems that one of the reasons for the improvement of cognitive function is increasing the level of dopamine following physical and cognitive exercises and its effect on the prefrontal cortex. Dopamine transmitter plays a key role in cognitive function and memory, and these exercises increase the activity of the frontal cortex parietal and thus can improve the performance of the prefrontal cortex. Accordingly, physical activity and sports during the aging period may postpone the initiation and the progression of cognitive deficits of the elderly, thereby reducing the cognitive loss of the elderly and increasing their working memory and cognitive flexibility, which was confirmed by the results of this study. For this reason, it is suggested to use these combined exercises to improve the working memory and cognitive flexibility of the elderly.

The results of the study by Jaff et al. (2001) suggest that physical activity has a direct correlation with brain function in the elderly, and women with higher levels of physical activity are less likely to experience cognitive problems (Segal et al., 2015). Researchers have also shown that physical exercise programs have a positive effect on the cognitive functioning of individuals and increase the cognitive function of the elderly people (Forbes et al., 2015). Entezari et al. (2018) also concluded in their study that there was a significant difference between cognitive flexibility of the elderly people with low, moderate and high levels of physical activity, and elderly with high physical activity had better cognitive flexibility. Therefore, the elderly can improve their cognitive flexibility by doing physical activities and choosing an active lifestyle to promote cognitive factors. Ruscheweyh et al. (2011) aimed at examining the role of physical activity on memory functions in the elderly, and they suggested that physical activity at any level can reduce the memory problems of the elderly and enhance their memory function, and this relationship is mediated by the increase of the gray matter of the prefrontal cortex and neurobiology factors. Therefore, physical activity can remove the negative stress and rumination of the elderly and lead them to a better position. Therefore, when people have more active lives, the levels of their cognitive affinities would be positively more and with continuous physical activity, the elderly can reach a higher level of cognitive flexibility (Entezari et al., 2018).

The second finding of the study showed that the cognitive rehabilitation program had an impact on improving working memory and cognitive flexibility of the elderly. This finding is consistent with previous findings (Alloni et al., 2018; Amini et al., 2010; Clare & Woods, 2004; McKerracher et al., 2005; Parker & Hagan-Burke, 2007; Stuss et al., 2007).

In explaining this finding, it can be admitted that cognitive rehabilitation exercises can enhance the level of cognitive abilities including working memory and cognitive flexibility in the elderly. In fact, the cognitive rehabilitation program involves cognitive stimulation and cognitive education, and it is a unique approach to help people with cognitive deficits, which increase the mental activity and performance of the individual and thus lead to improved cognitive processes.

Most new research on cognitive rehabilitation has focused on one of two damaged functions, such as memory, attention, and navigation (Al Boyah, 2014). The results of studies conducted in this area also indicate that cognitive rehabilitation program can promote the cognitive function of the elderly. The results of the study by Alonni et al. (2018) suggested that the cognitive rehabilitation program can enhance cognitive ability and function of the elderly, and this effect is preserved over time. The results of Amini et al. (2010) showed that cognitive rehabilitation program can reduce the cognitive deficits of the elderly. In their studies, Carrion et al. (2013) concluded that stimulating cognitive functions, in particular by cognitive exercises, improve the overall cognitive function of dementia patients. The results of the study by Miotto et al. (2008) showed that the cognitive rehabilitation intervention program can be generalized to the real living conditions of the elderly, and these interventions improve the cognitive deficits of dementia patients. Therefore, in general, the results of studies conducted in this field suggest that cognitive exercises can be effective in improving cognitive function of the elderly (Amini et al., 2010; Atri Ebrahimpour et al., 2013)

The final finding of the study showed that the combined rehabilitation program (cognitive-physical) had an effect on improving working memory and cognitive flexibility of the elderly, and its impact was more than the other two. This finding is consistent with previous findings (Hosseinpour et al., 2018; Nitz & Choy, 2004).

