Acta Scientiarum

http://www.uem.br/acta
ISSN printed: 1679-9291
ISSN on-line: 1807-8648
Doi: 10.4025/actascihealthsci.v34ispec.11353

Effect of an exercise program on risk factors of falls in elderly women

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ABSTRACT. The aim of this study was to verify the benefits of an exercise program on functional capacity and balance in elderly community. A longitudinal study was conducted with 11 female subjects with mean age 77 (SD = 13) years. All individuals were evaluated at the beginning and at the end of the study by 'Berg' Balance Scale and 'Timed Up and Go' Test. Initially, the participants answered a questionnaire about the socio-demographics aspects, health conditions, falls and physical activity practice. Then, the subjects were submitted to a program of exercises for balance, strengthening and stretching muscles. The results of the 'Berg' Scale ranged from 46 to 56 points before the intervention, and from 50 to 56, after the intervention ($p = 0.01$). Individuals older than 75 years old had a better improvement ($p = 0.04$). In the 'Timed Up and Go' Test the percentage of improvement was 8.2% ($\overline{x} = 13.1$; SD= 11.7). The exercise program showed a positive effect in improving risk factors of falls in the elderly community.

Keywords: aged, exercise therapy, postural balance.

Efeito de um programa de exercícios físicos nos fatores de risco de quedas em idosas

RESUMO. Objetivo deste estudo foi verificar os benefícios de um programa de exercícios físicos na capacidade funcional e equilíbrio de idosos. Foi realizado um estudo longitudinal com a participação de 11 indivíduos do gênero feminino, com idade média de 77 anos (DP = 13). Todos foram avaliados no início e final do estudo pela Escala de Equilíbrio de *Berg* e pelo teste *Timed Up and Go*. Inicialmente, as participantes responderam um questionário por meio de entrevista, que abordava aspectos sociodemográficos, condições de saúde, quedas e prática de atividade física. Na sequência, as idosas foram submetidas a um programa de exercícios de treino de equilíbrio, fortalecimento e alongamentos musculares. Os resultados da escala de *Berg* variaram de 46 a 56 pontos, antes da intervenção e de 50 a 56 após a intervenção ($p = 0,01$). Os sujeitos com mais de 75 anos tiveram melhora superior ($p = 0,04$). No teste *Timed Up and Go* o percentual de melhora foi de 8,2% ($\overline{x} = 13,1$; DP = 11,7). O programa de exercícios desenvolvido apresentou efeito positivo na melhora dos fatores de risco de quedas em idosos.

Palavras-chave: idoso, terapia por exercício, equilíbrio postural.

Introduction

Estimates point that there is about nineteen millions of elderly in Brazil. The postural control may be influenced by physiological changes of aging, chronic diseases, pharmacological interactions or specific dysfunctions. Aging affects all components of postural control: sensory, effector and central processing (CHANDLER, 2002). Alterations of functional capacity as increase in the reaction time and decreased postural balance are also associated with the aging process (ROSE, 2008).

The falls may be caused by intrinsic and extrinsic factors. The major risk factors for falling are: gait changes, functional disability, previous falls, cognitive impairment, psychotropic medication, excessive physical activity, and balance disorders (GAMA; GÓMES-CONESA, 2008; GANANÇA et al., 2006). The all is defined as unintentional movement of the body with an inability to fix in a timely manner (PEREIRA et al., 2001). It is a frequent event that may cause loss of independence, death, and loss of quality of life in elderly (CAMERON et al., 2010).

Healthy older people suffer falls from standing height at least once a year. This may cause musculoskeletal injuries, such as fracture, head trauma, and serious lacerations that reduce the range of motion and independence. Around half of elderly people hospitalized for hip fracture do not recover mobility prior to the event (SHERRINGTON et al., 2008). In 2009, R$ 57.61 million were spent on hospital admissions for falls in the elderly. Among women were 20,778,000 admissions. In the same year 1,478 elderly died from falls (BRASIL, 2010).

