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The Effect of Mental Rotation Training on the Balance and Falling of the Elderly Women with Physical Training Method

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Abstract

Purpose: The aim of this study was to compare the effect of eight weeks physical and mental rotation training on the balance and falling of elderly women. **Method:** The present study is a quasi-experimental study with a pre-test, post-test and two-way ANOVA, which is also t-test designed. Tools included: mental rotation questionnaire and functional reach test. The participants included: 36 patients (12 subjects in three groups of physical training, mental rotation and control group) have been randomly selected among the elderly women of an elderly Centre in Tabriz. The training program was administered in two groups of physical training and mental rotation for eight weeks, at three sessions in a week and a group of control with no intervention. For data analysis, the SPSS software, version 21 was used. **Results:** One-way ANOVA showed, the mean balance among the elderly women was significantly different from the physical training group. The relationship between post-test mental rotation and pre-test physical training was significant at the 0.01 level. Also, the relationship between the post-test mental rotation group and the pre-test mental rotation group was significant at the level of 0.05 and the relationship between mental rotation and balance among elderly women is significant at the 0.01 level, at the end the relationship between mental rotations and falling in the elderly was significant at 0.05 level. **Conclusions:** The results of this research indicates that the physical training and mental rotation training had a positive effect on the balance of the elderly women and it also showed that the elderly women of the physical training group had more improvement on balance than mental rotation groups. So, this research indicates that, cognitive abilities and movements could be facilitating and effective in this way.

***Keywords**:* Mental rotation, Physical training, Balance, Falling, Elderly

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INTRODUCTION

Present century has been witnessed to the evolvement of the medical care, technology, and public health efforts, so the life expectancies continue to rise despite the accumulation of age-related deficits (Vaupel, 2010). Upon aging there is a progressive decrease in functional capacity, verified by reduced strength of lower limbs, impaired balance and agility. Such changes may impact a patient's daily activities such as climbing and descending stairs or siting and standing up from a chair, besides reducing the ability of the elderly to promptly respond to external disturbances, such as slipping and stumbling, and to restore balance (Bento, Bastone, Alcântara & Gomes, 2010). After the age of 60, about 14% of elderly usually lose their independence (balance) in one or more daily activities. Falling is the sixth reasons of death in the elderly population, which is also associated with some illnesses and disabilities. falling is the reason of two third of all accidents in this age group, which about 40% of falls in elderly people over 85 years old could lead to death (Aslankhani, Farsi, Abdoli, Zamani Sani, and Fathi Rezaie, 2009). The Researchers consider the underlying causes of falling, lowering balance skills and impaired walking patterns as the key factors of falling and other motor problems in the elderly and believe that balance is the basic factor of an independent and dynamic life (Fathi Rezaei, Aslankhani, Farsi, Abdoli & Zamani Sani, 2010). The last two decades have been devoted to studies of mental rotation. Researches in this area began with the studies of Shepard and Metzler (1971). Researchers have introduced some insights into mental rotation. For example, Cooper (1976) stated that in mental rotation, the image is understood as a whole and the information from the whole image is stored in short-term visual memory. Mental rotation ability is considered as an important factor. Mental rotation tasks are widely described as exercises requiring mental multi positioning of a two or three-dimensional object (Dehghanizadeh, Mohammadzadeh, Hosseini, 2013). Vandenberg and Kuse (1978) have shown that people use short-term visual-spatial memory to solve problems in the spin task. Factors that affecting spatial ability and consequently mental rotation are age, gender, experience (its type and extent), social factors, superiority, and talent (Baghbanporshokohi, Alipur, 2007). Mental rotation ability interacts with cognitive and motor variables (Adams, Stull & Hegarty, 2014).

