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Roshan PSB

Assistant Professor,
Laxmi Memorial College of
Physiotherapy, Rajiv Gandhi
University of Health Sciences,
Karnataka, India

Rai R

Associate Professor, A.J
Institute of Medical Sciences and
Research Centre, Rajiv Gandhi
University of Health Sciences,
Karnataka, India

Saru DM

Post Graduate Student,
Laxmi Memorial College of
Physiotherapy, Rajiv Gandhi
University of Health Sciences,
Karnataka, India

Corresponding Author:

Saru DM

Post Graduate Student,
Laxmi Memorial College of
Physiotherapy, Rajiv Gandhi
University of Health Sciences,
Karnataka, India

Immediate effect of resistance exercise of two different intensities on blood pressure in hypertensive elderly women

Roshan PSB, Rai R and Saru DM

Abstract

Background: Hypertension (HTN) is a major risk factor for cardiovascular disease (CVD), including stroke, myocardial infarction, chronic kidney disease, continuous atherosclerosis and dementia. Resistance exercise (RE) is found to be beneficial for persons with or at risk for HTN. Therefore, the aim of this study is to assess the immediate effect of resistance exercise of two different intensities on blood pressure in hypertensive elderly women.

Methods: A total of 26 hypertensive elderly women were included in the study. The subjects were divided into two groups: group A – low intensity RE (50% of 1RM) and group B – high intensity RE (80% of 1RM). The blood pressure was measured pre – exercise (baseline) and post exercise (after 5 minutes).

Results: The reduction in systolic blood pressure (SBP) and diastolic blood pressure (DBP) was greater during low intensity exercise. Between groups analysis showed no significant difference between two groups.

Conclusion: Both low and high intensity resistance exercise can cause immediate reduction in blood pressure. However, low intensity resistance exercise is more effective in reducing blood pressure in hypertensive women.

Keywords: resistance exercise, blood pressure, hypertensive elderly women

Introduction

“Hypertension, also known as high or raised blood pressure, is a condition in which the blood vessels have persistently raised pressure” – World Health Organisation (WHO). Hypertension is diagnosed when a person’s SBP (systolic blood pressure) is 140 mmHg or higher, or their DBP (diastolic blood pressure) is 90 mmHg or higher, or both, on repeated examination [1]. It has been identified as the leading risk factor for mortality, and is ranked third as a cause of disability-adjusted life-years [2].

Although women's blood pressure is normally lower than men's, it begins to rise in early adulthood and eventually catches up to, if not exceeds that of their male counterparts [3]. It has been predicted that more women than men will have hypertension in the near future. The worldwide prevalence of hypertension is predicted to increase by 9% in men and 13% in women between 2000 and 2025 [4]. When compared to hypertensive men, hypertensive women have higher arterial stiffness, heart failure with preserved ejection fraction (HFpEF), and atrial fibrillation [5]. Because women's artery systems are smaller and aortic aneurysms burst at a lesser size, it's unclear whether the normal blood pressure threshold should be lower in women than in men [6, 7].

For moderate and severe hypertension individuals, as well as those with risk factors for cardiovascular disease and/or substantial target organ injury, pharmacological treatment is recommended⁸. Despite the fact that pharmacological therapy is helpful in lowering blood pressure, morbidity, and mortality, it comes at a hefty price. There is currently agreement that regular exercise is the most effective treatment for preventing HTN in individuals with normal blood pressure and lowering blood pressure (BP) in hypertensive patients. Its advantages include improved metabolic muscle performance, decreased endothelial dysfunction, improved neuro-hormonal abnormalities, and lower insulin resistance, all of which lead to a decrease in

systemic vascular resistance and a beneficial effect on associated cardiovascular risk factors^[9].

The studies indicated that a single bout of RE can lower blood pressure and can be used as non-pharmacological therapy, not only to prevent but to treat and control the hypertension^[10, 11, 12]. However, there are controversies regarding the effect of exercise intensity on blood pressure in hypertensive subjects. The studies demonstrated that a single session of high intensity resistance exercise is able to promote the post exercise hypotension in hypertensive elderly for approximately 20 to 80 minutes after resistance exercise and recommended to prefer high intensity over the low intensity resistance exercise^[13, 14] whereas the study conducted by de Oliveira Jacques NM *et al.* suggested that the low intensity is more beneficial to cause the hypotensive effect of blood pressure after resistance exercise and differences were observed after 10 minutes and lower value was occurred in 60 minutes after the resistance exercise^[15].

