

## The Effect of a Group Exercise Program on Muscular Function among Fall-Prone Elderly Women

Efecto de un Programa de Ejercicios Grupales sobre la Función Muscular entre Mujeres de Edad Avanzada Propensas a Caídas

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**SUMMARY:** In a sampled population of fall-prone elderly women, an exercise protocol was performed for 12 weeks on experimental group and at the end of exercise period, the strength and endurance of muscles and SF-6 Health Surveys were analyzed. Results showed that endurance and strength of muscles and also physical activity were improved in experimental group ( $P < 0.05$ ). Group exercise program causes improvement in both strength and endurance of muscles in fall-prone elderly women. The effect of group exercise program on women may be related to differences in central nervous system of this gender in comparison with men.

**KEY WORDS:** Physical activity; Exercise therapy; Frail elderly; Female.

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### INTRODUCTION

Because of, impaired balance, muscular weakness, and slowed reaction time, older people undergo to fall repeatedly and also reduce their physical activity (Carter *et al.*, 2001). In this regard, one third of people over 65 years old fall each year that the ratio of falling increases by ageing of individuals (Tinetti, 2003).

Exercises by correcting physiological impairments can reduce falls and the risk factors of fall in both community based general exercise program and by tai chi quan, home-based strength and balance training program in selected population based studies (Rosendahl *et al.*, 2006; Wolf *et al.*, 1996).

However, exercise comes in many forms, and further research is needed to delineate the specifics of exercise prescription for optimal fall risk and fall reduction. Defining the components of exercise that are effective in reducing fall risk would provide some insight into the possible underlying mechanisms by which exercise exerts its effect and allow those prescribing exercise to do so more effectively (Liu-Ambrose *et al.*, 2004).

The present study was undertaken to show the effect of exercise on daily physical activities of frail elderly women.

### MATERIAL AND METHOD

This randomized controlled trial research was carried out in the year 2011 on 40 women aged 65-70 years old in Mehrvarzan Adult Care Center of Kermanshah-Iran. The participant received care according research committee guidelines of the University. A pre test- post test researcher's made questionnaire was undertaken by an expert Physical exercise therapist and the co efficiency of reliability (Cronbach's  $\alpha$ ) was 0.86. Individuals were included if they had fallen at least two times during past 6 months. Individuals were excluded if they exercised regularly or had severe cardiac or pulmonary disease, a terminal illness, severe joint pain, dementia, medically unresponsive depression, or progressive neurologic disease (e.g., Parkinson's disease) (Rubenstein *et al.*, 2000). The intervention consisted of three 90-minute sessions per week for 12 weeks, led by exercise physiology graduated students. The exercise protocol is outlined in Table I. Control subjects were asked to continue their usual activities during the 12-week control period.

Physical performance tests used to assess strength, endurance, gait, and balance included a sit-to-stand test on a chair during 30 seconds (Hopkins *et al.*, 1990), a 6-minute walk test (by high speed) (Butland *et al.*, 1982), and a 15-second one-leg standing balance test.

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Table I. Group exercises in fall-prone elderly women in Mehrvarzan Adult Care Center of Kermanshah-Iran (2011).

Name of Exercise	Mode of exercise
<b>Knee</b>	Flexion and extension of knee in standing position on a chair without elevation of thigh (1 min)
<b>Ankle</b>	Standing on both toes (30seconds)
<b>Walking</b>	No motility hard walking (30 seconds)
<b>One leg balance</b>	Standing on one leg then on the next (15 seconds for each leg)
<b>Walking forward</b>	Walking on a straight course (6 minutes)
<b>Abduction of thigh</b>	Abduction of thigh in standing position (10 or more times for each leg)
<b>Stretching of upper limb</b>	Hand to hand of a ball on head (10 or more for each hand)

Three subscales of the RAND 36-item Health Survey (SF-36) (Ware & Sherbourne, 1992) were used to measure physical functioning, role limitations, and general health

perceptions. Physical activity was measured with the Yale Physical Activity Survey (Dipietro *et al.*, 1993). The data analyzed with SPSS version 16 for Windows.

Table II. The effect of group exercise program on muscle strength of fall-prone elderly women in Mehrvarzan Adult Care Center of Kermanshah-Iran in 2011.