Physical training improves balance and by improving coordination and balance, decreased muscle weakness (Liu-Ambrose et al., 2004), increased resistance to muscle fatigue and hypertrophy, especially in fibers Muscle type (II), reduces the risk of falls in the elderly (Bloch et al., 2010). The most common fear among the elderly (Todd & Skelton, 2004) is fear of falling (Tinetti, Richman & Powell, 1990).that means the lack of confidence in performing normal activities without losing balance related to trust in the balance (Hatch, Gill-Body & Portney, 2003) in both people with a history of falling (Cumming, Salkeld, Thomas & Szonyi, 2000) and in people without a history of falling (Arfken, Lach, Birge & Miller, 1994) about 22% to 59% have been reported (Wijlhuizen, Jong & Hopman-Rock, 2007; Cumming, Salkeld, Thomas & Szonyi, 2000) have a high prevalence in the elderly (Todd & Skelton, 2004), with fear of the elderly leading to over-care and over-restriction of their mobility and independence (Shumway-Cook and Woollacott, 2007). Elderly people who are afraid of falling also have limited ability to balance and trust in balance (Binda, Culham & Brouwer, 2003). balance it is a predictor of balance (Nemmers & Miller, 2008; Hatch, Gill-Body & Portney, 2003) and has a significant relationship with balance (Simpson, Worsfold, Fisher & Valentine, 2009; Kulmala et al., 2007 and Hatch, Gill-Body & Portney, 2003). Although there has been a large amount of researches on mental rotation and non-evaluation of mental rotation in the elderly, but comparing the effect of mental and physical exercises on the balance of the elderly doesn't seem as an interesting area for the researches which may provide useful information. Therefore, the present study aims to answer the question "Is the mental rotation or physical training effective on the balance and falling of elderly women?"

METHOD

Participants and procedure

The participants of the present study include the elderly who live in an elderly center in Iran. 36 elderly women were participated in this study. Internal criteria: 60 to 80 years Age range, lack of movement and behavioral disorders, approval of participation. Exclusion criteria: Enable to participants in groups i.e. (enable to balance and mental training). The samples were divided into three groups: physical training

(n = 12), mental rotation training (n = 12) and control group (n = 12) Have been investigated.

Instruments

Initially information was collected through demographic questionnaire (including age, sex, education, type of residence, history of falls, neurological problems, vision, mental and specific illness, training history and preservation balance). All the samples were collected and investigated for all three groups. **Mental rotation test (MRT):** This test is provided by Shepard and Metzler (1971), originally from the Auto CAD mapping version and the Vandenberg and Kuse (1978) rotation test. Mental rotation test in two ways: V, 20 Questions & K, is 24 the question. The mental rotation test used is a set of 24 questions. Each problem consists of a target shape on the right and four stimulus forms on the left. Two shapes of the four stimulus shapes are rotated versions of the target shape and the other two forms cannot be identical to the target shape (Peters et al., 1995). Reliability of the test was calculated 0.82 using the re-test method.

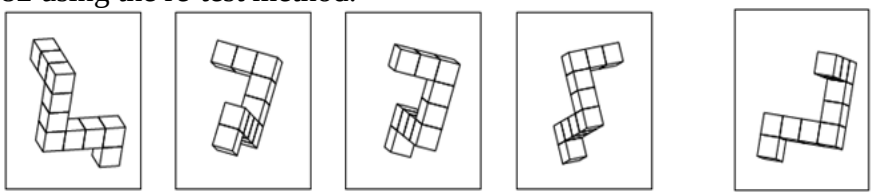

Figure 1: An example of a mental rotation test (Peters et al. 1995)

