



Effect of Circuit Training on Resting Blood Pressure: An Experimental Study in Hypertensive Older Women



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Abstract

Background: Hypertension is considered a primary risk factor for heart disease in the elderly. However, strength training can help control blood pressure levels.

Methods: Twenty elderly hypertensive women (73.6 ± 8.1 years, 61.6 ± 11.8 kg, 153.3 ± 5.8 cm) were recruited to participate in this study. All of them underwent resting blood pressure, anthropometric and muscle strength measurements. The training protocol was performed in a circuit (CT), with three sets of 8 to 10 repetitions with 30-second intervals between sets and 1 minute between sequences. Training was performed twice a week for twelve weeks. The exercises were performed following this sequence: leg press, bench press, knee extension, lat pulldown, plantar flexion, and triceps extension.

Results: After 12 weeks of CT, significant improvements in body composition ($p < 0.05$), increased levels of muscle strength ($p = 0.001$) and reduced systolic blood pressure ($p = 0.001$) were observed. There were no differences in body weight, BMI, and diastolic blood pressure ($p = \geq 0.05$).

Conclusion: The CT protocol is efficient for improving physical conditioning and reducing systolic blood pressure in hypertensive older women.

Keywords: Hypertension; Strength training; Elderly; Geriatrics

Introduction

Human aging produces several morphological, functional, and biochemical changes exposing the elderly to the risk of acquiring chronic degenerative diseases, such as diabetes, obesity, hypertension, osteoporosis, among others [1,2]. Considering chronic degenerative diseases, hypertension is one of the most important factors for heart disease and other disorders affecting the circulatory system [3]. Previous data have shown high prevalence among the adults, and even higher among the elderly [4,5,6]. In addition, older people also experience loss of muscle strength, which can adversely affect the performance of activities of daily living and quality of life in this population. For this reason, strength training (ST) is indicated for older people, as it contributes to lower blood pressure (BP) at rest, to increase muscle strength, bone mineral density, to improve functional capacity, and other benefits [1,2,7-9].

Recognized health organizations such as the American College of Sports Medicine and the American Heart Association recommend ST as a non-pharmacological support to control blood pressure [1,4]. However, most studies investigating hypertensive elderly population have focused on training intensity [10]. Therefore, considering that the ST can be manipulated by the combination of different training methods and systems, it is worth supporting further research that investigate other training possibilities. For this reason, the aim of the present study was to verify the effect of 12 weeks of circuit training on resting blood pressure in hypertensive older women.

Materials and Methods

Sample

Twenty older women were selected from an active aging program in the city of Juiz de Fora, MG, Brazil. This program is

offered to the community aiming to promote health and education for this population through a range of activities (physical, cognitive, and social interaction). Inclusion criteria adopted for participation in this study were: a) elderly women (60 years old or over), b) controlled arterial hypertension, c) absence of significant joint/muscle impairment that could affect the evaluation and physical training routines, d) cognitive capacity to understand physical training routines and e) cardiologist's approval to participate

in physical training sessions. The physical characteristics of the sample are explained in table 1. This study was approved by Institutional Review Board of Faculty of Medical and Health Sciences of Juiz de Fora (Brazil) number 847,611. All volunteers were informed of the objectives and procedures of this study. Once the terms were agreed, the volunteers were evaluated as reported below:

Table 1: Values expressed as mean and standard deviation in pre- and post-training.

Variables	Pre-training	Post-training	Difference post-pre
Age (years)	73.6 ± 8.1	-	-
Height (cm)	153.3 ± 5.8	-	-
Weight (kg)	61.6 ± 11.8	61.9 ± 11.4	0.3
BMI	26.2 ± 4.8	26.3 ± 4.6	0.1
Lean body mass (kg)	35.6 ± 4.3	36.8 ± 4.2*	1.2
Fat mass (kg)	25.9 ± 7.5	25.1 ± 7.6*	-0.8
% Body fat	41.4 ± 4.6	39.8 ± 5.2*	-1.6
SBP (mmHg) ^a	140.4 ± 9.6	130.3 ± 9.8*	-10.1
DBP (mmHg) ^b	76.5 ± 6.5	73.9 ± 6.8	-2.6
Muscle strength ^c (kg)	24.9 ± 6.5	39.0 ± 8.0*	14.1

a=systolic blood pressure; b= diastolic blood pressure; c= lower limb strength; *Indicates statistical difference in relation to pre-training (p≤0.05).

