Influence of Non-Periodized Resistance Training on Blood Pressure in Healthy Elderly Women


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ABSTRACT

Gambassi BB, Rodrigues B, Feriani DJ, Novais TMG, Oliveira PLL, Sauaia BA, Almeida FJF, Pulcherio JOB, Schwingel PA, Mostarda CT. Influence of Non-Periodized Resistance Training on Blood Pressure in Healthy Elderly Women. JEPonline 2016;19(3): 50-58. This study compared the chronic effects of moderate intensity resistance training on blood pressure in 13 healthy elderly women (Treatment Training Group, age: 65 ± 2 yrs) who trained 2 sessions·wk⁻¹ for 12 wks to 13 elderly women who did not undergo resistance training (Control Group, age: 65 ± 4 yrs). The findings indicate that there were no statistically significant changes in blood pressure in both groups after 12 wks. Hence, it is clear that while the 12 wks of moderate intensity resistance exercise did not lower the resting blood pressure of healthy elderly women, it did not increase it either.

Key Words: Aging, Prevention, Hypertension, Exercise
INTRODUCTION

The aging process is considered one of the main factors related to the difficulty of maintaining systolic blood pressure at normal levels (7). This is a concern in that untreated high blood pressure levels (i.e., arterial hypertension) can lead to coronary artery disease, heart failure, and stroke (17). Also, there is the increased likelihood of elevated blood pressure resulting in left ventricular hypertrophy (21).

On the other hand, the regular practice of physical exercise is an efficient non-pharmacological strategy for lowering blood pressure and decreasing the risk of a heart attack (20,25). In addition, resistance training has been shown to increase muscle strength, bone mineral density, and improve body composition and sleep quality (4,13,14,23,26). These lifestyle modifications are often used to define regular exercise as "exercise medicine" to either prevent or treat arterial hypertension (8).

Interestingly, the literature shows varied outcomes regarding the effects of physical exercise on arterial blood pressure due to, perhaps, the different training parameters, such as different types of exercises, durations, frequencies, and intensities. Hence, even though the American College of Sports Medicine (ACSM) (22) advocates the use of resistance training in the prevention and control of hypertension, the exercise prescription is not clear (10).

Because of the lack of consensus about the chronic effects of resistance training on blood pressure in the elderly population, it is important that more research is done in regards to the ACSM recommendations (22). The purpose of this study was to investigate the chronic effects of moderate intensity resistance exercise training on the blood pressure of elderly women without comorbidities.

METHODS

Subjects
The subjects in this study consisted of 26 elderly women randomly allocated to two groups: (a) Resistance Training Group (RTG, age: 65 ± 2 yrs) who performed 3 sets of maximum repetition over a period of 12 wks at 2 sessions·wk⁻¹ (n = 13); and (b) Control Group (CG, age: 65 ± 4 yrs) that did not exercise (n = 13).

After being informed of the possible risks and discomforts associated with the procedures, all the subjects gave their consent to participate in this study. Experimental procedures were conducted in accordance with resolution 466/2012 of the Brazilian National Health Council, and the procedures were approved by the Research Ethics Committee from the Ceuma University, Brazil (protocol number: 813.886).

Procedures
Data collection was performed by the undergraduate physical education students from the Ceuma University. All of the students were previously trained by researchers and professors from the Physical Education Department at Ceuma University, São Luis, Brazil.
Body Composition
Total body mass in kilograms (kg) and height in centimeters (cm) were determined using an anthropometric scale PL-200 (Filizola® S.A. Pesagem e Automação, São Paulo, SP, Brazil), with an accuracy of 50 gm and 0.1 cm (NBR ISO/IEC 17025:2005). Immediately after the evaluations, each subject's body composition (fat mass and fat free mass) was measured using a BIA 450 bioimpedance analyzer (Biodynamics® Corporation, Shoreline, WA, USA). All subjects were hydrated without eating solid food for 4 hrs after the test, having urinated prior to the evaluation without the use of diuretics for 7 d, using light clothing that was free of metal objects during the body composition evaluation (14). Body mass index was determined by body mass (kg) divided by the square of height (m²).

Blood Pressure
All blood pressure measurements were done using an automatic digital sphygmomanometer BP785 (Omron Healthcare Inc., Lake Forest, IL, USA) (15). Before the blood pressure measurement was taken, each subject was asked to sit in a comfortable chair for 10 min. It was previously recommended to all subjects that they avoid engaging in vigorous physical exercise for 48 hrs prior to the measurement. They were told not to drink caffeinated beverages or consume alcohol 24 hrs prior to the blood pressure measurement, and they were told to sleep at least 8 hrs the night before the exam.

All measurements were performed under similar conditions in the same place and position with the left arm raised to the midpoint of the sternum, the left palm turned upwards and resting on a table. The subjects' feet were touching the floor with the ankles touching the legs of the support chair. To ensure reliability in the blood pressure measurements, each measurement was repeated at least three times with 1-min intervals between each measurement (12). When the difference between the measures was higher than 4 mmHg, it was repeated until the difference was below it.

Resistance Training Program
An informal and detailed lecture described and clarified the program of multi-joint resistance exercises that were performed by the subjects. As recommended by ACSM (2) for whole body exercise, the program consisted of running leg press 180°, seated row, leg curl, bench press, abduction machine, push down, adduction machine, and biceps curl, alternated by segment.

The exercises were performed by isotonic contraction that lasted 3 sec for the concentric phase and 3 sec for the eccentric phase (12). To establish the training intensity, maximum repetition was used (i.e., the load which enabled the attainment of a specified number of repetitions per set to concentric fatigue).