The main test has 24 questions, which were taken as two 12-question tests. The time for solving each test was 4 minutes with a 2-minute rest period between the tests. There are two ways to score this test. The first method is to record a score for each correct answer and deduct a score for each incorrect answer. In this case the maximum score would be 48 points. However, the most common scoring method is used in this study which is to record a sore for every two correct answers and not to record any sores for one correct answer. (one score for only two correct answer was considered.) This means that the maximum score in this test was 24. Appropriate descriptions of mental spin function and its processes can be found in Weaver's work (Voyer & Bryden, 1990), and the specific information for the revised V and K tests described here can be found in the work of Peters, Chisholm & Laeng (1995), and Peters et al. (1995) found. **Functional reach Test**: The Functional Reach Test is designed

to assess the static balance of the elderly and according to definition, the distance a person can bend and reach beyond the length of his or her arms while maintaining a stable level of standing. Duncan, Studenski, Chandler & Prescott in 1992 have shown that the Functional Reach Test has concurrent validity in assessing elderly balance (Bennie et al., 2003).

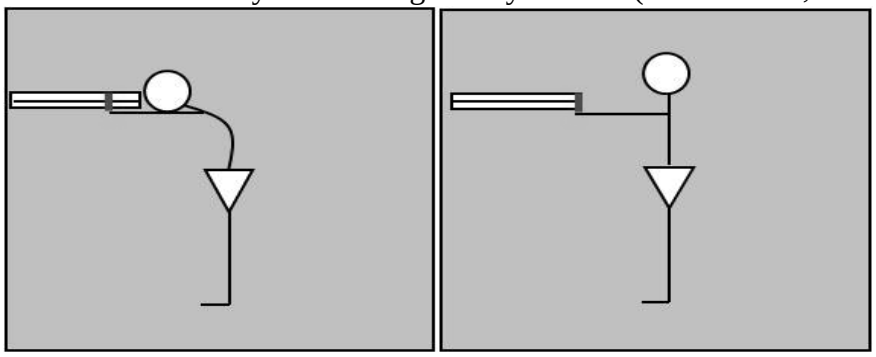

Figure 2: Functional Reach Test (FRT)

The functional Reach test is that the subject stands in a predetermined location next to one-meter paper that mounted on the wall. The subject stands next to the wall as she opens her legs as wide as her shoulder to create a 90-degree angle wall. The arm next to the wall should raise 90 degrees (hand in punched position) and is measured by grading in centimeters, then the subject is asked to take a step without disturbing her balance as far as possible. She can bend forward. After reaching the maximum possible displacement, the bending value of the person was measured again. The difference between the first and the second measurement in units of centimeters indicates the score. The validity of this test is 81%. Test performing: Initially, information was collected through the questionnaire. Then, mental rotation pre-test was performed for all three groups (physical exercise, mental rotation and control group). After data recording, physical training and mental rotation training groups were administered. The training program were 3 sessions training per week were administered to both groups of physical training and mental rotation for one hour. Physical training group: The protocol of functional training was performed three sessions per week for eight weeks and each training session was approximately 60 minutes. The training sessions started with ten minutes of stretching and walking to warming up, followed by 40-minute exercise protocol and the last ten minutes devoted to stretching to cool. the subjects in first two weeks was

focused on endurance and strength and in the second two weeks on the components of balance and flexibility. Control group: There was no intervention for control group subjects. First, a pre-test of mental rotation was performed, then after training, the post-test was performed as a pre-test procedure for the physical training and post-test mental of rotation groups.

Data analysis

In this research for statistical analysis, mean and standard deviation were used as descriptive statistics and classify the data. Before examining the data, the Shapiro Wilk test was used to examine the normal distribution, one-way analysis of variance (ANOVA) and t-test analyses was performed, at the significant level of 0.05 (p value ≤ 0.05 was considered statistically significant). Statistical analysis was executed using SPSS 21 version software.

RESULTS

Shapiro Wilk test was used to verify the normal distribution of data in small volume to ensure data is normal. Considering the table and the significant level values for the variables of balance and mental rotation, it can be said that the distribution of variables was normal with good probability.

