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RESISTANCE TRAINING INTENSITIES AND BLOOD PRESSURE OF HYPERTENSIVE OLDER WOMEN – A PILOT STUDY

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ABSTRACT

Background: The optimum intensity of resistance training for hypertensive elderly has not been studied yet and the few studies in the literature used training with distinct intensities. Objective: To verify the effect of two resistance training intensities on blood pressure (BP) of elderly women with controlled hypertension. Methods: Sixteen older women with hypertension controlled by anti-hypertensive drug were randomly divided into two groups. Nine patients were submitted to moderate resistance training (G1) and seven patients were submitted to mild resistance training (G2). The patients underwent eight weeks of resistance training, with frequency of three times per week on alternate days in the afternoon. The exercises performed were: leg press, bench press, knee extension, lat pull-down, knee flexion, shoulder abduction, standing cable hip abduction and biceps curl. Results: G1 patients presented reduction in both resting values in diastolic blood pressure (DBP) p<0.03 and mean arterial pressure (MAP) p<0.03. G2 presented decrease in resting values of MAP (p<0.03) and a tendency to decrease in DBP (p<0.06). Magnitude of values decrease in both groups was higher than the ones reported in the literature. Conclusion: Both light and moderate training promoted cardiovascular benefits, even when initiated at old age. Moreover, both can be indicated as supporting treatment for older women with hypertension controlled by medication.

Keywords: aging, resistance training, hypertension, exercise, the elderly health.

INTRODUCTION

The prevalence of systemic arterial hypertension (SAH) has considerably increased in many countries around the world. This increase has reached both men and women and in many age groups[1]. Among the main causes for installation of such pathology, we can mention low level of habitual physical activity and excess of body fat, especially in women[2-4].

According to Miranda *et al.*[5], SAH is the main factor for changeable cardiovascular risk, being associated with very frequent conditions in elderly subjects, such as: coronary artery disease, cerebrovascular disease, heart failure, terminal renal disease, peripheral vascular disease, left ventricular hypertrophy and diastolic dysfunction.

Non-pharmacological interventions have been stressed in the literature due to their low cost, minimum risk and efficiency in blood pressure (BP) decrease. Among these interventions we can name: body weight reduction, alcohol consumption restriction, smoking cessation and regular practice of physical activity[6].

Many studies have reported that regular practice of physical exercise may cause important alterations in the BP, both in normotensive and hypertensive individuals[7-11]. Meta-analysis studies have demonstrated that practice of resisted exercises may contribute to the treatment and/or prevention of cardiovascular dysfunctions such as SAH[12-14].

It is observed that in the studies about resisted training for hypertensive subjects, the intensities used range from light to heavy, and there is no consensus about the optimum intensity for reduction of the tensional levels[14]. Moreover, the literature lacks studies which focus on hypertensive elderly subjects[15].

Only one study [15] investigated the effects of resisted training on controlled hypertensive older women; however, one of the main imitations was the use of different training intensities in the same group.

Thus, the aim of this investigation was to study the effect of two intensities of resisted training on the BP of hypertensive older women controlled by medication.

METHODS

This study was previously approved by the by the ethics committee of the institution according to legal opinion number 223/08. All participants signed the Free and Clarified Consent Form, containing all the procedures to be developed.

Sample

The population of the study was composed of hypertensive older women participants of support and care of arterial hypertension programs. All the participants were invited to participate in the research; however, only the ones who met the inclusion criteria were selected.

The older women with age of 60 years or older, with systemic arterial hypertension previously diagnosed and controlled by medication were included.

The patients performed a maximal exercise test in ramp protocol on a Micromed® treadmill, model Centurion 200 and were submitted to a medical evaluation to release them to participate in the study.

The exclusion criteria were: congestive heart failure, recent acute myocardial infarction, hormone replacement therapy, important articular limitations such as acute arthritis and tendinitis, uncontrolled blood pressure (SBP > 180 and DBP > 110mmHg) and number of absences to the sessions surpassing 20% of the total or three consecutives absences.

The patients were divided in two groups through a draw, namely G1 (group 1) which performed moderate resisted training and G2 (group 2), light resisted training. All the older women were told not to change their medication during the study.

Procedures

BP at rest was evaluated according to the procedures described in the V Brazilian Guidelines on Hypertension[16]. The patients were told to empty their bladder, no to ingest alcoholic drinks, coffee and not to smoke 30 minutes before and not to practice physical exercise 60 to 90 minutes before the measurement.

