



Original Article

The Effect of Fun Physical Activities on Sarcopenia Progression among Elderly Residents in Nursing Homes: a Randomized Controlled Trial

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ABSTRACT

Introduction: Immobilization in the elderly can reduce the size and strength of muscle mass and ultimately lead to sarcopenia, the severity and progression of which can be prevented by exercise. However, due to physical and mental conditions, the elderly may be unable to take full advantage of regular exercise. Therefore, fun exercise through motivation and effective participation of older adults is likely to have positive effects on decreasing the volume and power of muscle mass. The aim of this study was to determine the effect of fun physical activities on the progression of sarcopenia among elderly residents in nursing homes.**Methods:** This study was a two-group randomized controlled trial conducted in 2014. Sixty three older adults were recruited by the random sampling. The elderly in the fun physical exercise group did the exercise for 8 weeks, three times a week for 20 minutes at a time, and in the control group, the adults did the routine exercises. The Berg Balance Scale, a dynamometer, and the Six-Minute Walk Test were used to measure sarcopenia criteria (balance, muscle strength, distance traveled). The statistical analysis was done by SPSS version 13.**Results:** The results showed that the mean score of the sarcopenia criterion (balance, distance walked, muscles strength) was significantly increased in the fun physical exercise group than in the control group.**Conclusion:** The fun physical activity reduces sarcopenia progression through improving balance, increasing distances walked, and strengthening muscles.**Citation:** Najafi Z, Kooshiar H, Mazloom SR, Azhari A. The effect of fun physical activities on sarcopenia progression among elderly residents in nursing homes: a randomized controlled trial. J Caring Sci 2018; 7 (3): 137-42. doi:10.15171/jcs.2018.022.

Introduction

Medical advances throughout the second half of the 20th century have led to the relative increase in human life expectancy, consequently increasing the elderly population and the number of elderly people who need care and rehabilitation. The elderly population is expected to increase. Accordingly, as the Iranian population gets older, the elderly population is expected to reach 25 million (about a quarter of the entire population) in 2050.¹ Aging is associated with complex mental and physical changes, particularly changes in the musculoskeletal system including loss of bone density, muscle mass, and strength, changes that often cause serious and life-threatening injury and disability.^{2,3,4} In many cases, for older people, these changes lead to problems in the individual's performance skills, disability, and loss of independence.⁵⁻⁷

In late 1980, sarcopenia was defined as an age-related, reduced skeletal muscle mass.⁸ Sarcopenia prevalence among the elderly may vary from 3% and 52%.^{9,10} The European Working Group on Sarcopenia in Older People (EWGSOP) states that sarcopenia is a known syndrome characterized by progressive loss of skeletal muscle mass, size, and strength.⁹ The result of such a disorder is progressive disability in 75% of older women and 50% of older men.^{7,11} There is a relationship between sarcopenia and disorders such as falls and fractures, impaired

balance, movement disorders, the incidence of inflammatory disease, cognitive disorders, and dementia.^{8,12,13} Studies have suggested various treatments to prevent the progression of sarcopenia, which include medication, hormone replacement therapy, dehydroepiandrosterone (DHEA), diet, and physical activity.^{14,15} In spite of the various treatments for sarcopenia, physical activity and exercise is considered as the most comfortable and easiest of all.¹⁶

Despite the benefits of physical activity in the elderly, 85% of older women and 70% of older men do not participate in regular physical activity in America.^{17,18} Similarly, in Iran, more than 80% of older adults are inactive in terms of physical activity.¹⁸ Regular exercise is usually difficult for the elderly, is not enjoyable, and is considered as a mandatory activity. Due to fatigue, chronic pain, and concern over their deteriorating health conditions, the elderly are not willing to do physical activities.¹⁹ The unwillingness of the elderly to do exercise increases inactivity and promotes excessive dependency on caregivers.²⁰ The physical and mental conditions of the elderly and their lack of interest in physical exercise, especially regular exercise in nursing homes, should be taken into account. Variety of entertainment, emphasizing the positive aspects of exercise, and creating innovative exercise programs are important in encouraging older adults to begin, then continue, to exercise.²¹

Since physical activities can be useful in preventing the onset of immobility and other resulting disorders such as sarcopenia, the elderly's caregivers and nurses can play an important role in the prevention of these disorders.

