

# INFLUENCE OF PHYSICAL EXERCISE ON THE FUNCTIONAL CAPACITY IN INSTITUTIONALIZED ELDERLY



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INFLUÊNCIA DO EXERCÍCIO FÍSICO NA CAPACIDADE FUNCIONAL DE IDOSOS INSTITUCIONALIZADOS

INFLUENCIA DEL EJERCICIO FÍSICO EN LA CAPACIDAD FUNCIONAL DE ANCIANOS INSTITUCIONALIZADOS

Catarina Covolo Scarabottolo<sup>1,2</sup>  
(Physical Education Professional)

Jair Rodrigues Garcia Júnior<sup>1</sup>  
(Physical Education Professional)

Luis Alberto Gobbo<sup>2</sup>  
(Physical Education Professional)

Marcelo José Alves<sup>1</sup>  
(Physical Education Professional)

Aline Duarte Ferreira<sup>1,3</sup>  
(Physiotherapist)

Everton Alex Carvalho Zanuto<sup>1,2</sup>  
(Physiotherapist and Physical Education Professional)

Weber Gutemberg Alves de Oliveira<sup>1</sup>  
(Physiotherapist)

Diego Giulliano Destro Christofaro<sup>2,3</sup>  
(Physical Education Professional)

1. Universidade do Oeste Paulista (UNOESTE), Departamento de Educação Física, Presidente Prudente, SP, Brasil.

2. Universidade Estadual Paulista (UNESP), Programa de Pós-Graduação em Ciências da Motricidade, Rio Claro, SP, Brasil.

3. Universidade Estadual Paulista (UNESP), Programa de Pós-Graduação em Fisioterapia, Presidente Prudente, SP, Brasil.

## Correspondence:

Rua Roberto Simonsen, 305,  
Presidente Prudente, SP, Brazil.  
19060-900  
catarinacovolo@hotmail.com;  
catarinacovolo@gmail.com

## ABSTRACT

**Introduction:** With the rapid increase in life expectancy, systematic physical exercise programs can have a good influence on the functional capacity of the elderly, especially in relation to institutionalization. **Objective:** To analyze the association between a systematic physical exercise program and functional capacity in institutionalized elderly. **Methods:** The sample included 30 elderly subjects (16 women and 14 men) aged 60 years or older (mean age = 74.43), divided into a control group (n=16) and a training group (n=14), residents in a long-stay institution. A training protocol of 12 weeks, two weekly sessions, was applied, and functional capacity was assessed before and after the intervention, through chair lift tests (lower limb strength), upper limb strength, timed up and go and handgrip dynamometry. The analysis pre and post-training of intervention and control groups was performed using paired Student *t* test and the ANOVA test for repeated measures. The level of significance was set at 5%. **Results:** The main statistical significance were found for the following functional tests: upper limb strength (training 15.6±4.1 x control 10.7±6.6 rep, p<0.05) and chair lift test (training 11.0±4.0 x control 8.0±3.1 rep, p<0.05). **Conclusion:** The protocol used proved to be effective in improving some of the functional capabilities of the institutionalized elderly.

**Keywords:** aged; health; life expectancy; longevity; homes for the aged.

## RESUMO

**Introdução:** Com o rápido aumento da expectativa de vida, os programas de exercícios físicos sistemáticos podem influenciar positivamente a capacidade funcional dos idosos, especialmente com relação à institucionalização. **Objetivo:** Analisar a associação entre um programa de exercício físico sistemático e a capacidade funcional em idosos institucionalizados. **Métodos:** A amostra incluiu 30 indivíduos idosos (16 mulheres e 14 homens) com idade de 60 anos ou mais (média de idade = 74,43), distribuídos em grupo controle (n = 16) e grupo treinamento (n = 14), residentes em uma instituição de longa permanência. Foi aplicado um protocolo de treinamento de 12 semanas, duas sessões semanais, e a capacidade funcional foi avaliada antes e após a intervenção, por meio de testes de levantar e sentar da cadeira (força de membros inferiores), força de membro superior, timed up and go e força de prensão manual. A análise pré e pós-treinamento dos grupos intervenção e controle foi realizada com o teste t de Student pareado e o teste de ANOVA para medidas repetidas. O nível de significância foi estabelecido em 5%. **Resultados:** A principal significância estatística foi encontrada para os seguintes testes funcionais: força do membro superior (treinamento 15,6 ± 4,1 x controle 10,7 ± 6,6 rep, p < 0,05) e levantar e sentar de uma cadeira (treinamento 11,0 ± 4,0 x controle 8,0 ± 3,1 rep, p < 0,05). **Conclusão:** O protocolo utilizado demonstrou ser eficaz na melhoria de algumas das capacidades funcionais dos idosos institucionalizados.