Table 1: Shapiro Wilk test was used to verify the normal distribution of data

Shapirowilk	Variables statistic
	sig
Mental rotation	0/121
Balance	0/174

Table 2: Percentage and Frequency Distribution of Respondents by separation

Percentage	**Frequency**	**Falling experience**
13/9	5	Yes
86/1	31	No
100	36	Total

According to datas in table 2, the mean age of the respondents was 67.47 years. The highest score was 79 and 60 was the lowest age. Falling record of the 36 respondents, indicates that 5 had history of falling and 31 had no history of falling. Among them, nearly 13.9 have a history of falling. Table below shows the frequency of the distribution and percentages of respondents by breakdown history.

Table 3: Statistics on the balance of elderly women

Mean	**SE**	**Variance**	**SD**	**Number of observation**
29/11	1/714	105/81	10/28	36
Minimum	Maximum	Range of changes	Elongation	skewed
14	61	47	1/489	1/137

According to table 3, the mean balance variable among female elderly is 29/11. A score of 61 indicates the highest balance and a score of 14 indicates the lowest level of balance.

Table 4: Statistics on the mental rotation variable

Mean	**SE**	**Variance**	**SD**	**Number of observation**
8/69	0/738	19/46	4/43	36
Minimum	Maximum	Range of changes	Elongation	Skewed
3	21	18	0/928	1/149

The mean of mental rotation variable is 8/69. A score of 21 indicates the highest level of mental rotation and a score of 3 indicates the lowest level of mental rotation (table 4).

Table 5: One-way ANOVA test analysis among the elderly

F sig	F	$s^2 mean$	df	S^2	Source of Changes	The dependent variable
0/004	259/03	129/51 0/5	9 2 11	1165/66 1 1166/66	Among group Intergroup Total	Balance among elderly women

Comparison of eight weeks of physical training on elderly's balance in table 5: Since balance scores between elderly women have been quantitatively quantified and physical training group has been considered as multivariate nomenclature group, one-way ANOVA was used to this.

According to Table below, the mean balance among the elderly women was significantly different from the physical training group.

Table 6: Difference between two groups

Difference of mean balance by separation of physical training group among the elderly	Sig	Difference of mean balance by separation of physical training group among the elderly	Sig
Pre-test of mental rotation Pre-test of balance Post-test of balance	0/048 0/009	Post-test of mental rotation Post-test of balance	0/038

Table 6 shows the difference between the two groups of mental rotation and inter-group physical training: In this study, LSD method was used to determine the significant differences between the means. Which the results of the LSD test show significant differences in the mean balances between the elderly women and the exercise group. LSD test obtained the most significant difference in binary averages. This test shows the most significant difference in physical training group is related to pre-test and post-test in mental rotation test.

Table 7: The relationship between post-test mental rotation and pre-test physical training

	Physical fitness pre-test of mental rotation	**Physical fitness post-test of mental rotation**	**Post-test of mental rotation group**	**Pre-test of mental rotation group**
Physical fitness pre-test of mental rotation	1			
Physical fitness post-test of mental rotation	0/495 0/009 12	1		
Post-test of mental rotation group	0/230 0/098 12	0/030 0/926 12	1	
Pre-test of mental rotation group	0/106 0/743 12	0/035 0/915 12	0/476 0/011 12	1

Pearson correlation coefficient was used to test the relationship between mental rotation group and physical training group. According to

the table (Table 7), the relationship between post-test mental rotation and pre-test physical training was significant at the 0.01 level. Also, the relationship between the post-test mental rotation group and the pre-test mental rotation group was significant at the level of 0.05 and because the level is less than 0.05, so the correlation between post-test mental rotation and pre-test physical training was significant. Mental rotation and post-test mental rotation group with pre-test mental rotation group were significant.

Table 8: Relationship between mental rotation and balance among elderly women

Pearson correlation coefficient	**Sig**	**Number of respondents**
-0/301	0/000	36

Pearson correlation coefficient was used to test of **relationship between mental rotation and balance among elderly** women in table 8. According to the information in the table below, the relationship between mental rotation and balance among elderly women is significant at the 0.01 level because of the level is less than 0.05, so the result of the correlation between the relationship of mental rotation and balance among elderly women is significant. The relationship is positive and moderate.