In view of the increasing physical and emotional problems in the elderly due to the problems of immobility, the presence of nurses in the pursuit of amusing sports activities leads to a sense of belonging among the elderly and a willingness to engage in such activities. The objective of this study was to determine the effect of fun physical activities on the progression of sarcopenia in the elderly population living in Mashhad nursing homes in Iran.

Materials and methods

This study was a randomized controlled clinical trial with an intervention (fun physical activity) and control group (regular physical activity). The intervention was performed for 20 minutes per session, 3 times a week for 8 weeks in the hall of the nursing homes from October to January 2014.

This study received ethics approval from the ethics committee at Mashhad University of Medical Sciences (code: 920788). In all stages of the research, all ethical codes related to the participants were upheld, including both written and verbal consent for participation in the research, the participants' right to decline participation, and the right to withdraw from the study at any time. All participants provided written and verbal consents. Written informed consent for the older participants who were not competent was obtained from their families or legal guardians.

This study was carried out with the participation of the elderly living in nursing homes in the city of Mashhad in Iran in 2014.

Nursing home residents were eligible to participate if their age was above 60; had no acute or chronic debilitating diseases; had no lack of balance disorders based on scores from the balance test (score less than 40); had the ability to communicate with the researcher; medical certificate of good health for exercising; had no contraindications for exercise (e.g. history of knee or hip arthroplasty, fracture history, heart pacemaker, a severe deformity especially in the lower extremities, joint problems such as arthritis and very severe osteoarthritis); and had no cognitive impairment based on Mini Mental Status Examination (MMSE).²² The exclusion criteria included: refusal to continue participating in the study; absences at more than two exercise sessions; death during the study; permanently departing from the nursing home; and being bedridden in the hospital (Figure 1).

In this study, an appropriate sample size was determined by the pilot study in a sample of 20 older adults (10 older adults in each group). Comparing the means of two populations was used to determine appropriate sample size (formula number one). Thus, with the statistical power of an 80% and 95% confidence interval, 70 eligible participants were randomly recruited

into the two groups (35 participant in each group). Four older adults were excluded from the control group for being absent in more than two exercise sessions, two people for disinterest in participating and one older adults because of hospitalization.

Intervention: The Intervention group engaged in fun physical activity and the control group in regular physical activity for 20 minutes per session, 3 times a week for 8 weeks in the hall of the nursing homes.^{22,23}

To avoid contact between the two group's homes, the intervention group and the control group were formed in separate nursing homes, due to physical space limitations in nursing (under the supervision of a center)

A certified clinical exercise specialist and a general practitioner were present during the exercise sessions. Exercise activities for both groups were performed an hour after breakfast. The diet was the same in both groups. For the regular physical activity group, the exercises consisted of the routine activities of the nursing home such as daily walking for half an hour around the area of the nursing home, and stretching. The protocol for the fun physical activity group included strength, balance, endurance, and walking activities in the form of rotational movements of the hands with plastic balls (also known as Beach Balls), Catch-a-Color Rockets, Wands, Audubon Bird, and stretch bands.

Outcomes: In this study, sarcopenia was measured through the assessment of balance, the distance walked in six minutes, and muscle strength by one educated research assistant who was blind to treatment allocation. The tools used for data collection were the Berg Balance Scale (BBS), the Six-Minute Walk Test (SMWT), and an assessment of muscle strength was made with a dynamometer. Demographic variables included age, sex, education levels, marital status, disease background, medication, and limb injury. Confounding variables included body mass index and smoking.

The Berg Balance Test (BBT) evaluates the functional balance of the older adult based on 14 simple balance-related tasks.²⁴ Each of the tasks consists of an ordinal scale ranging from 0 to 4, where 0 indicates the lowest level of function and 4 indicates the highest level of function. The total score of the BBT is 56, which indicates the highest possible level of balance. Each item is given a score of 0 to 4 based on a five-point ordinal scale, where 0 indicates the lowest level of function and 5 indicates the highest level of function. Scores of 0-20 represent "little balance" and high risk of falling, scores of 21-40 represent "balance" and a medium risk of falling, and scores of 41-56 represent "high balance" and a low risk of falling.