The RTG underwent 24 sessions (i.e., 2 sessions-week⁻¹ for 12 wks) with a 48-hr interval of rest between each session. During the first 2 wks, the subjects performed 3 sets of 15 maximum repetitions (low intensity) in order to adapt (6). Then, the subjects performed 3 sets of 8 maximum repetitions (moderate intensity) for 10 wks. Control of the training load was carried out in accordance with the recommendations of Baechle and Earle (5). A rest interval of 2-min between sets was adopted (1).
Statistical Analyses
The software Stata (StataCorp, College Station, TX, USA, Release 11.1, 2010) was used to analyze the data, which was expressed as means ± standard deviations (SD) after confirmation of a parametric distribution by Kolmogorov–Smirnov test and Bartlett’s criteria. The Student’s \( t \)-test was used to statistically compare the initial and final measures in each group and the unpaired \( t \)-test to verify differences between the two groups. All tests were two-tailed and statistical significance was set at \( P \leq 0.05 \).

RESULTS

Table 1 shows the results of physiological, demographic, and anthropometric data of the sample.

Table 1. General Characteristics of the Sample Prior to the Training according to the Group (\( n = 26 \)).

<table>
<thead>
<tr>
<th>Variables</th>
<th>Control Group (( n = 13 ))</th>
<th>Resistance Training Group (( n = 13 ))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yrs)</td>
<td>65 ± 4</td>
<td>65 ± 2</td>
</tr>
<tr>
<td>Blood Glucose (mg·dL(^{-1}))</td>
<td>93.5 ± 3</td>
<td>96.2 ± 3</td>
</tr>
<tr>
<td>Fat mass (%)</td>
<td>38 ± 1.5</td>
<td>36 ± 1</td>
</tr>
<tr>
<td>Total body mass (kg)</td>
<td>60 ± 4</td>
<td>61 ± 2.7</td>
</tr>
<tr>
<td>Fat free mass (kg)</td>
<td>37 ± 2</td>
<td>38 ± 1.5</td>
</tr>
<tr>
<td>Fat mass (kg)</td>
<td>23 ± 2</td>
<td>23 ± 1.2</td>
</tr>
</tbody>
</table>

SD: Standard deviation

The systolic blood pressure was statistically similar before the training (\( P > 0.05 \)) between the CG and the RTG (133 ± 3 mmHg vs. 127 ± 2 mmHg, respectively). After 12 wks of non-periodized moderate intensity resistance training (Figure 1) the differences between the groups were not significant (CG: 132 ± 3 mmHg vs. RTG: 126 ± 4 mmHg; \( P > 0.05 \)).
Figure 1. Systolic Blood Pressure Comparison between Groups and Time (n = 26).
*CG:* Control Group; *RTG:* Resistance Training Group

The subjects’ diastolic blood pressure (Figure 2) between the groups were also similar before (CG: 87 ± 3 mmHg vs. RTG: 84 ± 2 mmHg; P>0.05) and after the 12 wks of training (CG: 87 ± 3 mmHg vs. RTG: 84 ± 2 mmHg; P>0.05). The difference was not significant (P>0.05).

Figure 2. Diastolic Blood Pressure Comparison between Groups and Time (n = 26).
*CG:* Control Group; *RTG:* Resistance Training Group
DISCUSSION

When compared to the initial values of the RTG and to the CG, the 12 wks of non-periodized moderate intensity resistance training did not change the resting systolic and diastolic blood pressure values of the elderly women. Although not statistically significant, we observed what is commonly referred to as a clinical benefit in the systolic blood pressure mean on the RTG after the 12 training weeks (127 ± 2 mmHg vs. 126 ± 4 mmHg). However, contrary to the work of Wood et al. (21) regarding a clinical reduction without statistical significance, the fact remains that the difference in regards to systolic blood pressure after 12 wks of resistance training was not significant.

The findings of the present study also disagree with Taaffe and colleagues (24) who studied the effect of resistance training on central blood pressure and arterial stiffness in 17 healthy older adults (aged 65 to 78 yrs). Following 20 wks of training, systolic and diastolic blood pressure values were significantly reduced by 6 and 3 mmHg, respectively. They found that the changes may have been related to the subjects’ decrease in peripheral vascular resistance. In agreement with Taaffe et al. (24), Delmonico et al. (11) demonstrated reductions in systolic blood pressure in normotensive elderly persons after 23 wks of low intensity resistance training. The results led Delmonico and colleagues to hypothesize that resistance training must be >20 wks to provide a significant physiological benefit on blood pressure in elderly subjects without comorbidities.

While regular aerobic exercise is known to decrease the stiffness of large arteries (27) with a decrease in brachial blood pressure (16), much less is known about the effects of resistance training on blood pressure in normotensive elderly people. In addition, while resistance training in older adults may lead to cardiovascular benefits, the use of different protocols and/or types of exercises often lead to conflicting findings in the scientific literature. For this reason, there appears to be little consensus as to the benefits of resistance training on blood pressure in this population group while the literature does seem to support mild benefits in subjects with stage I hypertension (22).

There is also a modest lowering of blood pressure from aerobic exercise due to the decrease in total peripheral resistance (19). Either resistance training is not an effective exercise for older adults or the resistance training period in this study was too short to produce significant changes in resting blood pressure. Interestingly, Cornelissen and Fagard (9) reported that according to one meta-analysis (15) resistance training has the potential to decrease systolic blood pressure and the risk of developing cardiovascular disease.

CONCLUSIONS

The 12 wks of non-periodized moderate intensity resistance training did not decrease systolic and diastolic blood pressure values in elderly women without comorbidities. Further studies using a larger sample with the same protocol, but with more training time (e.g., >20 wks) and/or the use of a more invasive method of measuring blood pressure to monitor the specifics of its behavior during various stages of training are needed to better understand the prevention and non-pharmacological treatment of hypertension with resistance training.
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