**Descritores:** idoso; saúde; expectativa de vida; longevidade; instituição de longa permanência para idosos.

## RESUMEN

**Introducción:** Con el rápido aumento de la esperanza de vida, los programas sistemáticos de ejercicio físico pueden influir positivamente en la capacidad funcional de adultos mayores, especialmente con respecto a la institucionalización. **Objetivo:** Analizar la asociación entre un programa sistemático de ejercicio físico y la capacidad funcional de los ancianos institucionalizados. **Métodos:** La muestra incluyó a 30 sujetos de edad avanzada (16 mujeres y 14 hombres) mayores de 60 años (edad promedio = 74,43), distribuidos en el grupo control (n = 16) y grupo entrenamiento (n = 14), residentes en hogares para ancianos. Se aplicó un protocolo de entrenamiento de 12 semanas, con dos sesiones semanales, y la capacidad funcional se evaluó antes y después de la intervención, a través de pruebas de levantarse y sentarse en la silla (fuerza de las extremidades inferiores), la fuerza de las extremidades superiores, levantarse y caminar y la fuerza de presión manual. El análisis de los grupos de intervención y control pre y post-entrenamiento se realizó con la prueba de t de Student pareada y la prueba ANOVA para medidas repetidas. El nivel de significación se fijó en 5%. **Resultados:** La principal significación estadística se encontró para las siguientes pruebas funcionales: fuerza de las extremidades superiores (entrenamiento 15,6 ± 4,1 x control 10,7 ± 6,6 rep, p < 0,05) y levantarse y sentarse en la silla (entrenamiento 11,0 ± 4,0 x control 8,0 ± 3,1 rep, p < 0,05). **Conclusión:** El protocolo ha demostrado ser eficaz en la mejora de algunas de las capacidades funcionales de los ancianos institucionalizados.

**Descriptor:** anciano; salud; esperanza de vida; longevidad; hogares para ancianos.

## INTRODUCTION

The life expectancy of elderly people is increasing all over the world at an accelerated rate, especially in Brazil<sup>1-3</sup>. Whilst the population aged 65 or over, in 1970, represented 3.1% of the Brazilian population, in 2050, according to projections, it may reach 19% of the total population<sup>4,5</sup>. The fact that people are living longer also increases the number of long-term care institutions, which attend dependent and independent elderly people<sup>6</sup>.

It appears that institutionalization can be a negative factor for disability since it encourages sedentary habits and lack of exercise, which in turn further impair some characteristics of advancing age such as reduction in muscle mass and function, termed sarcopenia, leading to loss of functional capacity<sup>7,8</sup>. Functional capacity is related to the ability to perform activities of daily living (ADLs) such as eating, bathing, taking a bus, making a phone call or walking<sup>9,10</sup>.

These activities are very important for maintaining an independent life in old age. It is believed that systematic practice of physical exercise in the institutionalized elderly can prevent the onset of chronic diseases that are associated with aging, and maintain or even improve their functional capacity<sup>11,12</sup>.

Some types of training exercise can be applied to this population. One in particular is the combination of resistance training and functional training. The former includes exercises that require lifting weights such as dumbbells and ankle weights or working with resistance bands. Functional training includes exercises such as walking on the heels or toes, standing on one leg or dynamic exercises. In general, exercises bring several benefits to the human body, and the proposed combination of both training models may increase muscle strength, proprioception and stability, all of which are needed to perform daily activities<sup>8,13</sup>. The American College of Sports Medicine<sup>13</sup> also indicates that the combination of aerobic training with resistance training presents to be more effective when performed together than each of them performed in separate training sessions. Moreover it is noteworthy that such exercises have low cost materials which would facilitate their application for the elderly living in long-term institutions.

Whereas there should be an increase in demand for long-term institutions due to the increase in life expectancy, this study can contribute to exercises programs to be introduced in these institutions and to be part of the routine, enabling the independence and autonomy of the elderly.