The distance walked by participants was measured by the SMWT. This test was performed twice for each older adult on the same day. Between the tests, the participants rested for 30 minutes, then the results of both tests were recorded, and the best results were used to determine functionality. The participants rested for at least 15 minutes before beginning the test and avoided eating for at least two hours before the test. Any inhaled bronchodilator taken within one hour before testing was taken into consideration. A dynamometer, model T.K.K.540, was used to measure muscle strength.

In the present study, content validity was used to verify the validity of the BBT and the SMWT. Cronbach's alpha coefficient was used to measure internal consistency. The alpha coefficient for the BBT and the SMWT were 0.75 and 0.92, respectively. Kervio et al., determined Cronbach's alpha as 0.95 for internal consistency of the Six-Minute Distance Walk.²⁵ Steffen et al., used internal consistency with Cronbach's alpha as 0.97 for the entire balance test.²⁶

The data was analyzed by using SPSS ver.13. In order to establish the variables were normally distributed, the Kolmogorov-Smirnov test was used. In order to interpret the results, independent and paired t-tests were run to express the results of balance and muscle strength, the Mann-Whitney U test and the Wilcoxon test were used for distance walked within and between groups, and the Chi-square test was applied to compare the characteristics of the subjects. P-values for all tests are reported and the level of significance selected for this study was P- values of less than 0.05.

Results

All participants were followed up for 2 months since randomization until excluded from the study. Seven participants in the control group were excluded from the study due to a disinterest in participating, hospitalization, and an absence of more than two exercise sessions; therefore, the control group decreased to 28 participants. Fig 1 shows recruitment and participation.

The results showed that the mean and standard deviation of the participants' age was 72.5 (7.0) years. Most of the participants were women (70 %). In both groups, the majority of the participants had arthritis and a history of using sedative drugs (Table 1). The control and intervention groups were not significantly different in terms of age, sex and other variables (Table 1). The result of independent t-test showed that the mean of balance score in the two groups after the intervention, the mean of balance score was significantly higher in the intervention group 38.3 (12.0) than in the control group 29.4 (6.1) (P= 0.001).

The Mann-Whitney test showed that there was a significant difference regarding the mean distance walked in six minutes in the two groups after the intervention (P=0.002) (Table 2).

Independent t-test results showed that the mean muscle strength score in the control group before the intervention was significantly higher than that in the intervention group, but no significant difference was observed after the intervention (P= 0.240).

Analysis of covariance was used to adjust preexisting differences between the groups regarding muscle strength score. By eliminating the effects of muscle strength before the intervention, muscle strength score was significantly higher in the intervention group 17.99 (0.18) in comparison with the control group 16.89 (0.20) (P= 0.001) (Table 2).

Discussion

The aim of the current study was to compare the effects

Table 1. Baseline demographic and clinical data

Variable	Intervention n=35 N (%)	Control n=28 N (%)	P*
Gender			>0.05
Male	12 (3.34)	10 (7.35)	
Female	23 (7.65)	18 (3.64)	
Smoking			>0.05
Yes	10 (1.13)	53 (9.86)	
No	20 (7.15)	43 (7.85)	
Chronic disease			
Arthritis	20 (7.15)	13 (4.64)	
Diabetes	7 (7.20)	10 (7.35)	
High blood pressure	6 (1.17)	4 (3.14)	
Hyperlipidemia	1 (1.29)	1 (3.6)	
Heart disease	0	1 (9.29)	
History of drug use			>0.05
Antidepressants	14 (0.40)	11 (3.39)	
Sedative	21 (0.60)	17 (7.60)	

*P- values were calculated using fisher's exact test

Table 2. Mean and standard deviation of elderly balance score, distance walked score, and muscle strength in the intervention and control groups

Score	Control group Mean (SD) N=28	Intervention group Mean (SD) N=35	Statistical indicator
Balance	29.4 (6.1)	38.3 (12.0)	P= 0.001 t=3.5
Distance walked	24.1 (6.7)	27.9 (11.1)	P= 0.002 z = 1.4
Muscle strength	18.3 (4.7)	16.8 (5.3)	P= 0.240 t=1.1
Muscle strength [†]	16.89 (0.20)	17.99 (0.18)	P= 0.001 ANCOVA

*P-Values were calculated using the independent t-test,**P-Values were calculated using the Mann-Whitney U-test, [†]Muscle strength adjusted score

of fun and regular physical activity on Sarcopenia among the elderly living in nursing homes in Mashhad. The results of this study showed that fun physical activity led to the reduction of sarcopenia progression. In this study, sarcopenia was examined using three factors of balance, the distance walked in six minutes, and muscle strength; accordingly, the discussion will be based on these variables.