Table 9: Mean balance among the elderly

	Levine test **sig**			Levine test	
Balance among elderly women	T	Df	Sig	F	Sig
	0/536	34	0/596	0/141	0/710

The results of mean balance test among female elderly by history of falling have shown in table 9.

Table 10: Relationship between mental rotation and falling of elderly women

Number of respondents	**Sig**	**Pearson's correlation coefficient**
36	0/047	0/131

According to table number 10, the relationship between mental rotation and falling in the elderly was significant at 0.05 level, and since the level was less than 0.05, the result of the correlation between the

relationship between mental rotation and falling in the elderly was significant. Positive and moderate reported.

DISCUSSION

Analyzing the first hypothesis of the study, comparing the effects of eight weeks of physical training and mental rotation on the balance of elderly women shows that physical training affects the balance of elderly women with research by Azimzadeh, Hosseini, Nourozi, & Davidson, 2015; Abdoli, Shams & Shamsipour Dehkordi, 2012 is in line. The present Research shows that physical activity and physical training in the elderly reduces the amount of eating and promotes the dynamic and static balance of the elderly (men and women). Another result of this hypothesis suggests that exercise increases the mental rotation of elderly women. Another consequence of this hypothesis is that there is a correlation between physical training group and mental rotation group. Given the research background mentioned, there was no research directly examining the relationship between physical exercise and mental rotation. Based on these results, it is likely that there is a relationship between physical exercise and mental rotation motor and mental activity is affecting the mental and physical performance. The results of the second hypothesis, which examines the relationship between mental rotation and equilibrium in elderly women, show that mental rotation has a positive effect on equilibrium of elderly women and improves their equilibrium. No research has been conducted to investigate whether the results are consistent with this hypothesis or not, but the results showed that the mental rotation of the elderly with regard to their mental activity and increased imagery is effective in reducing their falls and improving their balance. In support of this hypothesis, one can point to the results of Abdoli, Shams & Shamsipour Dehkordi, (2012) research which showed that physical and mental exercise improve the balance function of elderly women. By examining the third hypothesis that there is a relationship between mental rotations and falling in the elderly, we concluded that mental rotation increases the balance of the elderly and reduces their falls. Overall: Overall mental exercise improves mental rotation and physical activity, improves exercise and physical activity, and increases mental rotation and physical activity, improves balance in older women. Moreover, the researcher has encountered some limitations in the present research process which may affect the quality

of research, some of them are mentioned below. Some Elderly people got tired earlier than other ages due to physical limitations due to age, so research work can sometimes be done in several stages which might have affected the outcome. Another limitation of the study was the lack of patience of some seniors and the belief that they were unable to perform mental games and activities. Elderly who lacked literacy and vision due to old age found it difficult to understand the mental rotation test. Motivational and behavioral problems made it difficult to perform physical and mental exercises that required more practice and repetition, which required more time outside of the research timeframe. It takes a long time to follow the ethics of doing research with the elderly. Failure to cooperate with older staff is one of the limitations of the study, because there was no research on comparing the mental rotation in internal and external sources and there were very few resources, it was not possible to compare the results with similar ones. The results would be comparable in different provinces. According to the results of this study, it is suggested that: Comparison of mental rotation of elderly women with men The Elderly Center in which this study was conducted was for the elderly with disabilities, and it is recommended that the Elderly Center get included in this study. In this study, we compared the motor and mental activities of female elderly, suggesting different mental activities in relation with mental rotation.

CONCLUSIONS

The results showed that physical training and mental rotation training had a positive effect on the balance and falling of elderly women and the effect of physical training group was more on balance improvement in elderly women than mental rotation groups. So cognitive abilities and movements could be facilitating and effective in this way.

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