Groups	Muscle	Mean± SD		P- Value
		Pre-test	Post-test	
<b>Experimental</b>	Right thigh extensors	40.20 ± 4.61	49.50 ± 8.18	0.040*
	Left thigh extensors	44.70 ± 7.27	55.20 ± 6.20	0.040*
<b>Control</b>	Right thigh extensors	39.90 ± 1.52	39.70 ± 1.49	0.063
	Left thigh extensors	39.20 ± 1.32	39.00 ± 1.63	0.063
<b>Experimental</b>	Right thigh flexors	63.80 ± 4.32	73.10 ± 3.48	0.037*
	Left thigh flexors	40.30 ± 6.06	49.80 ± 5.41	0.034*
<b>Control</b>	Right thigh flexors	61.70 ± 1.34	60.90 ± 1.29	0.063
	Left thigh flexors	43.10 ± 2.33	42.40 ± 2.27	0.060
<b>Experimental</b>	Right knee flexors	46.80 ± 7.51	57.80 ± 6.66	0.034*
	Left knee flexors	48.00 ± 6.25	57.00 ± 5.68	0.035*
<b>Control</b>	Right knee flexors	49.90 ± 1.66	49.60 ± 1.51	0.060
	Left knee flexors	49.30 ± 2.31	48.80 ± 2.39	0.067
<b>Experimental</b>	Right knee extensors	48.90 ± 4.20	57.80 ± 4.47	0.035*
	Left knee extensors	42.70 ± 5.77	54.60 ± 4.81	0.034*
<b>Control</b>	Right knee extensors	50.10 ± 1.60	49.80 ± 1.40	0.067
	Left knee extensors	39.80 ± 1.75	39.60 ± 1.84	0.063
<b>Experimental</b>	Right ankle dorsi flexors	28.70 ± 2.79	38.70 ± 1.57	0.034*
	Right ankle plantar flexors	25.70 ± 1.95	36.80 ± 1.93	0.033*
<b>Control</b>	Right ankle dorsi flexors	31.60 ± 1.51	31.50 ± 1.27	0.073
	Right ankle plantar flexors	27.40 ± 1.43	26.90 ± 1.37	0.056
<b>Experimental</b>	Left ankle dorsi flexors	22.00 ± 1.63	32.80 ± 1.93	0.033*
	Left ankle plantar flexors	23.60 ± 3.24	33.50 ± 2.76	0.034*
<b>Control</b>	Left ankle dorsi flexors	25.50 ± 3.72	25.10 ± 3.48	0.063
	Left ankle plantar flexors	26.80 ± 1.75	26.50 ± 1.78	0.056

(\*P<0.05).

Repeated measures two-way analysis of variance (ANOVA) was performed on outcome variables. Significant interactions were examined (Tukey's test) to determine if effects were greater in the exercise or control group.

## RESULTS

The effects of group exercise program on muscle strength of fall-prone elderly women are presented in Table II. In experimental group, strength of the muscles of both lower limbs significantly increased ( $P < 0.05$ ). Group exercise program was the most effective on the strength of Right ankle plantar flexors and Left ankle dorsi flexors ( $P = 0.033$ ) and the least effective on Right thigh extensors and Left thigh extensors ( $P = 0.040$ ). Table III shows the data of Siconolfi step test that indicates group exercise program increases endurance in fall-prone elderly women ( $P = 0.034$ ).

The effects of group exercise program on physical function among fall-prone elderly women are presented in Table IV. There was a significant increased in sit to stand test in 30 second ( $P = 0.034$ ) and six minute walk ( $P = 0.035$ ) of group exercised women that showed the positive effect of these exercises on movement ability of individuals. The balance tests on one legs of dominant ( $P = 0.034$ ) and non dominant ( $P = 0.037$ ) showed also an increased ability in balancing of the body according to the group exercises. In overall, physical functioning of fall-prone elderly women that was calculated according SF-36 health survey subscales significantly increased ( $P = 0.034$ ).

Table III. The effect of group exercise program on muscle endurance (Siconolfi step test) of fall-prone elderly women in Mehrvarzan Adult Care Center of Kermanshah-Iran in 2011

	Mean $\pm$ SD		P-Value
	Pre-Test	Post-Test	
<b>Experimental</b>	42.70 $\pm$ 0.14	43.92 $\pm$ 0.20	0.034*
<b>Control</b>	42.63 $\pm$ 0.20	42.41 $\pm$ 0.26	0.059

(\* $P < 0.05$ ).

Table IV. The effect of group exercise program on physical function of fall-prone elderly women in Mehrvarzan health Care Center of Kermanshah-Iran in 2011.