A. Balance

The results of this study showed the mean of balance score in intervention group was significantly more than that in control group. The results found in this study regarding improvements in balance and mobility of the elderly is consistent with another study conducted by Nitz et al., who examined the impact of a balance strategy training program (BSTP) in improving functional mobility and reducing falls among elderly residents in nursing homes. They showed a significant improvement in all functional balance and mobility of elderly people after intervention.²⁷ One possible reason for the impact of the intervention in the present study may pertain to the type of exercise. In the present study, activities were carried out as a kind of fun activity. These kinds of activities are likely go together with relish and strengthen the positive thinking in the elderly as well as

physical activities. The results of this study are in line with the study done by Pata *et al.* Their results showed that eight weeks of Pilates-based exercise improved balance, postural stability and mobility in older adults.²⁸

The intervention of the present study was much like Pilates-based exercise in terms of the effects on muscle strength and mobility in the elderly. Exercise activities in Nitz *et al.*,²⁹ and the present study were done well by the elderly because of the comfort and happiness that the exercise programs promoted, and the similarity in the results of both studies may have resulted from this point. The results of the Avelar study also demonstrated that the Balance Exercises Circuit program, twice a week for 12 weeks, improved leg strength and power, static and dynamic balance, and mobility.²⁹

The result of this study is comparable to the results of Aslankhani *et al.*,³⁰ who studied the comparison of mental practice, physical practice, or a combination of both on static and dynamic balance of healthy older adults. Their study results showed that the mean of static and dynamic balance score increased after physical exercises. In Aslankhani *et al.*,³⁰ and the present study, the balance scores improved, while in Aslankhani study, the rate of balance (81%) was higher than that in the present study (48.9%). The higher balance score in the study by Aslankhani *et al.*,³⁰ may have been related to the type of intervention that was conducted, which included physical and mental practice, while for the intervention of the present study, only physical exercises were conducted.

B: The distance walked

The mean distance walked score in this study showed a significant increase after fun physical activities. The present study results are in line with Kawanabe *et al.*,³¹ who investigated the effect of whole-body vibration exercise, muscle strengthening, balance, and walking exercises on the walking ability in the elderly. They reported that after the 2-month exercise program, walking speed and step length were significantly improved in the elderly. The results of Kawanabe's study and the present one showed improvements in the walking ability of the elderly, while the length of the intervention were the same. Sadeghi *et al.*,³² examined the effects of eight weeks of muscular endurance trainings on gait kinematics parameters (step length, rhythm, and gait speed) in elderly women. Their results showed a significant increase in the size of the step length, walking speed, and lower extremity strength with muscular endurance training.³² Sadeghi's study results are inconsistent with the current study results. Possible reasons for this difference are the types of exercise intervention. The exercises in the study by Sadeghi were resistance training and strength training to improve muscle strength, while our study used less strength training and more exercises to improve balance. Also, in the present study, the exercises consisted of fun activity in order to create a fun environment and promote mobility in the elderly.

C. Muscle strength

In present study the mean of muscle strength score increased after fun physical exercise compared control

group. Consistent with this study, Eyigor *et al.*, reported the effects of a group-based exercise program on the physical performance, muscle strength, and quality of life in older women.³³ Exercise programs in both studies improved the elderly's muscle strength. Eyigor and present studies were done with powerful walking exercises. Improvements in the elderly's muscle strength may be related to the type of interventions. Because of problems during the aging process, the elderly are not interested in participating in physical activity. In this study, activities were designed to create interest and enthusiasm in older people for exercise, and the activities were considered as a kind of entertainment since we created a happy environment. Similarly, in the study by Eyigor, designing group exercises could be a factor in attracting older adults to exercise.

Behpor *et al.*, reported that a 12-week group exercise program improved the endurance and muscle strength of fall-prone elderly women.³⁴ The same results in Behpor and the present study may be related to doing group physical activities and creating a motivational and invigorating environment. Mathieu L. Maltais also found that resistance training is an effective way to increase muscle mass and strength. Lack of designated spaces for exercise in nursing homes, lack of interest and motivation to participate in activities and exercise at the beginning of the intervention, and overdependence on the researchers by some of the elderly people were some limitations of this study.