The participants remained at rest for at least five minutes in a calm environment. During the BP check, they kept their legs uncrossed, feet resting on the ground, back relaxed and touching the chair. The BP measurements were obtained in both upper limbs and in case of difference; the arm with the highest pressure value with the subsequent measurements was used.

Three measurements with one-minute intervals between them were performed, and the mean of the two last ones were considered the BP of the individual. The heart rate (HR) was collected with the last BP measurement. Mean BP (MBP) was calculated with the use of the formula: MBP = DBP + (SBP – DBP)/3.

BP and HR were checked with a Omron® digital sphygmomanometer model HEM 433INT. Additionally, stature was checked with a measuring tape and weight on a Soenhle® digital scale. All measurements were performed in the afternoon shift and by the same evaluator.

Training program

Initially, the participants performed two weeks of adaptation to the exercises to learn the correct performance technique, normal range of motion and suitable breathing. During this period, the exercises were performed without overload. After the adaptation period, the test of eight repetition maximum (8RM) was performed. That test corresponded to the maximum overload which could be lifted by the participant in the entire normal amplitude with maintenance of the suitable technique (without compensation) in eight successive repetitions.

During the test performance, each patient performed a maximum of five attempts with interval of five minutes between them. The modified Borg's scale[17] was used to question about the perceived exertion with the overload intensity in each attempt. Range of motion and possible compensations during the exercise were also monitored.

The patients performed eight weeks of resistance training with frequency of three weekly times, in alternated days and always in the afternoon shift. The patients from G1 performed two sets of eight repetitions with overload of 8RM and the ones from G2, two sets of 16 repetitions with half of the overload of 8RM. The training intensities were based on the proposal by Polito *et al.*[18], in which different intensities were used, with equal overload-repetition ratio, though (training volume).

The exercises performed were, respectively: *leg press*, bench press, knee extension on extension machine, front pull, knee flexion on flex machine, shoulder abduction with dumbbells, hip unilateral abduction with *cross over* and barbell curl.

The exercise order was established according to criteria of the ACSM[19], which defends priority demand of the large muscle groups over the small ones, alternating lower and upper limbs exercises.

The performance velocity was of 2:2 and the recovery interval was of two minutes between sets. At the end of each week, the patients were told to perform two additional repetitions of each exercise and in case it was possible to perform them without compensation, the overload would be increased in 5% in the following subsequent week.

Before the exercises, the patients performed five minutes of light walk warm-up. Before and after the training, self-stretching of the main muscles recruited during the exercises was performed.

The reevaluation of the patients was performed eight weeks from the beginning of the training with a 48-hour pause after the last session. It was performed by the same evaluator, with the same criteria and instruments of the initial evaluation.

Statistical Analysis

The data were analyzed through the statistical software Statistical Package for Social Science (SPSS – version 16.0), with significance level of 5%. The normality of the variables of the study was verified through the Kolmogorov-Smirnov test (K-S). The Student's *t* test was used to verify the differences in the clinical characteristics between G1 and G2.

The exact Fisher test was used to compare the comorbidities and medication prevalence between G1 and G2. The differences of the pre and post-training SBP, DBP, MBP and HR means between groups was analyzed with two-way ANOVA (2x2) for repeated measures with the Tukey *post hoc* test for multiple comparisons.

RESULTS

From the 32 initially recruited patients, six were excluded after the clinical evaluation and 10 did not conclude the training program due to health problems not related to training such as eye surgery and personal problems as lack of financial resources for transportation. The final sample hence was composed of 16 patients out of which nine subjects were submitted to moderate resistance training (G1) and seven to light resistance training (G2).

Table 1 presents the clinical characteristics of the studied groups. There was no difference in any of the analyzed variables, which presented homogeneity between groups.

After data analysis, differences in DBP ($F = 5.8$; $p < 0.03$) and MBP ($F = 6.5$; $p < 0.02$) between groups were analyzed; however, there were no differences between groups in SBP ($F = 2.0$; $p < 0.132$) or HR ($F = 2.2$; $p < 0.099$).