Therefore, the aim of this study was to investigate whether a concurrent training, including strength, functional training, and walking could improved the functional capacity of the institutionalized elderly.

## MATERIALS AND METHOD

### Sampling

This longitudinal study took place in the city of Presidente Prudente, São Paulo, Brazil<sup>14</sup>, with residents from a philanthropic long-term institution. Of the 83 elderly of both genders who were resident in the institution, individuals who were unable to walk; visually impaired; and/or demonstrated the III degree of dependence, according to Resolution nº 283/05 (elderly that need assistance in all activities of daily life and/or elderly that have cognitive impairment)<sup>15</sup>, were excluded from this study. Nineteen were wheelchair users and one was visually impaired. Initially, 35 residents were invited to participate, but five declined at some point during the study, therefore, the sample included 30 institutionalized elderly subjects aged 60 years or over of both genders (14 male and 16 female), who agreed to participate in this study. All participants were informed about the objectives and methods, and they or someone responsible for them, signed a consent form. This study was approved by the Ethical and Research Committee involving humans of the University of Oeste Paulista (protocol 146029/2013-5).

Body mass was measured with an electronic scale of the Filizola brand with a precision of 0.1 kg. Height was measured with a stadiometer. Using this information, the body mass index was calculated by dividing the weight by the height squared.

### Functional capacity evaluation

Also called the Sitting and Standing Test, this was performed in an armless chair. The participant began the test in the sitting position; arms crossed over the chest and, at a sign from the evaluator, stood up and sat down as often as possible in 30 seconds; number of repetitions was recorded. Verbal encouragement was given throughout the test<sup>16</sup>.

### Upper-limb strength

Sitting in an armless chair, the individuals were instructed, to hold a halter with their dominant hand and perform the flexion-extension of the elbow movement as often as possible in 30 seconds. The test started with the dominant arm extended alongside the body. Women used a 2kg weight and men 4kg; number of repetitions was recorded. Verbal encouragement was given throughout the test<sup>17</sup>. A weight reduction was allowed for those who didn't have the strength to achieve the test with the pre-established weight.

### Timed Up and Go (TUG)

The participants were instructed to cross their arms in front of their chest, rise from a chair without arms, and walk a distance of three meters, turn 180°, return and sit in the same chair as fast and safely as possible. The course was timed, in seconds, and the timer started when the participant disengaged their column from the chair and stopped when they leaned back again. Verbal encouragement was given throughout the test<sup>18</sup>.

### Evaluation of Upper-limb muscle strength

Handgrip dynamometry was measured using a dynamometer Biodex System 3 Pro®. The test was performed three times using the dominant upper limb with intervals of 10 seconds between each execution, and the highest measurement, in kg, was considered for the study. Verbal encouragement was given throughout the test<sup>19</sup>.

### Training protocol

The participants were divided into two groups for attending the 12 weeks training or not: the control group (n=16) and the training group (n=14).

The training group performed a combination of exercises in the training program over 12 weeks. Sessions lasted for approximately 40 to 50 minutes, twice a week. The intensity of exercises was monitored using the scale of Subjective Perception of Effort from 6-20 as proposed by Borg<sup>20</sup>. The concurrent training included functional training, resistance training and walking within the physical space of the institution.

The session started with functional training, with all exercises being repeated three times for 20 seconds. Exercises consisted of walking on the heels, walking on the toes, marching with increased hip flexion and walking sideways, in addition to exercises performed on a small matress: dorsiflexion, plantar flexion, marching with increased hip flexion, and balancing on one-leg.

After functional training, still in the same session, the resistance training was performed, in which all exercises were carried out with two to three sets of eight to ten repetitions. The women generally used 1-2 kg of weight divided between dumbbells and ankle weights, and the men 2-4 kg. Exercises consisted of: exercises for the chest and back with a resistance band, triceps and biceps development with dumbbells and knee flexion and knee extension with ankle weights. The session ended with a walk through the physical space of the institution. Chart 1 shows the details of the training protocol.