Gillespie et al. (2009) determined the effects of individual and group therapy to prevent the

incidence of falls in the elderly. This study also evaluated the effect of hormone replacement therapy, calcium supplementation, visual fixes, and medical intervention. The authors concluded that individually programs of muscle strengthening and balance training prescribed were different between the intervention group and control group. However, there was no statistical difference when the exercise was performed in groups for the reduction of falls. Howe et al. (2007) described improvement of balance, gait, and reduction of falls in the elderly during anterior-posterior displacement with open eyes immediately after the interventions.

Preventing falls is considered an indicator of quality of services for the elderly. Moreover, it is a public health issue, because it affects the quality of life for seniors and their families, and increases the economic resources to address their consequences (COELHO et al., 2004). Thus, an exercise program that aims the improvement in functional capacity and the balance in the elderly is essential.

The objectives of this study were: to determine the effect of an exercise program on balance and functional capacity in the elderly community, and to determine their benefits according to age and frequency of participation.

Material and methods

This is a longitudinal study with a convenience sample (n = 20). The inclusion criteria were healthy people, female, aged 60 years or more. The exclusion criteria were: functional disability, medical diagnosis of diseases such as neurological, cardiac and other diseases that prevented the practice of physical exercise. Also were excluded those volunteers with a frequency lower than five therapies or who did not attend the final evaluation.

Initially, the participants answered a questionnaire through an interview that encompassed sociodemographic characteristics (age, education and occupation), health conditions (diseases, downtime), falls (number of falls in the last four years, number of months since last fall, fractures, and previous treatment) and physical activity. The assessments and exercise program were applied after reading, understanding and signing the consent form. This study was approved by the Ethics Committee of the Universidade Estadual de Londrina (CEP 055/08).

All subjects were evaluated at the beginning and completion of the study by the 'Berg Balance Scale' (MIYAMOTO et al., 2004) and the 'Timed Up and Go' test (PODSIADLO; RICHARDSON, 1991). The 'Berg Balance Scale' assesses the performance of the functional balance through 14 items common to everyday life. Each item has an ordinal scale of five alternatives ranging from zero to four points. Therefore, the maximum score could reach 56. Points are based on the time in which a position can be maintained, the distance at which the arm is able to reach the front of the body and time to complete the task (BERG et al., 1992).

The 'Timed Up and Go' test assesses the functional capacity (mobility and balance). The test requires the individual to get up from a standard chair with backrest and no arms, walk 3 m, turn around, go back towards the chair, and sit back. The result of the test is based on the time spent to complete the task (PODSIADLO; RICHARDSON, 1991).

From the end of the initial assessment, the elderly underwent an exercise program that lasted one hour, once a week, for ten weeks. For strengthening exercises were used dumbbells from 0.5 to 1 kg. The program consisted of active exercises of ankle and cuffs, muscle stretching of upper and lower limbs, trunk, lateral trunk muscles, back muscles and cross-strengthening exercises, balance exercises, and coordination. Further information is listed in Table 1.

Table 1. Exercise program.

Exercise	Duration/Repetition
Warm – up	
Active exercise of dorsiflexion and plantiflexion;	2 min.
Active exercise of wrists flexion and extension;	2 min.
Active exercise of metacarpal-phalangeal and interphalangeal flexion and extension;	2 min.
Stretching	
Rotators of the trunk in standing;	1 min.
Flexor side of the trunk in standing;	1 min.
Quadriceps with standing patient (leaning on a chair);	1 min.
Pectoral, elbow and wrist flexors with sitting patient ;	1 min.
Posterior chain with sitting patient;	1 min.
Strengthening	
Squat;	3 x 10 rep
Quadriceps with sitting patient (weight in the ankle);	3 x 10 rep
Hip abductors;	3 x 10 rep
Dorsiflexors and plantiflexors;	3 x 10 rep
Shoulder flexors with sitting patient (dumbbells);	3 x 10 rep
Elbow flexors with sitting patient (dumbbells);	3 x 10 rep
Shoulder abductors with sitting patient (dumbbells);	3 x 10 rep
Elbow extensors with sitting patient (dumbbells);	3 x 10 rep
Up and down steps;	3 x 10 rep
Balance	
Standing still on one foot;	30 s
Standing still on one foot on a mat, eyes open;	30 s
Standing still on one foot on a mat, eyes closed;	30 s
Walking (heel of one foot in front of other);	3 m
Aerobic	
Walking at 50% of the maximum heart rate;	20 min.
Relaxation	10 min.

min = minutes; rep = repetitions; s = seconds; m = meters.

