

## Hypotensive effects of resistance exercises performed at different intensities and same work volumes

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### ABSTRACT

The aim of this paper was to compare the effects of two sequences of resistance exercises (RE), with different intensities but same training volume, on post-exercise blood pressure responses. Sixteen young subjects with previous experience in RE were evaluated during three non-following days in chest press, legpress, pulley pull down, leg curl, shoulder press, and biceps curl. On the first day, the load associated with six maximal repetitions (6RM) were determined for each exercise. On the second day, three sets of 6RM were performed (SEQ6), with a two minute interval between the sets. On the last day, the same procedure was repeated, but using 12 repetitions with 50% of 6RM load (SEQ12). Rest BP was measured before the sequences by auscultatory method. Post-exercise resting BP was measured each 10 minutes by ambulatory BP monitoring during 60 minutes. The magnitude and duration of BP variability were compared by repeated ANOVA measures followed by Tukey post-hoc test ( $p < 0.05$ ). A significant reduction in diastolic blood pressure (DBP) was observed in the first 20 minutes after SEQ12, but not after SEQ6. SEQ12 elicited significant decline in systolic blood pressure (SBP), at least during the first 50 minutes after the exercise, while significant reductions were observed in all measures after SEQ6. There were no significant differences between the absolute values of DBP and SBP after both sequences. In conclusion: a) RE had hypotensive effects on blood pressure, main-

ly SBP; b) the absolute decline of SBP seem not to be influenced by different interactions between workload and number of repetitions; c) higher workloads seem to extend the total time of SBP post-exercise reduction; d) the number of repetitions seems to have more influence on DBP than SBP, but for a short period of time.

**Key words:** Blood pressure. Hypotension. Weight lifting. Health.

### INTRODUCTION

Heart disease is the main cause of death in the US<sup>1</sup>. In Brazil, cardiovascular conditions are the main cause of deaths, with a mortality rate of 32.6%<sup>2</sup>. One of the main risk factors for a heart disease is hypertension. Lowering blood pressure (BP), even in normotense subjects, is important in reducing the risk of heart disease<sup>3</sup>. The regular practice of exercises aids the reduction of resting BP in two ways. The first is a hypotensive post-exercise effect, which means resting BP levels would decrease once the effort is over<sup>4</sup>. This response takes place over hours after the exercise practice is ended<sup>5</sup>, and may last for a few days<sup>6</sup>. Another way BP is reduced is by chronic response due to the continuing practice of physical activity.

There is consensus in the literature about rest-related BP chronic reduction through aerobic exercises<sup>1,7,8</sup>. About resistance exercises, some data show that continuing training can either decrease<sup>9-11</sup> or maintain BP levels<sup>12,13</sup>. As to decreasing BP levels immediately after physical activity, there are consistent evidences that the reduction is induced by aerobic exercise, considering intensity<sup>14</sup>, age group<sup>15,16</sup>, gender<sup>17</sup>, duration<sup>18</sup>, and muscular mass<sup>19</sup>.

On the other hand, information on hypotensive effects after resistance exercises are somewhat scarce. During this type of activity, BP tends to raise rapidly, and may reach high levels<sup>20-22</sup>. The magnitude of the load and the muscular mass involved may be determinant for such gradient<sup>23,24</sup>. However, the behavior of BP levels soon after resistance exercises is not well defined in the literature. While some studies show decrease in BP levels after the exercises<sup>25,26</sup>, others do not report changes<sup>27</sup> or report BP increase<sup>28</sup>.

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Thus, the purpose of this study was to compare post-exercise BP levels over 60 minutes, between two sessions of resistance exercises, performed under different intensities but with the same load:repetition ratio (training volume), between the sessions.

## METHODS

Sixteen volunteers were studied, being 9 males ( $20 \pm 1$  years old;  $68 \pm 11$  kg;  $173 \pm 7$  cm) and 7 females ( $21 \pm 5$  years old;  $53 \pm 6$  kg;  $164 \pm 5$  cm). All of them had been practicing resistance exercises for, at least, 6 months. This criterium was adopted to prevent occurrence of late muscular pain, and errors in establishing the workload due to lack of necessary coordination to perform the exercises. Exclusion criteria were the use of ergogenic substances; bone, muscle or joint impairment that totally or partially prevented performance of the exercises, the use of medication that affected resting or under exercise BP values, intake of caffeine or alcoholic beverages on data collection day, and performance of a daily activity that demanded high energy. All subjects signed the informed consent form after the trial had been approved by the Ethics Committee of the Institution.