Conclusion

The result of this study showed that fun physical activity reduces sarcopenia progression through improving balance, increasing distance walked, and strengthening muscles.

Nurses play the most important role in maintaining and providing quality care in nursing homes. Due to the increasing physical and emotional problems in the elderly resulting from the problems of immobility, the presence of nurses in the pursuit of amusing sports activities leads to a sense of belonging among the elderly and a willingness to engage in activities.

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Ethical issues

None to be declared.

Conflict of interest

The authors declare no conflict of interest in this study.

References

- Eshaghi SR, Shahsanai A, Mellat Ardakani M. Assessment of the physical activity of elderly population of Isfahan. *Journal of Isfahan Medical School* 2011; 29 (147): 939-46. (Persian)
- Lee TW, Ko IS, Lee KJ. Health promotion behaviors and quality of life among community-dwelling elderly in Korea: a cross-sectional survey. *Int J Nurs Stud* 2006; 43 (3): 293-300. doi:10.1016/j.ijnurstu.2005.06.009
- Jones S, Cooper SA, Smiley E, Allan L, Williamson A, Morrison J. Prevalence of, and factors associated with, problem behaviors in adults with intellectual disabilities. *The Journal of Nervous and Mental Disease* 2008; 196 (9): 678-86.
- Najafi Z. A comparison of the effect of education through video versus demonstration on fear of falling in nursing home residents of Mashhad, Iran. *Iranian Journal of Nursing and Midwifery Research*. 2017; 22(3):195. (Persian)
- Janssen I, Heymsfield SB, Ross R. Low relative skeletal muscle mass (sarcopenia) in older persons is associated with functional impairment and physical disability. *J Am Geriatr Soc* 2002; 50 (5): 889-96.
- Wiener JM, Hanley RJ. *Measuring the activities of daily living among the elderly: a guide to national surveys* [Internet]. 1989 [Cited 25 Feb 2017]. USA: US Department of Health and Human Services.
- Tanimoto Y, Watanabe M, Sun W, Sugiura Y, Tsuda Y, Kimura M, et al. Association between sarcopenia and higher-level functional capacity in daily living in community-dwelling elderly subjects in Japan. *Arch Gerontol Geriatr* 2012; 55 (2): 9-13. doi: 10.1016/j.archger.2012.06.015.
- Cruz-Jentoft AJ, Baeyens JP, Bauer JM, Boirie Y, Cederholm T, Landi f, et al. Sarcopenia: European consensus on definition and diagnosis report of the European working group on Sarcopenia in older people. *Age Ageing* 2010; 39 (4): 412-23. doi:10.1093/ageing/afq 034.
- Fielding RA, Vellas B, Evans WJ, Bhasin Sh, Morley JE, Newman AB. An undiagnosed condition in older adults. Current consensus definition: prevalence, etiology, and consequences. *J Am Med Dir Assoc* 2011; 12 (4): 249-56. doi:10.1016/j.jamda.2011.01.003
- Grimby G, Saltin B. The ageing muscle. *Clin Physiol* 1983; 3 (3): 209-18. doi:10.1111/j.1475-097X.1983.tb 00704.x.
- Bauer JM SC. Sarcopenia and frailty: a clinician's controversial point of view. *Experimental Gerontology* 2008; 43 (7): 674-8.
- Jones Dp, Moore Ms, Urban Rj, Sanford Ap, Aarsland A, Robert R, et al. Essential amino acid and carbohydrate supplementation ameliorates muscle protein loss in humans during 28 days bedrest. *The Journal of Clinical Endocrinology & Metabolism* 2004; 89 (9): 4351-8.
- Kooshar H. Comparison of the effects of exhilarating and normal physical activities on the balance and fear of falling in the elderly residing in nursing homes of Mashhad. *Evidence Based Care* 2015; 5 (1): 35-46. (Persian)
- Malafarina V, Úriz-Otano F, Iniesta R, Gil-Guerrero L. Sarcopenia in the elderly: diagnosis, physiopathology and treatment. *Maturitas* 2012; 71 (2): 109-14. doi:10.1016/j.maturitas.2011.11.012
