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Original Article

Effect of strength training on the agonist-antagonist sequence to improve functional fitness in older women

Effect of strength training on the agonist-antagonist sequence to improve functional fitness in older women

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ABSTRACT

Introduction: Strength training (ST) is effective to improve functional fitness (FF) in older people. However, the literature is scarce in relation to some ST methods. **Objective:** To verify the effect of an agonist-antagonist circuit training model (AACT) on FF in older women. **Methods:** Thirteen older women (68.6 ± 6.1 years, 66.4 ± kg, 1.57 ± 0.07 meters) were recruited to participate in this research. These women were submitted to the Senior Fitness Test to evaluate FF and measurements of body weight, height and calf circumference to check body composition. The training protocol was based on AACT model with exercises performed following this sequence: knee extension, knee flexion, abductor and adductor machine, bench press, rowing machine, triceps and biceps curls during eight weeks. The participants performed three sets of 8 to 10 repetitions with 30-second intervals in the circuit training model. **Results:** After eight weeks of AACT training, FF improved significantly ($p \leq 0.05$). However, there were no differences in body composition ($p \geq 0.05$). **Conclusion:** The training organized in an AACT model improves FF and may be used to maintain an active lifestyle and improve the quality of life in this population.

Key-words: Older people, Strength training, Functional capacity.

RESUMO

Introdução: O treinamento de força (TF) é efetivo para aumentar a aptidão funcional (AF) em idosos. Entretanto, a literatura é escassa em relação a alguns métodos de TF. **Objetivo:** Verificar o efeito de um modelo de treinamento agonista-antagonista realizado em circuito (AAC) na AF em mulheres idosas. **Métodos:** Foram recrutadas 13 mulheres idosas (68,6 ± 6,1 anos, 66,4 ± kg, 1,57 ± 0,007 metros) para participar desta pesquisa. Todas foram submetidas ao Sênior Fitness Test para avaliar a AF e medidas de peso, estatura e circunferência de panturrilha para medir a composição corporal. O protocolo de treinamento foi em um modelo AAC com exercícios realizados na sequência: extensão de joelhos, flexão de joelhos, cadeira abdutora, cadeira adutora, supino reto, remada articulada, rosca tríceps e rosca bíceps durante oito semanas. Todas realizaram entre 8 e 10 repetições, intervalo de 30 segundos e três séries no circuito. **Resultados:** Após oito semanas de treinamento AAC, a AF melhorou significativamente ($p \leq 0,05$). Porém, não foram observadas diferenças para a composição corporal ($p \geq 0,05$). **Conclusão:** O treinamento organizado em um modelo AAC promove melhora da AF e pode ser utilizado para manutenção de uma vida ativa e melhora da qualidade de vida nessa população.

Palavras-chave: Idoso, Treinamento de força, Capacidade funcional.

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Introduction

Strength training (ST) is considered as an effective training method in order to increase the strength, muscle mass and functional fitness gains in older people [1-4]. Recognized health organizations such as the American College of Sports Medicine (ACSM) [5] and the American Heart Association (AHA) [6] recommend ST as a relevant support for the treatment of many different pathologies. However, the various possibilities of training methods and systems that can be performed in ST sessions [7] should be considered.

Concerning the training method, the ACSM indicates in the guidelines the training organized in a circuit format alternating upper and lower limb exercises [1]. This type of training helps to improve cardiorespiratory capacity and promote strength gains and functional fitness in older people [3,4,8,9].

Cardozo *et al*. [4] have recently demonstrated that the ST performed in a circuit training with different exercise sequences increased strength, muscle mass and improved functional fitness in older women. However, the authors emphasized that to achieve muscle strength gains the exercise sequence must respect the principle of priority, considering that the exercises allocated at the beginning of the training sessions showed greater gains in muscle strength.