In explaining this finding, it can be admitted that physical and cognitive exercises individually can reduce cognitive loss and improve cognitive abilities by increasing age, which was confirmed both in this study and previous studies. However, if these two types of exercises are implemented in the form of a coherent program on the subjects, they can have a more effect on their cognitive abilities, and thus enhance their working memory and cognitive flexibility. In fact, in addition to physical exercises, these individuals simultaneously perform cognitive tasks, which cause their simultaneous interaction with the balance activity and cognitive activity that leads to the improvement of cognitive abilities and the proper division of attention between assignments. In this regard, studies have also shown that combined exercises enhance cognitive abilities in the elderly (Nitz & Choy, 2014). The results of Hussein Pour et al. (2018) show that cognitive-motor training program is effective on the improvement of cognitive function in elderly women, which seems that this type of exercise program is a useful way to improve the cognitive abilities of the elderly.

The results of this study indicated that all three types of rehabilitation program have a significant effect on improving working memory and cognitive flexibility of the elderly. The results also showed that among these three programs, the combined rehabilitation program is more effective in improving working memory and cognitive flexibility of the elderly, and there is no difference between the two types of physical and cognitive programs. Combined exercises focusing on functional readiness are associated with a significant improvement in the level of independency in the elderly. Therefore, these exercises, with emphasis on both physical and cognitive exercises, have a significant role in improving the working memory and cognitive flexibility of the elderly, which mechanism of action is by increasing the secretion of dopamine neurotransmitter in the prefrontal cortex and by increasing stimulation and activities of this cortex that can affect the improvement of cognitive function and memory of the elderly.

One of the limitations of the present study was the use of convenient sampling method which suggests cautious in generalizing the results, due to non-randomness. Also, the lack of follow-up period due to the lack of access to all the participants after some time can be considered as another limitation of the research. Future researchers are recommended to examine the effect of rehabilitation programs on other cognitive abilities of the elderly to determine their impact. Another recommendation of the research is the use of rehabilitation programs, especially cognitive-physiological rehabilitation, in nursing home centers to improve the cognitive abilities to work memory and cognitive flexibility. Also, implementing these programs in the form of intensive workshops for the elderly living in nursing homes, retirement homes and day care centers can be effective in improving cognitive function and working memory of this group.

Acknowledgments

The researchers thank all the elderly who participated in the research, as well as seniors of the nursing home, as it was not possible to conduct the research without their assistance and cooperation.

Conflict of Interest: There are no conflicts of interest from the authors of the article.

References

1. Al Boyah, M. (2014). *Effectiveness of cognitive rehabilitation therapy on improving cognitive functions and decreasing the positive and negative symptoms of patients with paranoid and non-paranoid schizophrenia admitted to Razi psychiatric hospital in Tehran.* Master's dissertation, Islamic Azad University, Khorasgan Branch.
2. Alloni, A., Quaglini, S., Panzarasa, S., Sinforiani, E., & Bernini, S. (2018). Evaluation of an ontology-based system for computerized cognitive rehabilitation. *International Journal of Medical Informatics*, 115, 64-72.
3. Amini, M., Dowlatshahi, B., Dadkhah, A., & Lotfi, M. (2010). Cognitive Rehabilitation An Effective Intervention to Decrease the Cognitive Deficits in Older Adults With Alzheimer Disease. *Iranian Journal of Aging*, *5*(1), 78-86.
4. Asadzadeh, H. (2009). A Study on the relationship between active memory capacity and academic performance among secondary school students in Tehran. *Quarterly Journal of Education*, *25*(1), 53-69.
5. Atri Ebrahimpour, R., Babapour Khairadin, J., & Ahmadi, M. (2013). The effect of computer based cognitive empowerment on active memory performance, attention, language ability, visual-spatial abilities and eloquence and fluency in elderly people. *Quarterly Journal of Education and Evaluation*, *6*(24), 93-110.
6. Baeler, J.S., & Snomen, L. (1993). *Renewal: The anti-aging revolution*. London: Rodale Press.
7. Bayatlou, A., Salavati, M., & Akhbari, B. (2011). The ability to selectively allocate attentional demands on walking during secondary cognitive and motor tasks in elderly people with and without a history of falls. *Salmandi Journal*, *5*(18), 14-20.
8. Brown, B., Piper, E., Riggs, C., Gormann, D., Garzo, E., & Dykes, D. (1992). Acute and chronic effects of aerobic and anaerobic training upon brain neurotransmitters and cytochrome oxydase activity in muscle. *International Journal Sports Medical*, 13, 92-93.
9. Bull, R. (2008). *Working memory function in Aging period.* Philadelphia: Dexel University.