Thus, various studies on hypertensive subjects have discovered that low and high intensity exercises have varying effects on SBP and DBP. There has been no consensus on the intensity of resistance exercise which will have an optimal effect on the different components of blood pressure. Considering that the effect of resistance exercise is seen maximally during the 60 minutes post exercise, there is a dearth of research in the immediate effect of resistance exercise on blood pressure. Therefore, the purpose of the study is to find the immediate effect of high as well as low intensity resistance exercise on blood pressure in women with hypertension and compare the effectiveness.

Methodology

In this comparative study, a total of 26 individuals were recruited. Elderly women aged ≥ 65 years, clinically diagnosed hypertension, stage 1 and 2 according to JNC classification and under medication were included in the study. Elderly women with musculoskeletal, cardio respiratory disorders and clinically diagnosed hypertension but not under medication were excluded from the study. The study was undertaken between March 2020 to March 2021. A written informed consent was obtained from each participant. The study was approved by the institutional ethics committee.

Instruments

Physical evaluation and blood pressure measurement

An initial examination including demographic data and anthropometric variables such as weight, height and BMI (Body Mass Index) was carried out prior to the study. The blood pressure was measured using mercury sphygmomanometer before the intervention and five minutes after the intervention.

Test of 1 maximum repetitions (1-RM)

To determine the maximum load, the participants initiated the test with lighter load and then progressed to heavier loads to determine 1 RM in the following exercises: Biceps curls, triceps extension, legs curls, side leg raises and knee extension.

Procedure

The participants were divided into two groups: group A (receiving low intensity RE – 50% of 1RM) and group B (receiving high intensity RE – 80% of 1RM). Each session consists of warm up (dynamic and active stretching of the muscles involved in the main exercise), main exercise and cool down (passive and floor stretching). The main exercise

includes: Biceps curls, triceps extension, legs curls, side leg raise. The exercise program consists of three series of ten repetitions of each exercise with one minute interval between the sets and 2 minutes interval between each exercises and knee extension (three sets, ten repetitions for each exercise).

Data analysis

Statistical package SPSS (IBM SPSS Statistics for Windows, ver. 21.0. Armonk, NY: IBM Corp.) was used to analyze the data. Demographic data and descriptive characteristics of the outcome measures were presented as Mean and Standard Deviation (SD). Pre and post blood pressure domains difference in both groups was analyzed using paired sample 't' test. Difference in blood pressure domains between the groups was analyzed using independent 't' test. Statistical significance was inferred at $p < 0.05$.

Results

A total of 26 female individuals were included in the study. The mean age of group A and B was 66.46 ± 1.506 years and 65.53 ± 0.877 years respectively. Similarly, the mean BMI of group A and B was 26.88 ± 2.22 kg/m² and 27.95 ± 2.13 kg/m² respectively. The descriptive statistics of demographic data are described in Table 1.

The mean pre – SBP of group A and B are 126.29 ± 5.007 mmHg and 128.61 ± 6.75 mmHg respectively; mean pre – DBP of group A and B are 79.84 ± 5.80 mmHg and 79.07 ± 5.97 mmHg respectively. Similarly, the mean post – SBP of group A and B are 124.46 ± 5.007 mmHg and 126.76 ± 5.32 mmHg respectively; mean post – DBP of group A and B are 76.76 ± 4.28 mmHg and 77.84 ± 5.063 mmHg respectively. (Table 2)

Using paired 't' test, the statistically significant difference was found in pre and post BP measure in group A (low intensity exercise) where as in group B (high intensity exercise) the statistically significant difference was found only in SBP domains but not in DBP ($p < 0.05$). (Table 3)

Using unpaired 't' test, statistically no significant difference was observed in mean SBP as well as mean DBP recordings ($p < 0.05$). (Table 4)

Table 1: Descriptive statistics of demographics measures

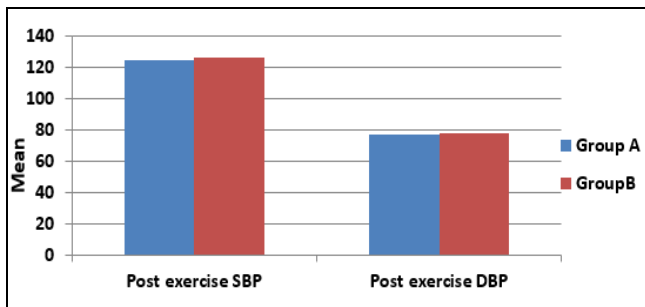
	Group	N	Mean	Std. Deviation	Std. Error Mean
Age	A	13	66.4615	1.50640	.41780
	B	13	65.5385	.87706	.24325
height	A	13	1.5238	.04501	.01248
	B	13	1.5046	.04427	.1228
weight	A	13	62.307	3.987	1.10584
	B	13	63.1538	3.2364	.8976
BMI	A	13	26.8886	2.22655	.61754
	B	13	27.9589	2.13619	.59247