- Greenlund LJS, Nair KS. Sarcopenia--consequences, mechanisms, and potential therapies. *Mechanisms of Ageing and Development* 2003; 124 (3): 287-99.
- Kalache A Gatti A. Active ageing: a policy framework. *Advances in Gerontology* 2003; 11: 7-18.
- Garrett N, Brasure M, Schmitz KH, Schultz MM, MS, Huber MR. MHSA Physical inactivity: direct cost to a health plan. *Am J Prev Med* 2004; 27 (4): 304-9. doi:10.1016/j.amepre.2004.07.014
- Taylor AH1, Cable NT, Faulkner G, Hillsdon M, Narici M, Van Der Bij AK. Physical activity and older adults: a review of health benefits and the effectiveness of interventions. *J Sports Sci* 2004; 22 (8): 703-25. doi: 10.1080/02640410410001712421
- Salehi LTM Gasemi H, Shkrvsh B. Evaluation of physical activity in preventing and facilitating factors Tehran nursing home in elderly. *Iranian Journal of Epidemiology* 2010; 6 (2): 7-15.
- Schutzer KA, Graves BS. Barriers and motivations to exercise in older adults. *Preventive Medicine* 2004; 39 (5): 1056-61. doi:10.1016/j.ypmed.2004.04.003
- Brill P. *Functional fitness for older adults*. 1st ed. United Kingdom: Human Kinetics; 2004.
- Cvecka J, Tirpakova V, Sedliak M, Kern H, Mayr W, Hamar D. Physical activity in elderly. *European Journal of Translational Myology* 2015; 25 (4): 249-252.
- Myers J, Prakash M, Froelicher V, Do D, Partington S, Atwood JE. Exercise capacity and mortality among men referred for exercise testing. *N Engl J Med* 2002; 346 (11): 793-801.
- Berg KO, Maki BE, Williams JI, Holliday PJ, Wood-Dauphinee SL. Clinical and laboratory measures of postural balance in an elderly population. *Arch Phys Med Rehabil* 1992; 2 (73): 1073-83.
- Kervio G, Carre F, Ville NS. Reliability and intensity of the six-minute walk test in healthy elderly subjects. *Medicine and Science in Sports and Exercise* 2003; 35 (1): 169-74.
- Steffen TM, Hacker TA, Mollinger L. Age-and gender-related test performance in community-dwelling elderly people: six-minute walk test, berg balance scale, timed up & go test, and gait speeds. *Phys Ther* 2002; 82 (2): 128-37. doi:10.1093/ptj/82.2.128.
- Nitz JC, Josephson DL. Enhancing functional balance and mobility among older people living in long-term care facilities. *Geriatric Nursing* 2011; 32 (2): 106-13. doi:10.1016/j.gerinurse.2010.11.004
- Pata RW, Lord K, Lamb J. The effect of Pilates based exercise on mobility, postural stability, and balance in order to decrease fall risk in older adults. *Journal of Bodywork & Movement Therapies* 2014; 18 (3): 361-7. doi:10.1016/j.jbmt.2013.11.002
- Avelar BP, de Almeida JN, Safons MP, Dutra MT, Bottaro M, Gobbi S, et al. Balance exercises circuit improves muscle strength, balance, and functional performance in older women. *Age* 2016; 38 (14): 1-17. doi: 10.1007/s11357-016-9872-7.
- Aslankhani MA, Poordehkordi P. Comparison of mental practice, physical or a combination of static and dynamic balance in healthy elderly. *Aging* 2008; 3 (9-10): 19-26. (Persian)
- Kawanabe K, Kawashima K, Sashimoto I, Takeda T, Sato Y, Iwamoto J. Effect of whole-body vibration exercise and muscle strengthening, balance, and walking exercises on

- walking ability in the elderly. *Keio J Med.* 2007; 56 (1): 28-33.
32. Sadeghi H. Strength training and kinematics parameters of gait in healthy female elderly. *Salmand Journal* 2008; 3 (9): 27-33. (Persian)
33. Eyigor S, Karaplot H, Durmaz B. Effects of a group-based exercise program on the physical performance, muscle strength and quality of life in older women. *Archives of Gerontology and Geriatrics* 2007; 45 (3): 259-71. doi: 10.1016/j.archger.2006.12.001
34. Behpor N, Ghanbari A. The effect of a group exercise program on muscular strength and endurance in fall-prone elderly women. *Zahedan Journal Research Medical Sciences* 2012; 13 (10): 47. (Persian)