Groups	Control (Mean $\pm$ SD)			Experimental (Mean $\pm$ SD)		
	Pretest	Post-test	P-Value	Pretest	Post-test	P-Value
<b>Sit to stand test in 30 second</b>	9.90 $\pm$ 1.10	9.40 $\pm$ 0.97	0.053	10.50 $\pm$ 0.85	12.90 $\pm$ 0.74	0.034*
<b>Six minute walk</b>	373.10 $\pm$ 2.13	372.30 $\pm$ 2.36	0.063	373.10 $\pm$ 6.31	392.60 $\pm$ 7.40	0.035*
<b>15 second one leg balance (dominant leg)</b>	6.17 $\pm$ 0.89	6.03 $\pm$ 0.92	0.059	6.16 $\pm$ 0.86	8.23 $\pm$ 0.89	0.034*
<b>15 second one leg balance (non dominant leg)</b>	4.26 $\pm$ 0.76	4.17 $\pm$ 0.80	0.068	4.17 $\pm$ 0.76	6.36 $\pm$ 0.75	0.037*
<b>SF-36 (physical functioning)</b>	62.05 $\pm$ 1.10	61.41 $\pm$ 1.08	0.080	61.59 $\pm$ 0.87	71.25 $\pm$ 0.81	0.034*

(\* $P < 0.05$ ).

## DISCUSSION

Falling in the elderly is associated with muscle weakness, balance impairment and gait deficit especially in lower extremity muscles (Daubney & Culham, 1999; Lord & Dayhew, 2001; Lord *et al.*, 2003). Furthermore, leg muscle strength is positively related to mobility (Aagard *et al.*, 2007), and inversely related to the incidence of hip fractures (Aniansson *et al.*, 1984). According to sit to stand test in 30 second and six minute walk tests, we can say that group exercise increases the strength of lower extremity muscles. This data is in parallel with other studies (Daubney & Culham; Karavirta *et al.*, 2011; Rubenstein *et al.*).

On the other hand, control of posture that is important for the successful performance of most daily activities is under control of sensory system and deterioration in postural stability may be a major contributor to many falls, resulting in an impaired ability to correct for the many postural disturbances in daily life (Daubney & Culham). For normal relaxed standing posture requires continuing muscle activity (primarily of the gastrocnemius muscles) and also an integrated reflex response to visual, vestibular and somatosensory inputs (Rogers & McClosky).

In elderly the capacity of neuromuscular responses decreases and causes postural sway (Aagard *et al.*). Although, there is a small amount of postural sway in standing, this sway increases by aging either in elderly healthy subjects.

Thus, increased time of standing test shows improvement in peripheral somatosensory and neuromuscular responses induced by group exercise. Moreover, either standing test of dominant and non dominant legs improved that shows the affectivity of group exercise on central nervous system of prone failed fall-prone elderly women. Falling rates are higher in older women than in older men and continue to increase with age above 65 years and after the age of 75; the frequency is similar for both (Varas-Frabra *et al.*, 2006).

But Baltimore Longitudinal Study on aging (Metter *et al.*, 1999) reported that men had greater rates of strength decline in muscles than women, and that increasing age was associated with greater loss of strength.

Thus, we suggest that in fall-prone elderly the role of central nervous system is more prominent in women than men and improvement in strength of muscles is secondary response to group exercise in women.

Anatomical studies revealed that males have more overall volume of gray and white matter than females, which may mean that females might use more neural resources (e.g., in both hemispheres) to achieve the same cognitive performance (Good *et al.*, 2001).

Consistent with this hypothesis, it has been revealed that females have a relatively larger isthmus segment of the callosum, perhaps reflecting a sex-specific difference in the inter-hemispheric connectivity (Steinmetz *et al.*, 1992; Steinmetz *et al.*, 1995). These issues maybe considered as explanation of improvement in balance of both dominant and non dominant legs in this study and either callosum that connects cerebral hemispheres or other related connections such as vermis that connects cerebellar hemispheres are involved in process of recovery of fall-prone elderly.

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**BEHPOOR, N.; DARABI, M. R.; HOJATOLESLAMI, L.; BAYAT, P.-D. & GHANBARI, A.** Efecto de un programa de ejercicios grupales sobre la función muscular entre mujeres de edad avanzada propensas a caídas. *Int. J. Morphol.*, 30(2):567-571, 2012.

**RESUMEN:** En una población de mujeres de edad avanzada propensas a las caídas, se realizó un protocolo de ejercicios durante 12 semanas. Al final del período de ejercicios, se analizó la fuerza y resistencia muscular junto a la encuestas de salud SF-6. Los resultados mostraron que tanto la resistencia y la fuerza muscular, así como la actividad física mejoraron en el grupo experimental ( $p < 0,05$ ). El programa de ejercicio grupal mejoró la fuerza y la resistencia de los músculos en las mujeres de edad avanzada propensas a las caídas. El efecto del programa ejercicio grupal en las mujeres puede estar relacionada con diferencias en el sistema nervioso central de este sexo en comparación con los hombres.

**PALABRAS CLAVE:** Actividad física; Terapia de ejercicios; Ancianos frágiles; Mujer.

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