Another way of organizing the exercise sequence may be performed using the agonist-antagonist model, which consists of after performing an exercise for the agonist's muscle, an exercise is performed for the antagonist's muscle [7,10]. This training method provides a higher volume of muscle work comparing to the traditional training method [11] and greater training efficiency because it reduced overall training time to perform the exercise sessions [12]. Therefore, it can be implemented as a plan to optimize training results spending less time. However, there is not much research approaching circuit training organized in an agonist-antagonist model applied to older people. Thus, new studies that investigate the effects of different training methods are required to contribute to providing more information for the prescription of exercises in this population. For this reason, the objective of this study was to verify the effect of an agonist-antagonist training model in a circuit format focusing on functional fitness in older women.

Methods

Sample

Thirteen older women (68.6 ± 6.1 years, 66.4 ± kg, 1.57 ± 0.07 m) that took part of a physical activity program to older people were recruited to participate in this research.

Inclusion criteria adopted for participation in this study were: a) older women with at least six months in ST practice with training frequency twice a week; b) do not present any cardiological and/or motor contraindications that would negatively influence the training routines and c) any type of exercise different from those prescribed in the ST protocols was allowed to prevent any type of interference. This study was approved by Research Ethics Committee, under the number 847.611.

Assessment of functional fitness and body composition

The functional tests applied were based on the Senior Fitness Test [13,14]:

a) **30s Chair Stand** - Number of times the subject gets up from the chair for a period of 30 seconds. This test measures the dynamic strength of the lower limbs;

b) **Arm Curl** - Number of elbow flexions in which the subject performs for a period of 30 seconds. This test measures the dynamic strength of the upper limbs;

c) **Chair Sit and Reach** - Number of centimeters reached with one leg extended. This test measures the flexibility of the lower limbs;

d) **8-Foot Up-and-Go** - Number of seconds required to get up from the chair, walk 2.44 meters and return to the initial position. This test measures muscle power, agility and balance.

For body composition, data such as body weight, height, body mass index (BMI) and calf circumference were collected. Specifically, the calf circumference measure was used in the present study to indicate the muscle mass of the participants [15]. All tests used in the present study were validated and presented an adequate correlation with more sophisticated assessment methods [14,15].

Training protocol

After the initial evaluations, the volunteers were directed to eight weeks of ST. The exercises were organized in an agonist-antagonist model with the exercises following the sequence: knee extension, knee flexion, abductor and adductor machine, bench press, rowing machine, triceps and biceps curls.

The training was performed in a circuit format and three sets of 30-second interval were applied. The number of repetitions was eight to ten and the loads were subjectively adjusted (scores between 7 and 8 as a reference) according to the OMNI-RES effort perception scale. When any participant was comfortably able to do three sets of ten repetitions comfortably, the weight was raised to maintain the number of repetitions and the training stimulus [3,4]. During the training sessions, all volunteers were monitored by a Physical Education professional with experience in ST.

Statistical analysis

To verify the normality of the sample, the Shapiro Wilk test and homoscedasticity (Bartlett's criterion) were applied. For the analysis of functional fitness and body composition, the paired t-test was applied to investigate the possible differences between the pre and post-training periods. Data are represented by the mean and standard deviation. A significance level of $p \leq 0.05$ was adopted. The analyzes were performed using the SPSS 20.0 software.

Results

Table I shows the results of functional fitness and body composition in the pre- and post-training periods. After eight weeks of ST performed in circuit format, significant improvements were observed in the functional tests $p \leq 0.05$. However, there were no differences in body composition after the training period $p \geq 0.05$.

Table I - Values in the mean and standard deviation of functional fitness and body composition.