The exercises were prescribed considering the needs of the group. After the period of the exercise program, subjects were reevaluated using the 'Berg

Balance Scale' (MIYAMOTO et al., 2004) and 'Timed Up and Go' test (PODSIADLO; RICHARDSON, 1991).

The descriptive analysis was presented according to the normality distribution (mean and standard deviation, or median and quartiles) for continuous data, and absolute and relative frequency for categorical data. In order to compare the beginning versus completion of treatment we used a paired Student's T-test or Wilcoxon test, depending on normal distribution. Still, to compare the groups and to stratify the results according to age and frequency of participation was used an independent Student's T-test or Mann-Whitney test. The percentage of improvement of the groups was also calculated. Statistical significance was set at 5% ($p \leq 0.05$). The 'Statistical Package for Social Sciences' (SPSS, version 15.0) was used for analyses.

Results

Of the 20 participants initially assessed, only 11 completed the exercise program. The age ranged from 64 to 90 years ($\bar{x}$ = 77; SD=13). Five participants (45.5%) reported being illiterate and six (54.5%) have studied for four years. The most frequent diseases reported by the elderly were hypertension (45.5%), diabetes (27.3%), hypercholesterolemia (18.2%) and osteoarthritis (18.2%). Seven (63.6%) reported having had a fall in the last 24 months. None of these falls resulted in hospitalization or a bedridden period, but one (9.1%) participant reported that suffered upper limb fracture and received conservative medical treatment. Of the total assessed, 81.8% reported practicing some physical activity, such as stretching (81.8%), walking (9.1%) or muscle strengthening (18.2%). About the frequency of exercises 9.1% reported practicing every day, 9.1% three times a week, twice a week, 36.4%, 18.2% once a week, and 9.1% rarely.

The results of the 'Berg' scale ranged from 46 to 56 points before the intervention and 50 to 56 after the intervention ($p = 0.01$). In the 'Timed Up and Go' test, the values varied between 8.4 and 14.5 seconds before the intervention, and between 7.8 and 13.3 seconds after the intervention ($p = 0.007$) (Table 2).

The percentage of improvement in 'Berg' was 4.9%. To compare the influence of age on the improvement, the participants were divided into two groups: 1 (G1) for individuals under 75 years (n = 6) and 2 (G2) for individuals over 75 (n = 5). Overall improvement in the Berg was a median of 1.8 (1st quartile = 1.8, 3rd quartile = 4). The results are shown in Table 3 and indicated that individuals over 75 years had an improvement in the 'Berg' scale ($p = 0.04$).

Table 2. Results of the 'Berg' scale and the 'Timed Up and Go' test of the participants (n = 11).

Scales	Initial Assessment $\bar{x}$ (SD)	Final Assessment $\bar{x}$ (SD)	95% CI	P
Berg scale	51. 8 (1. 9)	53.5 (1.2)	1.7 [0.5;2.9]	0.01
Timed Up and Go (s) test	11. 7 (1. 4)	10.16 (1.3)	1.6 [0.5;2.7]	0.007

s = seconds; $\bar{x}$ = mean; SD = standard deviation; CI = confidence interval.

Table 3. Percentage of improvement (%) according to the age.

	G1 (n = 6)	G2 (n = 5)	P
	$\bar{x}$ (SD)	$\bar{x}$ (SD)	
Timed Up and Go (s)test	16.9 (13.2)	8.5 (8.9)	0.26
	Md (1st-3rd)	Md (1st-3rd)	
Berg scale	1.8 (1.89-0)	4.0 (10.6-2.83)	0.04

$\bar{x}$ = mean; SD = standard deviation; Md = median; s = seconds.

The mean percentage of improvement in Timed Up and Go was 8.25% ($\bar{x}$ = 13.1, SD = 11.7; Table 3). In order to double-check the influence of age, individuals were analyzed in two groups. We observed an improvement for those individuals with less than 75 years, but without statistical significance ($p = 0.26$).