Each subject made three, non-consecutive visits to the study site. First, 6 maximal repetition (6MR) tests were performed for the following exercises: chest press, legpress, pulley pull down, leg curl, shoulder press, and biceps curl. On the second day, the exercises were performed in three sets of 6MR, with a two-minute interval between the sets (SEQ6). On the last day, the procedure was the same, except that the number of repetitions was 12, and the load was half of that of the 6MR (SEQ12). This allowed the same work volume to be kept for each set, considering the load:repetition ratio. Thus, the total weight was the same for each day, but the intensity of the exercises was differ-

ent. In performing both sequences of exercises, subjects were instructed not to do the Valsalva maneuver. Prior to beginning the workout on the second and third day, BP was measured by a trained evaluator using auscultatory method, once the subject had been seated and quiet for 10 minutes. After each sequence was finished, BP was recorded in a 10-minute cycle by ambulatory monitoring (ABPM), with the subject in total rest for 60 minutes (Spacelabs Medical, Redmond, WA, USA).

For data analysis, ANOVA two-way with repeated measures was used followed by Tukey post-hoc test to compare systolic and diastolic BP for the different exercises. Statistical analysis compared the systolic and diastolic BP values for each sequence against resting, considering  $p < 0.05$  as statistically significant.

## RESULTS

The table 1 presents mean SBP and DBP in rest and after each sequence of exercises. No significant differences were found between post-exercise SBP and DBP when sequences were compared, and they were not associated to significantly higher BP levels than those of resting. It was also noted that SBP was lowered in all measurements, whereas SEQ12 was associated to SBP reduction for a period of time no longer than 50 minutes. As to DBP, SEQ12 caused significant reduction in less than 20 minutes after ending the exercise, whereas SEQ6 did not induce significant changes. For a better visualization, figures 1 and 2 show progression of SBP and DBP in rest and after the sequences of exercises, respectively.

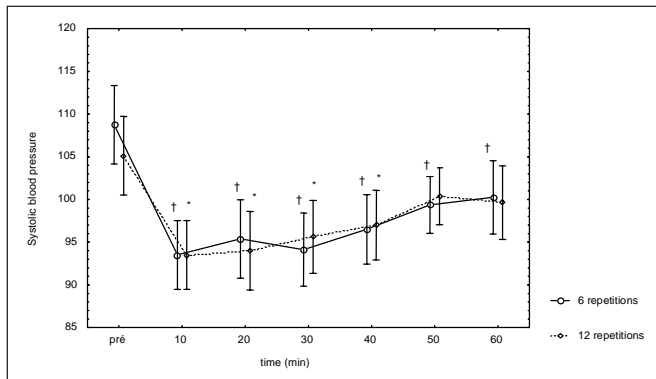
## DISCUSSION

Some studies failed to demonstrate hypotensive effect from this type of activity, regardless of subject fitness and gender. O'Connor et al.<sup>28</sup>, for instance, have observed SBP

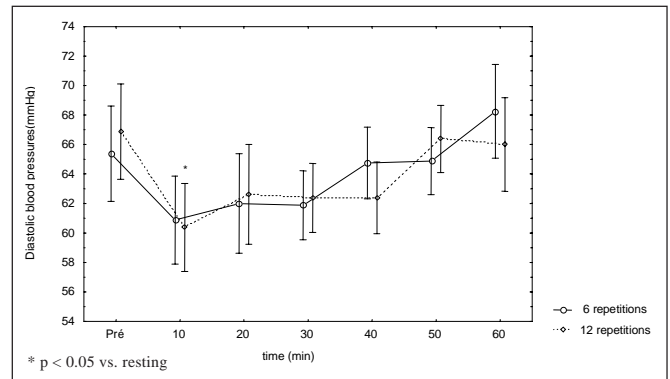
TABLE 1  
Mean values ( $\pm$  standard deviation) for systolic and diastolic blood pressure after the end of each sequence