Variables	Pre	Post	p Value
30s Chair Stand[1]	11.1 ± 1.8	12.7* ± 2.6	0.001
Arm curl[1]	14.5 ± 3.4	15.8* ± 3.0	0.004
Chair Sit and Reach[2]	-3.9 ± 7.6	-1.3* ± 7.0	0.020
8-Foot Up-and-Go[3]	7.3 ± 1.8	6.4* ± 1.8	0.001
Weight (kg)	66.4 ± 12.2	65.9 ± 12.7	0.487
Height (meters)	1.59 ± 0.07	1.59 ± 0.07	0.431
BMI (kg/m2)	26.2 ± 4.4	25.9 ± 4.6	0.065
Right Calf	33.8 ± 3.5	34.1 ± 3.5	0.337

*Indicates significant difference in relation to the pre-training period; 1 = Number of repetitions; 2 = values in centimeters; 3 = Values in seconds; BMI = Body mass index.

Discussion

The findings of this study demonstrated that eight weeks of ST performed in an agonist-antagonist circuit model improves functional fitness in older women. These results are important and emphasize relevance of prescription of ST as a measure to improve/maintain functionality in this population.

It is well known that human aging is a period marked by a reduction in physiological functions that can impact the performance of activities of daily living.

According to Rikli and Jones [14], functional capacity, which is defined as the physiological capacity to perform independently activities of daily living, in a safe way and without fatigue, can decrease around 40% between 60 and 90 years of age [14]. These negative adaptations could be explained by the reduction in levels of strength and muscle mass over the years. It is estimated a reduction in muscle mass of approximately 1% to 2% after 50 years of age and another 40% between 50 and 80 years of age [16]. Related to the levels of muscle strength, these reductions can reach values of 28.5% (over twelve years of follow-up) in muscle groups of lower limbs, which may lead to a reduction in the level of physical activity, physical dependence and the acquisition of diseases chronic degenerative disorders [14,17-19]. On the other hand, when elderly people are submitted to an ST program, the levels of strength and muscle mass can increase, keeping them fit to manage an active and independent life [4,19]. Literature data report surprising increases of 174% in muscle strength gains in nonagenarian people, demonstrating that despite their advanced old age it is possible to obtain these benefits [20].

It was observed an improvement in all functional tests evaluated in the present study. Thus, the increase in the number of repetitions in the 30s chair stand and arm curl tests can be attributed to the increase in the dynamic muscular strength of the lower and upper limbs, respectively. The Chair Sit and Reach test was improved due to gains in flexibility in the lower limbs, besides the 8-Foot Up-and-Go test that measures the time spent getting up from the chair, walk a few meters and returning to the starting position can be related to the increasing levels of muscle power, agility and balance. These results corroborate other studies developed, demonstrating that the ST performed in a circuit is effective to improve functional fitness in people older [3,4,20,21]. However, this study approached an agonist-antagonist training model different from the traditional training models adopted in other studies. Therefore, our findings reinforce the agonist-antagonist training model offering another training option to be prescribed in training programs for older individuals.

Regarding body composition, our results showed a tendency to reduce body weight and BMI. However, these values were not sufficient to induce statistically significant differences.

Some studies attribute the measure of calf circumference as an indicator of muscle mass in older people [15]. In this study, this measurement increased but it was not statistically significant in relation to initial values. Perhaps this outcome may be attributed to the fact that a specific exercise for the gastrocnemius muscle was not used in this study. Regardless of this fact, the training protocol used here promotes improvement in functional fitness and can therefore be adopted in ST programs for the elderly.

Conclusion

According to the results of this study, training organized in an agonist-antagonist circuit model improves functional fitness and may be used to maintain an active lifestyle and improve quality of life in this population.

Potential conflict of interest
No conflicts of interest with potential potential for this article have been reported.

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There were no external sources of funding for this study.

Academic link
There is no link between this study and graduate programs.

Authors' contributions
Conception and design of the research: Vasconcelos APS, Cardozo D. Obtaining data: Vasconcelos APS, Cardozo D. Data Analysis and interpretation: Vasconcelos APS, Cardozo D. Statistical analysis: Vasconcelos APS, Cardozo D. Obtaining financing: None. Manuscript Writing: Vasconcelos APS, Cardozo D. Critical review of the manuscript for important intellectual content: Vasconcelos APS, Cardozo D.

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