Resting blood pressure

Resting blood pressure measurements were taken after a 10-minute rest period, with the sphygmomanometer positioned on the right arm, sitting position, supported back and uncrossed legs. Two readings were performed with an interval of 5 minutes between readings. Depending on the magnitude of the difference between readings, if it were greater than 5 mmHg from first to second reading, a third reading would be performed. The lowest value between measurements was considered as resting BP. All procedures are in accordance with the American Heart Association [11].

Anthropometric measurements:

Body weight was measured with a calibrated scale and height was measured using a stadiometer. For body composition measurements, the skinfold protocol by Durnin and Womersley was used [12].

Muscle strength test:

After a two-week period of familiarization, the volunteers were submitted to a test of 10 maximum repetitions (RM) in the leg press exercise. The test and retest were performed on two non-consecutive days (48h interval) to determine the reliability of the measurements. All volunteers had up to five attempts with a 5-minute interval between attempts to determine the 10RM load. The heaviest load between two days was considered 10RM load [8]. After twelve weeks of circuit training, measurements of rest

blood pressure, anthropometric measurements and lower limb muscle strength were repeated.

Training Protocol

After first procedures, the volunteers were submitted to the circuit training with three sets with a 30 second interval between exercises and 1 minute to restart the sequence. The number of repetitions was between 8-10 and the training loads were adjusted using the Omni-Res perception scale [8,13]. The training frequency was twice a week for 12 weeks. The exercises were performed as following: leg press, bench press, knee extension, lat pulldown, plantar flexion, and triceps extension.

Statistical Analysis

Initially the Shapiro-Wilk normality test was applied with all variables showing normal distribution. Subsequently, the paired t-test is used to analyze the differences in measurements considering pre- and post-training periods. Data are presented as a mean and standard deviation and a significance level of p≤0.05 was considered for all comparisons. All data were analyzed using IBM SPSS version 20.0.

Results

Table 1 shows the comparisons between the periods of pre- and post-training. After 12 weeks of circuit training, significant differences were observed for Lean body mass (p = 0.001), fat mass (p = 0.004),% body fat (p = 0.001), systolic blood pressure

(SBP) ($p = 0.001$) and in muscle strength of the lower limbs muscle ($p = 0.001$). However, there were no differences for variables such as weight ($p = 0.069$), BMI ($p = 0.771$) and diastolic blood pressure (DBP) ($p = 0.121$).

Discussion

The results of this study demonstrated that 12 weeks of circuit training revealed significant increases in muscle strength and mass, decreases in fat mass, fat percentage and SBP in hypertensive older women. Concerning blood pressure, the results reveal great importance clinical, as the training protocol promoted a reduction of 10.1 mmHg in SBP. The magnitude of SBP reduction after the training period was higher than the values reported by some meta-analyses that showed reductions between 3.5 and 8.2 mmHg in SBP [10,14]. Previous evidence suggested that a reduction of only 3 mmHg in blood pressure may reduce the risk of stroke, coronary artery disease and cardiovascular mortality [4].

There were no statistical differences about DBP in this study. However, other research has demonstrated significant reductions in DBP after a period of ST. These differences can happen due to different ST protocols and probably to the initial values in the DBP [15,16]. In the present study, the volunteers showed controlled values for this physiological variable. Besides cardiovascular complications, human aging results in a loss of muscle mass and strength negatively affecting autonomy. Therefore, the loss of muscle mass and strength in the elderly makes it more difficult for them to perform activities of daily living. This physical deconditioning can expose older people to other diseases, such as diabetes, obesity, osteoporosis, among others. On the other hand, when they are submitted to a health-oriented ST program, they can reverse/minimize negative effects of aging [1,2,9,17].

Our results demonstrated that the circuit training protocol is efficient to increase muscle mass, strength levels and reduce the percentage of fat in this population. These results corroborate with other studies developed in other age groups, showing that even at older ages the capacity of increasing strength and muscle mass is preserved [18]. This study has some methodological limitations, such as the absence of a control group and more sophisticated measures to investigate muscle mass. However, the results here highlight the importance of circuit training prescription as a low-cost option aiming to enhance physical conditioning and control blood pressure at rest.

Conclusion

In conclusion, the circuit training protocol proves effective not only in improving physical fitness but also reducing blood pressure at rest in hypertensive older women.

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