	SBP		DBP	
	SEQ6	SEQ12	SEQ6	SEQ12
Resting	108.8 $\pm$ 10.6	105.1 $\pm$ 7.2	65.4 $\pm$ 6.4	66.9 $\pm$ 6.3
10 min.	93.5 $\pm$ 7.2*	93.5 $\pm$ 8.6*	60.9 $\pm$ 6.2	60.4 $\pm$ 5.5*
20 min.	95.4 $\pm$ 8.0*	94.0 $\pm$ 9.9*	62.0 $\pm$ 6.2	62.6 $\pm$ 7.0
30 min.	94.1 $\pm$ 7.6*	95.6 $\pm$ 9.1*	61.9 $\pm$ 4.6	62.4 $\pm$ 4.5
40 min.	96.5 $\pm$ 7.6*	97 $\pm$ 8.3*	64.8 $\pm$ 5.7	62.4 $\pm$ 3.7
50 min.	99.4 $\pm$ 6.1*	100.4 $\pm$ 6.9	64.9 $\pm$ 3.8	66.4 $\pm$ 5.0
60 min.	100.3 $\pm$ 7.5*	99.6 $\pm$ 9.3	68.3 $\pm$ 6.8	66.0 $\pm$ 5.6

\*  $p < 0.05$  vs. resting



**Fig. 1** – Behavior of systolic blood pressure before and after the sequences



**Fig. 2** – Behavior of diastolic blood pressure before and after the sequences

increase within 15 minutes after a sequence performed by females at 80% of 1MR load. Hill et al.<sup>29</sup> noted an important BP reduction in trained males immediately after performing resistance exercises, but in a few minutes BP levels reached pre-exercise levels, which were maintained over the 60 minutes of monitoring. Recently, Roltsch et al.<sup>21</sup> did not identify significant BP level changes after resistance exercises performed by normotense males and females, both sedentary or physical exercise practitioners. In this study, BP was assessed by 24-h ABPM. It is possible that a resistance exercise session may not trigger significant BP reduction for a somewhat lengthy period of time, which can explain the results of this study.

However, some evidences show significant BP reduction immediately after resistance exercises are finished. In Hardy's and Tucker's study<sup>25</sup>, for instance, ABPM identified SBP and DBP reduction for, at least, 1 hour after a resistance exercises session, in 24 males. In our trial, we noted a lengthy post-exercise reduction of SBP only. This could be explained, in part, by the features of the sample. We used healthy, trained subjects, whereas Hardy and Tucker<sup>25</sup> studied sedentary, hypertensive subjects. It is known that higher BP reductions after aerobic workout tend to be typical of hypertensive individuals<sup>6</sup>, and it is likely that the same occurs for resistance exercises. However, studies involving populations of hypertensives and their performance of resistance exercises are relatively scarce, and do not allow further inferences<sup>10</sup>. It is expected, however, that BP reduction in healthy individuals occurs similarly in hypertensives, as shown by Fisher's study<sup>26</sup> with normotensive and hypertensive females, after performing 15 repetitions of 5 sequential exercises at 50% of 1MR load. Post-exercise BP was recorded over 60 minutes, and only SBP was significantly reduced. Our data support Fisher<sup>26</sup> outcomes, that found significant SBP decrease also for exercises of some-

what low intensity. As that author did not compare BP reduction to other intensities, a more detailed comparison of the outcome for both trials is compromised.

Anyway, high-intensity resistance exercises do not seem to be associated to higher post-exercise BP reductions, like somewhat lesser strain with higher number of repetitions (SEQ6 x SEQ12). In our trial, no differences in SBP and DBP were found for the two training sequences. This fact had already been reported by Brown et al.<sup>30</sup>, who did not find BP changes over 1 hour when sequences using 40% and 70% of 1MR with 20-25 and 8-10 repetitions, respectively, were compared. On the other hand, in spite of the similar behaviors of SBP and DBP under different intensities, some trials could not prove any post-resistance exercises hypotensive effect. Focht and Koltyn<sup>31</sup>, for instance, could only note DBP reduction for 20 minutes after a sequence performed at 50% of 1MR in 84 individuals, and no changes were found at 80% of 1MR. Our results partially agree with these data: DBP reduction was also seen in a less intense sequence, for a similar period of time. It is likely that Focht and Koltyn<sup>31</sup> did not reach more significant results because BP was measured in long intervals (20, 60 and 120 minutes after the exercise).

To conclude, our results suggest that intensity of resistance exercises may influence the duration of hypotensive effect once that activity is over, but not the magnitude of such reduction. Apparently, more intense sessions could promote a longer period of SBP reduction. Less intense sessions could reduce DBP for a somewhat short period, whereas a more strenuous workout would not change acute responses. Other trials should be carried out to confirm these results and expand them to other exercises, including the control of potentially intervening variables, such as muscular mass, velocity of execution, and associated aerobic training.

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