10. Carretti, B., Cornoldi, C., De Beni, R., & Palladino, P. (2004). What happens to information to be suppressed in working–memory tasks? Short and long term effects. *The Quarterly Journal of Experimental Psychology Section A, 57*(6), 1059-1084.
11. Carrion, C., Aymerich, M., Baillés, E., & López-Bermejo, A. (2013). Cognitive psychosocial intervention in dementia: a systematic review. *Dementia and Geriatric Cognitive Disorders, 36*(5-6), 363-375.
12. Carroll, N.V., Slattum, P.W., & Cox, F.M. (2005). The cost of falls among the community-dwelling elderly. *Journal of Managed Care Pharmacy, 11*(4), 307-316.
13. Clare, L., & Woods, R.T. (2004). Cognitive training and cognitive rehabilitation for people with early-stage Alzheimer's disease: A review. *Neuropsychological Rehabilitation, 14*(4), 385-401.
14. Clarys, D., Bugaiska, A., Tapia, G., Alexia, & Baudouin, A. (2009). Ageing, remembering, and executive function. *Memory, 17*(2), 158-168.
15. Cool, I. (2006). Role of working memory in aging period. *Mena Cognitive Journal*, 28, 105-116.
16. Cortese, S., Ferrin, M., Brandeis, D., Buitelaar, J., Daley, D., Dittmann, R.W, Holtmann, M., Santosh, P., Stevenson, J., Stringaris, A., & Zuddas, A. (2015). Cognitive training for attention-deficit/hyperactivity disorder: meta-analysis of clinical and neuropsychological outcomes from randomized controlled trials. *Journal of the American Academy of Child & Adolescent Psychiatry, 54*(3), 164-174.
17. Daneman, M., & Carpenter, P.A. (1980). Individual differences in working memory and reading. *Journal of verbal learning and verbal behavior, 19*(4), 450-466.
18. Danielle, S.M, Dana, L.R, Neil, A.C., Stan, W.S., & Nancy, H.D. (2006). A mediated of perfectionism, affect, and physical health. *Journal Research Psychology*, 40, 482-500.
19. Davis, R.N., & Nolen-Hoeksema, S. (2000). Cognitive inflexibility among ruminators and nonruminators. *Cognitive Therapy and Research, 24*(6), 699-711.
20. Demon, H., & Hart, T.M. (2007). Parented attitudes and the preschool child's self-concept. *Journal of Instructional Psychology*, 1, 45-52.
21. Dennis, J.P., & Vander Wal, J.S. (2010). The cognitive flexibility inventory: Instrument development and estimates of reliability and validity. *Cognitive Therapy and Research, 34*(3), 241-253.
22. Entezari, M., Shamsipour Dehkordi, P., & Sahaf, R. (2018). Effect of physical Activity on Cognitive Flexibility and Perfectionism in the Elderly. *Iranian Journal of Ageing, 12*(4), 402-413.
23. Farooqui, A.A., & Farooqui, T. (2015). *Diet and exercise in cognitive function and neurological diseases*. OH: John Wiley & Sons.
24. Fazeli, M., Ehteshamzadeh, P., & Hashemi S. S. (2014). The effectiveness of cognitive behavior therapy on cognitive flexibility of depressed people. *Journal of Clinical Psychology Andishe va Raftar, 9*(34), 27-36.
25. Forbes, S. C., Forbes, D., Forbes, S., Blake, C. M., Chong, L. Y., Thiessen, E. J., & Little, J. P. (2015). Exercise interventions for maintaining cognitive function in cognitively healthy people in late life. *Cochrane Database of Systematic Reviews*, (5).
26. Hosseinpour, S., Behpour, N., Tadibi, V., Ramezankhani, A. (2018). Effect of cognitive-motor exercises on physical health and cognitive status in elderly (Persian). *Iran Journal of Health Education Health Promotion*, *5*(4), 336-344.
27. Karaminoori, R. (2004). *Psychology of memory and learning: with cognitive viewpoint.* Tehran: Research organizations and universities to develop humanities books (SAMT).
28. Kee, N., Teixeira, C.M., Wang, A.H., & Frankland, PW. (2007). Preferential incorporation of adult-generated granule cells into spatial memory networks in the dentate gyrus. *Nature Neuroscience, 10*(3), 355-362.
29. Kline, L.J. (1990). Psychiatric Mental Health Nursing: The Therapeutic Use of Self. *Journal of Psychosocial Nursing and Mental Health Services, 28*(11), 42-43.
30. Lange, M., Rigal, O., Clarisse, B., Giffard, B., Sevin, E., Barillet, M., Eustache, F., & Joly, F. (2014). Cognitive dysfunctions in elderly cancer patients: a new challenge for oncologists. *Cancer Treatment Reviews, 40*(6), 810-817.
31. McKerracher, G., Powell, T., & Oyebode, J. (2005). A single case experimental design comparing two memory notebook formats for a man with memory problems caused by traumatic brain injury. *Neuropsychological Rehabilitation, 15*(2), 115-128.
32. McQuail, J.A., Krause, E.G., Setlow, B., Scheuer, D.A., & Bizon, J.L. (2018). Stress-Induced Corticosterone Secretion Covaries with Working Memory in Aging. *Neurobiology of Aging*, in press.
33. Miotto, E.C., Serrao, V.T., Guerra, G.B., Lúcia, M.C., & Scaff, M. (2008). Cognitive rehabilitation of neuropsychological deficits and mild cognitive impairment: A review of the literature. *Dementia & Neuropsychologia*, *2*(2), 139-145.
34. Moatamedi, A. (2017). *The Psychology of aging*. Tehran: SAMT, 1.
35. Mojtaba Zadeh, M. (2006). *The study of the relationship between active memory, anxiety and academic achievement among high school boy students in Zanjan city*. Master's thesis, Allameh Tabataba'i University.
36. Moore, J.B., Mitchell, N.G., Bibeau, W.S., & Bartholomew, J.B. (2011). Effects of a 12-week resistance exercise program on physical self-perceptions in college students. *Research Quarterly for Exercise and Sport, 82*(2), 291-301.