The Tukey *post hoc* test indicated that G1 presented reduction both in the rest DBP ($p < 0.03$) and MBP ($p < 0.03$), while G2 presented reduction in the rest MBP values ($p < 0.03$) and a tendency to reduce DBP ($p < 0.06$). The found results are demonstrated in table 2.

Table 1. Cardiovascular and anthropometric clinical characteristics, comorbidities and medication therapy of group 1 (G1) nd group 2 (G2) pre-resisted training.

Variables	G1 (n = 9)	G2 (n = 7)	p
Age (years)	69.1 ± 5.7	68.2 ± 9.3	ns
Weight (kg)	63.4 ± 12.2	63.3 ± 13.2	ns
Stature(cm)	1.56 ± 0.09	1.52 ± 0.08	ns
BMI (kg/m^2)	25.7 ± 4.3	27.3 ± 4.7	ns
SBP (mmHg)	126.9 ± 12.7	134.6 ± 13.1	ns
DBP (mmHg)	68.1 ± 11.3	73.4 ± 9.0	ns
HR (bpm)	71.7 ± 7.7	80.8 ± 10.5	ns
Comorbidities			
Diabetes mellitus (%)	11.1%	28.6%	ns
Cholesterolemia (%)	66.7%	42.9%	ns
Osteoporosis (%)	22.2%	28.6%	ns
Arthritis (%)	22.2%	28.6%	ns
Obesity (%)	11.1%	28.6%	ns
Denies (%)	11.1%	14.3%	ns
Medication			
Betablocker (%)	22.2%	14.3%	ns
Associations with betablocker (%)	22.2%	14.3%	ns
Angiotesin-converting enzyme (%)	22.2%	42.9%	ns
Diuretics (%)	55.6%	71.4%	ns
Calcium channel blocker (%)	0.0%	28.6%	ns
Other associations	33.3%	57.1%	ns

BMI – body mass index; SBP – systolic blood pressure; DBP – diastolic blood pressure; HR – heart rate.

Table 2. Effects of eight weeks of training in the systolic blood pressure (SBP), diastolic blood pressure (DBP), mean blood pressure (MBP) and heart rate (HR).

	Group 1 (n = 9)			Group 2 (n = 7)		
	Pre	Post	Δ%	Pre	Post	Δ%
SBP (mmHg)	126.9 ± 12.7	115.3 ± 21.9	-9.1	134.6 ± 13.1	118.7 ± 16.9	-11.8
DBP (mmHg)	68.1 ± 11.3	55.6 ± 5.5*	-18.3	73.4 ± 9.0	60.7 ± 10.0	-17.3
MBP (mmHg)	87.6 ± 9.8	75.5 ± 8.1*	-13.8	93.8 ± 7.7	80.0 ± 9.5*	-14.7
HR (bpm)	71.7 ± 7.7	71.0 ± 11.3	-0.9	80.8 ± 10.5	78.7 ± 5.1	-2.5

* Significant difference compared with the pre-training, $p < 0.05$.

DISCUSSION

The results presented demonstrated that, after eight weeks of moderate resistance training, significant reduction was observed in DBP and MBP at rest, the same way the same training period with low intensity caused significant reduction in MBP at rest of controlled hypertensive older women.

Our findings corroborate previous studies involving resistance training and BP control, in which reduction in DBP[20,21] and in MBP[15,22] was also verified. On the other hand, some studies did not observe reduction in DBP after intervention with resistance training[23,24].

Concerning reduction in SBP at rest, our results are similar to the ones in many studies[23-26], which did not verify hypotensive effect after resistance training in SBP either. Nevertheless, such reduction was verified in other studies[15,20,27-29].

Regarding magnitude of BP reduction, it was verified that in both groups of the present study this reduction was more remarkable than in the values found in previous investigations conducted specifically with an elderly population[15,20,23,27]. G1 presented reduction of 11.6mmHg for SBP; 12.5mmHg for DBP and 12.1mmHg for MBP, while G2 presented reduction of 15.9mmHg for SBP; 12.7mmHg for DBP and 13.8mmHg for MBP.

A study carried out with older men and women submitted to six months of heavy resistance training verified mean reduction of 3mmHg for SBP and 4mmHg for DBP in the group of women[27].

Another study conducted with older patients of both sexes did not observe alterations in BP values after six months of moderate resistance training[23].

In a pilot study with 17 older subjects of both sexes who performed resistance training with intensity of 8RM during 20 weeks, the authors verified decrease of 6mmHg for SBP and 3mmHg for DBP[20].