Once not all the volunteers participated effectively in the exercise program, they were divided into two groups for the analysis of the results: G1 - attended up to six sessions (n = 6) and G2 - attended from seven to ten sessions (n = 5). The results are shown in Table 4 and an improvement was verified for the participants of G2, but with no statistical significance ($p = 0.79$). For the results of % of improvement in the 'Timed Up and Go' a similar procedure was adopted, and the participants who attended the sessions more frequently, had presented an improvement in the test, but without statistical significance ($p = 0.26$; Table 4).

Table 4. Percentage of improvement (%) according to the frequency in the exercise program.

	G1 (n = 6)	G2 (n = 5)	P
	$\bar{x}$ (SD)	$\bar{x}$ (SD)	0.26
Timed Up and Go (s)test	9.2 (8.4)	17.6 (14.5)	
	Md (1st-3rd)	Md (1st-3rd)	0.79
Berg scale	2.8 (1.3-5.1)	1.8 (0.9-7.2)	

$\bar{x}$ = mean; SD = standard deviation; Md = median; s = seconds.

Discussion

This study intended to verify the effect of an exercise program on the balance and functional capacity of elderly women, and also to check these benefits according to age and frequency of participation. A significant improvement was

observed for both outcomes (functional capacity and balance) in the 'Timed Up and Go' test and 'Berg' scale. However, when the results were evaluated according to age group, a difference was found only for the group older than 75 years for the balance outcome.

The risk of falls in elderly can be predicted by analyzing the following factors: reduced muscle strength, impaired balance and gait. These risk factors can be reduced with specific exercises. However, other points, such as decreased visual acuity and use of psychoactive medications require different interventions (SHERRINGTON et al., 2008). A review by McClure et al. (2005) evaluated the effectiveness of exercise programs promoted by the government in different countries, whose goal was to reduce the risk of falls in the elderly. Regarding the reduction of fracture it was observed a 20% decrease in Australia, 37% in Denmark, and 6.6% in Sweden, in the latter the reduction was observed only in elderly female.

Gait analysis in the elderly is an important test, since even small changes indicate significant loss of function. The walking speed is another important marker for future falls and functional losses. Changes in the rate and regularity of the gait can be consequences of the fear caused by the previous falls. The 'Timed Up and Go' test has a great relationship with balance, rhythm and regularity of gait, functional capacity and mobility (ROCHAT et al., 2010). The values of this test were improved during the course of the present study, i.e; most participants performed it in a time shorter than in the initial assessment. This result corroborates the study of Silva et al. (2008), which compared a group that performed physical activity and a control group. A statistically significant difference was detected for the results of the 'Timed Up and Go' test ($p = 0.02$) for the experimental group ($\overline{x} = 7.95$, $SD = 1.31$) compared with the control ($\overline{x} = 8.58$, $SD = 1.03$).

In this study, there was an improvement in the variation of the 'Berg Balance Scale' in performing some activities after the implementation of the exercise program. A study evaluated the effectiveness of two interventions in improving balance and functional ability of elderly people; the results showed that dynamic exercises had been able to improve balance, evaluated by a force platform, in an elderly population (medial-lateral displacement: $\overline{x} = 6.1$; $SD = 1.7$ cm to $\overline{x} = 3.1$; $SD = 1.6$ cm, $p = 0.02$; anterior-posterior displacement: $\overline{x} = 4.7$; $SD = 4.2$ cm to $\overline{x} = 3.4$; $SD = 1.0$ cm, $p = 0.03$) (ALFIERI et al., 2010).

For the interpretation of the present results, some limitations should be considered. The participants had already performed exercises before the study, which limits the understanding of the effects of the program. Moreover, it was found a ceiling effect in the Berg Scale, i.e., the baseline score was close to the maximum of the test, indicating that these participants have no balance disorders. Another limitation was the lack of adherence to the proposed program, which resulted in a low number of participants. It is necessary to carry out further studies, for example, a randomized clinical trial following the recommendations of the Consort-Statement (SCHULZ et al., 2010) with an appropriate number of participants.

Conclusion

The exercise program proposed in this study had a positive effect on the improvement of functional capacity and balance in elderly women.

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Received on October 5, 2010.
Accepted on June 8, 2011.