**Chart 1.** Training protocol.

Functional training:	
Walking on the heels	3 sets of 20 seconds
Walking on the toes	3 sets of 20 seconds
Walking with increased hip flexion	3 sets of 20 seconds
Walking sideways	3 sets of 20 seconds
	Pause of 30 to 60 seconds among exercises
Exercises performed on mats:	
Dorsiflexion and plantar flexion	3 sets of 20 seconds
Marching with increased hip flexion	3 sets of 20 seconds
Balancing on one-leg	2 or 3 sets of 20 seconds
	Pause of 30 to 60 seconds among exercises
Resistance training:	
Chest fly with resistance band. Position: sitting	2 or 3 sets of 10 repetitions
Knee extension with ankle weights (2 to 4kg). Position: sitting	2 or 3 sets of 10 repetitions
Seated row with resistance band. Position: sitting	2 or 3 sets of 10 repetitions
Knee flexion with ankle weights (2 to 4kg). Position: standing	2 or 3 sets of 10 repetitions
Biceps curl and shoulder over head press (2 to 4 kg dumbbell). Position: standing	2 or 3 sets of 10 repetitions
Seated triceps press (2 to 4kg dumbbell). Position: sitting	2 or 3 sets of 10 repetitions
	Pause of 30 to 60 seconds among exercises
Walking within the physical space of the institution	It was timed how many minutes the elderly could walk in each session

## Statistical analysis

Initially the Komogorov-Smirnov test was performed to verify the normality of the data. After verifying the fit in the Gaussian distribution the sample characteristics were presented as mean and standard deviation. Student t test was used for the analysis of the values of the sample's characteristic. Repeated measures for Anova test was used to compare the moments and groups. The magnitude between differences was observed by Duncan's post hoc tests. The level of significance was set at 5% and the statistical program used was BioEstat (5.0).

## RESULTS

The average age of the 30 participants was 74.43 ( $\pm 9.08$ ) years. Of these, 14 were male and 16 were female, with no statistical discrepancy between the study participants according to gender ( $p = 0.715$ ). The mean BMI of the study sample was 23.88 kg/m<sup>2</sup> ( $\pm 6.14$ ), being 22.82 kg/m<sup>2</sup> ( $\pm 7.52$ ) for the control group and 24.42 kg/m<sup>2</sup> ( $\pm 3.81$ ) for the training group ( $p = 0.472$ ). Table 1 shows the details of the sample characteristics, at the pre-training moment, presented according to gender.

When comparing groups (control and training, respectively) for the variables of functional capabilities, no statistical differences were found at the pre-training moment for the variables handgrip (17.9 versus 13.5 kg [ $p = 0.184$ ]), rising from a chair (7.8 versus 9.7 rep/30seconds [ $p = 0.121$ ]) and TUG (26.7 versus 23.3 seconds [ $p = 0.540$ ]), with a statistical difference being observed only for upper-limb strength (8.3 versus 12.2 rep/30seconds [ $p = 0.241$ ]). Table 2 shows the comparisons in the pre and post time between the intervention and control groups. Significant differences were found in the strength of upper limbs for both groups in moments 1 and 2 and between the intervention group and the control group. Significant difference was found in rising from a chair between the times of the intervention group and also in the intervention group compared with the control (Table 2).

**Table 1.** Characteristics of the sample according to group.

	Control group		Training group		p-value
	Mean	SD	Mean	SD	
Age (years)	76.47	7.08	73.79	6.85	0.295
Weight (kg)	60.23	15.33	55.82	11.24	0.332
Estature (cm)	158.71	95.90	150.14	71.02	0.010
BMI (kg/m <sup>2</sup> )	22.51	7.90	24.4	3.81	0.415

**Table 2.** Functional capacity of older adults before and after twelve weeks of training.

	Mean (SD)		F		
	M1	M2	Group	Time	Interaction
Variable					
Handgrip					
- Training	13.5 (5.4)	15.3 (5.3)	1.20	0.14	1.79
- Control	17.9 (9.8)	16.9 (10.1)			
ULS					
- Training	12.2 (3.1) <sup>a,b</sup>	15.6 (4.1) <sup>a,b</sup>	6.81 <sup>c</sup>	16.5 <sup>c</sup>	0.54
- Control	8.3 (4.9) <sup>a,b</sup>	10.7 (6.6) <sup>a,b</sup>			
RFC					
- Training	9.7 (3.1) <sup>ab</sup>	11.0 (4.0) <sup>ab</sup>	4.61 <sup>c</sup>	4.31 <sup>c</sup>	2.47
- Control	7.8 (2.5) <sup>b</sup>	8.0 (3.1) <sup>b</sup>			
TUG					
- Training	23.3 (14.3)	19.8 (11.4)	0.87	1.01	0.49
- Control	26.7 (12.0)	26.0 (16.9)			

a= Difference between moments ( $p \leq 0.05$ ); b= Difference between groups ( $p \leq 0.05$ ); c=  $p \leq 0.05$ . ULS= Upper-limb strength; RFC= Rising from a chair; TUG= Timed up and go.