Table 2: Descriptive statistics of blood pressure measures

	Group	N	Mean	Std. Deviation	Std. Error Mean
Pre-sbp	A	13	126.9231	5.00769	1.38888
	B	13	128.6154	6.75202	1.87267
Pre-dbp	A	13	79.8462	5.80009	1.60866
	B	13	79.0769	5.97859	1.65816
Post-sbp	A	13	124.4615	5.00769	1.38888
	B	13	126.7692	5.32531	1.47698
Post-dbp	A	13	76.7692	4.28474	1.18837
	B	13	77.8462	5.06370	1.40442

Table 3; Paired 't' test value of blood pressure domains within the groups

	Paired Samples Test					
	Group	Mean	Std. Deviation	t	df	Sig. (2-tailed)
Pre-sbp-post-sbp	A	2.461	3.478	2.551	12	.025
	B	1.846	2.230	2.984	12	.011
Pre-dbp-post-dbp	A	3.076	4.132	2.685	12	.020
	B	1.2307	3.70031	1.199	12	.254

**Table 4:** Independent 't' test value of blood pressure domains between two groups

	t-test for Equality of Means		
	t	df	Sig. (2-tailed)
Post-sbp	-1.195	24	.244
	-1.95		
Post-dbp	-.585	24	.565

Discussion

The purpose of this study was to find the immediate effect of low intensity and high intensity resistance exercise in hypertensive elderly women those who are under medication. The finding of this study revealed that the resistance exercise performed in low intensity was found to be more effective in reduction in blood pressure measures than those who performed in high intensity. Similar to this result, dos Reis JP *et al.* also found that low intensity (50% of 1 RM) resistance exercise was more effective in the reduction of blood pressure in hypertensive individuals¹⁶. They found that high (80% of 1RM) as well as low intensity exercise showed significant reduction of blood pressure in untrained individuals whereas low intensity exercise showed significant reduction in both trained and untrained individuals. Therefore, they concluded that low intensity resistance exercise is more effective in reducing blood pressure in hypertensive individuals.

In this present study, the results showed that a single bout of resistance exercise can cause immediate reduction in post exercise systolic blood pressure. However, only low intensity resistance exercise causes significant decrease in DBP and high intensity exercise was more effective in reducing SBP. The similar results have been proven by Medeiros AL *et al.* in their study^[17].

In regard to diastolic blood pressure, only after low-intensity resistance exercise diastolic blood pressure was found to be reduced significantly in contrast to pre-exercise values. However, diastolic blood pressure did not rise during high intensity exercise, indicating that high-intensity resistance training has a diastolic hypotensive impact. However, this effect was less than that seen following low-intensity exercise. These claims have also been proven by Rezak CC *et al.* in their study^[18]. They stated that blood pressure decrease was due to a reduction in cardiac output (CO) that is not completely compensated by an increase in systemic vascular resistance (SVR).

In this study, we found that a single resistance exercise

session is effective in immediate (5 minutes post exercise) reduction of the blood pressure, more significant depletion in SBP, regardless to the intensity of the exercise. The duration of blood pressure reduction is seen to be influenced by the intensity of the exercise. A study conducted by Melo CM *et al.* found that the reduction in blood pressure measures persisted for 10 hours post exercise and this reduction was greater in individuals with greater ambulatory blood pressure levels^[19]. However, our study did not address this explanation.

There are several limitations in this study. First is the sample size, only small size of the population was included which may hinder the reliability of the results. Second, is only female individuals are included in this study, but there might be gender differences of effect of resistance exercise in blood pressure measures. Third limitation is that this study evaluated only the immediate or acute effect of the resistance exercise. This study did not investigate the duration of exercise effect or its chronic effect on blood pressure measures. Fourth, only stage 1 & 2 HTN (according to JNC) was included. Due to these limitations, this study requires the further investigation for the higher reliability of results of this study.

Conclusion

The conclusion of this study gives the information that in hypertensive elderly women, a single session of resistance exercise is effective in reduction of blood pressure measures. The more significant decrease in blood pressure is found in those performing the low intensity resistance exercise comparing to high intensity.

Conflict of interest

The authors declare no conflicts of interest.

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