Although the BP decrease values in the present study are higher than the ones reported by the majority of the investigations with resistance training (3.2mmHg in SBP and 3.5mmHg in DBP)[14] more remarkable decrease was verified in a recent study with hypertensive women presenting reduction of 10.5mmHg for SBP and 6.2mmHg for MBP. However, this reduction cannot be attributed to the training intensity, since different intensities have been applied in the same group[15].

We believe that our findings were higher than the ones reported in the literature due to the fact that the majority of the studies are performed with normotensive patients. Some authors highlight that the pressure reductions related to resistance training are higher in hypertensive individuals than in normotensive ones[30].

In our study, the group that performed moderate resistance training obtained reduction in DBP and MBP and the group which performed light training obtained reduction in the MBP, with tendency to reduction in DBP. Nonetheless, the magnitude of DBP reduction of both groups was satisfactory, since some authors[31] verified that reduction of only 5mmHg in DBP at rest reduces in 35-40% the risk of cerebrovascular accidents and in 20-25% the risk of acute myocardial infarction.

The most recent meta-analysis about resistance training and BP control points out that this kind of training with moderate intensity may be useful in preventing and fighting SAH. However, the authors suggest that further studies should be conducted in order to verify the hypotensive effects of resistance training[14].

It could be observed that both moderate and light resistance exercise cause important reduction in BP of controlled hypertensive older women. These findings are relevant since many older patients are afraid of performing resistance training with heavier overloads[32]; thus, these patients may experience benefits with light resistance training as supporting measure in the control of the SAH.

The cardiovascular safety of the resistance training evidenced in previous studies[15,33] was also verified in our study since none patient presented clinical complications during the intervention. According to some authors, this safety is associated with low double product during the performance of the resistance exercises. Benn *et al.*[34] have stated that the double product presented during the *leg press* exercise with 80% of maximum overload is lower than the one found in daily activities such as climbing stairs.

According to Câmara *et al.*[35], another aspect of cardiovascular safety in resistance exercises is that the volume overload is small when compared with continuous exercises, causing lower blood volume return to the heart in the time unit, decreasing hence the onset of ischemia and arrhythmia[36].

The mechanisms responsible for the chronic hypotensive responses caused by resistance training are not completely clear. It is believed that reduction in the cardiac debt and total peripheral vascular resistance may explain, at least partly, such alterations, since after physical exertion there seems to be more remarkable increase of vasodilator substances in the circulation as the nitric oxide[37].

Some authors[38] believe that BP reduction after exercise is mainly caused by decrease of cardiac debt. This decrease is related to reduction in ejection volume and BP increase. However, in the present study, as in a previous study[15], BP reduction has not been observed. The analysis of the mechanisms involved in the BP reduction was not the aim of the present study; however, further studies with this evaluation as a goal should be carried out in order to better clarify this issue.

Our proposal was to verify the best resistance training intensity for controlled hypertensive older women; nevertheless, our study presented some limitations such as sampling size and loss. This fact is justified by the practice of aerobic exercises, including daily household activities, as well as high number of comorbidities in our population, such as arthritis, which hampered the performance of the proposed resistance training and consequently, the analysis of the influence of the use of beta blockers in the found results.

However, it is worth mentioning that the sampling size of the present study was similar to those in previous studies [8,20,33] since it was difficult to maintain engagement in a population with so many household tasks and prone to the onset of limiting chronic diseases. However, we believe that studies with bigger samples should be conducted so that a more reliable response can be reached to that and other issues.

Thus, this study becomes important for being an eight-week long resistance training which contemplates a not much explored population, as is the case of hypertensive older women controlled by medication.

CONCLUSION

In this pilot study, it could be observed that both moderate and light resistance trainings, even when initiated at the third age, promoted cardiovascular benefits to the studied patients. Moderate resistance training promoted reduction in DBP and MBP, while light resistance training caused MBP reduction and tendency to DBP decrease. Our findings suggest that both training intensities may be incorporated in the supporting treatment for hypertensive older women controlled by medication. Nevertheless, since it is a pilot study, further studies with bigger samples are necessary to corroborate the found data, and hence, aid the professionals perform the prescription and monitoring of resistance training for older subjects.

All authors have declared there is not any potential conflict of interests concerning this article.

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