## DISCUSSION

Life expectancy has increased rapidly worldwide, however, together with the increase in the elderly population, there has been an increase in the prevalence of chronic diseases and a decrease in functional capacity in this age group<sup>1,3,7</sup>. Therefore, the aim of this study was to analyze whether an exercise program, consisting of concurrent training, would contribute positively to the functional capacity of the institutionalized elderly. The results of our study showed that, in general, there was improvement in some functional abilities in older adults who participated in the training program.

When analyzing the functional capacities included in this study, an improvement in the training group for the upper-limb strength and rising from a chair test was verified over the training program. In an 8-week pilot study, conducted by Krist et al.<sup>21</sup>, with the use of resistance training twice weekly, significant strength improvements were found in the upper and lower limbs of institutionalized elderly subjects, comparable to the results presented here. In a study by Sá et al.<sup>11</sup> with 20 institutionalized elderly participants, the authors verified an improvement in some functional capacities such as balance, handgrip and lower limb strength, after an exercise program consisting of three types of training, performed three times a week over 18 weeks. However, in this same study, no significant gains were found for the variable gait speed, which was similar to the patterns found in our study, in relation to the TUG variable.

Low muscle strength in the lower limbs is associated to limit the functional capacity for everyday tasks and can also lead to an increased risk of falls which is a significant public health problem<sup>22,23</sup>. In this sense we choose a training program that would increase or at least maintain the resistance force of the lower limbs, as we concluded in our results with the training group.

Lobo et al.<sup>24</sup> conducted an exercise intervention in institutionalized elderly from north of Portugal during 1 year, plus 3 months of a detraining period. They investigated many variables and their results emphasize the importance of physical activity to promote health and to prevent the risk factors that increase with age and with physical inactivity, as

we would like to highlight in our study. One of their variables was the muscle strength. After a year of intervention, they showed a significant improvement in the strength of lower and upper limbs, which are very important to the maintenance of the functional capacity of the elderly as we have mentioned before. Nevertheless, they found out that after the one year intervention period, elders in the control group decreased their levels in all variables, except for flexibility and upper strength. We associated that data with the improvement that our control group had in the upper limb strength. The hypothesis is that the most used muscles are the ones from upper extremity and this could lead to this result<sup>24</sup>. In addition, we could not control all the activities carried out by the elderly within the institution, and some of them helped the caregivers in domestic activities and maybe that influenced this result.

It is important to emphasize that physical activity, especially the resistance training, is very important to increase muscle strength so the elderly can preserve their functional capacity. Besides, this kind of training can promote reductions in loss of bone mass, contributing to the preservation of functional capacity since both are related<sup>25</sup>.

It is also important to mention, that our study presented some limitations. The sample was not randomized, which may have influenced the results. The weight used during the exercises was pre established for men and women, and therefore there was no progression weight intensity. However, after approximately 4 weeks of training, weight were increased to those who said that the exercise was very light or very easy. In our exercise program, we did not included flexibility which is important to maintain and extend range of motion, reducing the risk of injury and falls<sup>13</sup>.

Even with these limitations, the results are important, since this type of exercise program can slow down the processes of aging, especially the ones related to the ability to perform the activities of daily living<sup>21,26</sup>.

## CONCLUSION

It was found that a concurrent training can improve the functional capacity of the institutionalized elderly, which is of great interest, since this capacity is directly related to independence to perform everyday activities. The results supported our initial hypothesis that the combination of strength training and functional training would improve at least some of the capabilities evaluated, as was the case of the strength of upper and lower limbs. More studies in this area of institutionalized elderly are needed, and perhaps a longer period of intervention that was realized in our study would be necessary so that the other variables analyzed here, could present a statistically significant improvement.

Nevertheless, a simple and low cost protocol, as used in this study, could be applied in long-term institutions, encouraging the professionals in this area to develop interventional programs for the institutionalized elderly.

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