37. Nitz, J. C., & Choy, N. L. (2004). The efficacy of a specific balance-strategy training programme for preventing falls among older people: a pilot randomised controlled trial. *Age and Ageing, 33*(1), 52-58.
38. Parker, R.I., & Hagan-Burke, S. (2007). Useful effect size interpretations for single case research. *Behavior Therapy, 38*(1), 95-105.
39. Quested, E. (2014). Profiles of perfectionism, motivation, and selfevaluations among dancers: An extended analysis of Cumming and Duda. *International Journal of Sport Psychology, 45*(4), 349-368.
40. Randles, D., Flett, G.L., Nash, K.A., McGregor, I.D., & Hewitt, P.L. (2010). Dimensions of perfectionism, behavioral inhibition, and rumination. *Personality and Individual Differences, 49*(2), 83-87.
41. Ruscheweyh, R., Willemer, C., Krüger, K., Duning, T., Warnecke, T., Sommer, J., Völker, K., Ho, H.V., Mooren, F., Knecht, S., & Flöel, A. (2011). Physical activity and memory functions: An interventional study. *Neurobiology of Aging, 32*(7), 1304-1319.
42. Segal, N.A., Hein, J., & Basford, J.R. (2004). The effects of pilates training on flexibility and body composition: An observational study. *Archives of Physical Medicine and Rehabilitation, 85*(12), 1977-1981.
43. Stoeber, J., & Damian, L.E. (2014). The Clinical Perfectionism Questionnaire: Further evidence for two factors capturing perfectionistic strivings and concerns. *Personality and Individual Differences*, 61, 38-42.
44. Stuss, D.T., Robertson, I.H., Craik, F.I., Levine, B., Alexander, M.P., Black, S., Dawson, D., Binns, M.A., Palmer, H., Downey-Lamb, M., & Winocur, G. (2007). Cognitive rehabilitation in the elderly: A randomized trial to evaluate a new protocol. *Journal of the International Neuropsychological Society, 13*(1), 120-131.
45. Taranis, L., & Meyer, C. (2010). Perfectionism and compulsive exercise among female exercisers: High personal standards or self-criticism? *Personality and Individual Differences, 49*(1), 3-7.
46. Wang, S., & Blazer, D.G. (2015). Depression and cognition in the elderly. *Annual Review of Clinical Psychology*, 11, 331-360.
47. Zare, H., & Sharifi, A. (2017). The effect of computerized cognitive rehabilitation on working and prospective memory function in Multiple Sclerosis patients. *Quarterly Journal of Cognitive Psychology, 5*(1), 1-10.