

## Original Research Article

# Evaluation of exercise hypertension in healthy young adults: an observational study

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### ABSTRACT

**Background:** The prevalence of hypertension is increasing globally as well as in Indian subcontinent. Exercise leads to an increase in the blood pressure especially systolic blood pressure. However, an increase in the diastolic blood pressure after exercise remarks for a risk of cardio-vascular disease. This study was undertaken to evaluate the exercise hypertension among the healthy young adults.

**Methods:** This prospective study was undertaken in a tertiary health care facility. A total of 150 healthy students were finally included in this study for analysis. The study subjects were belonging to 18-22 years old of both genders. The blood pressure was measured by sphygmomanometer. Author used two stair equipment for exercise in which students are allowed to step-up and step down for 5 minutes without any rest. The statistical analyses were carried out by using Graph-Pad Instate.

**Results:** The mean age of the students was  $19.8 \pm 1.3$  years and 92(61.33%) being males. The mean systolic blood pressure was  $117.1 \pm 7.74$  mmHg in resting condition which was significantly increased to  $140.0 \pm 13.9$  mm Hg after exercise ( $p < 0.0001$ ). In contrast, the diastolic blood pressure in resting condition was  $78.3 \pm 7.89$  mm Hg which was significantly reduced to  $71.85 \pm 7.96$  mm Hg after exercise ( $p < 0.0001$ ). The decrease in the diastolic blood pressure was inconsistency and 9 students had increased value after exercise which was found to be normal.

**Conclusions:** Both systolic and diastolic blood pressure measured during resting condition and after exercise was significantly differs. These differences were found to be normal which remarks for a better cardio-logical status in healthy young students.

**Keywords:** Blood pressure, Diastolic blood pressure, Exercise, Gender, Hypertension

### INTRODUCTION

The global burden of hypertension is large and increasing. It has been estimated that approximately 1.5 billion people worldwide would suffer from hypertension by 2025.<sup>1</sup> As per the National Nutrition Monitoring Bureau report conducted in nine States of India, the pooled estimate of prehypertension in rural men to be approximately 45%.<sup>2</sup> Hypertension is one of the most important risk factors for the development of premature cardiovascular disease.<sup>3</sup> The two important parameters

which are considered for diagnosis or treatment of hypertension are the systolic blood pressure and diastolic blood pressure.<sup>3</sup>

As per the guidelines of Centers for Disease Control and Prevention, "normal" blood pressure is less than 120/80 mm Hg which includes a systolic pressure reading less than 120 mmHg and a diastolic pressure reading less than 80 mmHg. After exercise the blood pressure can increase. This increase in blood pressure after exercise termed as "exercise hypertension", are temporary and should

gradually return to normal after completing the exercise. The quicker returns of the blood pressure to its resting level after exercise remarks for the healthier life. However, the magnitude and the time taken for changes in the blood pressure after exercise are inconsistent.<sup>4,8</sup> Kaufman et al, (1987) described the significant changes in both the systolic and diastolic blood pressure in 19 to 29 years old normotensive individuals was  $-12\pm 1$  mm Hg and  $-5\pm 2$  mm Hg respectively from pre-exercise rest to post-exercise rest.<sup>5</sup> Similarly, Pescatello et al, (1991) defined their normotensive group individuals with a change of systolic blood pressure to  $5\pm 1$  mm Hg higher for 12.7 hours after exercise but no significant changes in the diastolic blood pressure.<sup>6</sup>

The increase in systolic blood pressure after exercise considered as normal phenomena whereas the diastolic blood pressure after exercise should be either same or lower. The significant increase in the diastolic blood pressure after exercise considered as a risk for cardiovascular problems.

In the elderly population the risk for cardiovascular disease is mostly driven by systolic blood pressure however in younger generations the risk is measured by diastolic blood pressure.<sup>9</sup> The risk for cardiovascular disease in young adults can be known by measuring blood pressure during rest and after exercise. There is paucity of literatures regarding analysis of blood pressure and exercise in Indian young adults and globally. This study was undertaken to evaluate the exercise hypertension among the healthy young adults in a tertiary health care facility.

## METHODS

This prospective observational study was carried out in the Department of Physiology, Maharaja Krishna Chandra Gajapati Medical College, Berhampur, Odisha, India. In this institution, it is mandatory for all the undergraduate medical students to see the effect of exercise on the blood pressure during their 1st year of study.

The study subjects were selected as follows. Study period was from January 2019 to April 2019.

### *Inclusion criteria*

- Undergraduate medical students belonging to age group of 18-22 years.
- Both male and female students
- Healthy students with no such diseases which affects their blood pressure

### *Exclusion criteria*

- Students with known cardiovascular diseases
- Students experienced with chest pain after exercise

The blood pressure in each subject was measured by manual sphygmomanometer. The blood pressure was measured twice: i.e. (1) during resting condition and (2) after exercise. Blood pressure is considered normal when it is measured as less than 120/80 mmHg including a systolic pressure reading less than 120 mm Hg (numerator) and a diastolic pressure reading less than 80 mmHg (denominator). After exercise, the diastolic blood pressure response was considered as abnormal when there was an increase or decrease of  $\geq 15$  mmHg.<sup>10,11</sup> For exercise, we used two stair equipment. Students were allowed to step-up and step down for 5 minutes without any rest. The blood pressure was measured just after finishing the 5 minutes exercise.

### *Statistical analysis*

The generated data was entered in a predesigned excel Microsoft window sheet for further analysis. The comparison of both systolic and diastolic blood pressure between males and females was analyzed by using Mann-Whitney test whereas comparison of both systolic and diastolic blood pressure before and after exercise was analyzed by using Wilcoxon matched pairs test. A P value of  $<0.05$  was considered for statistically significant. Graph-Pad InStat version 3 for window was used for all statistical data analysis.

## RESULTS

One hundred fifty students were included in this observational study. The mean age of the students was  $19.8\pm 1.3$  years. Of the included cases, 92(61.33%) were males and 58(38.67%) were females' students. The mean age of the males and females' students was  $19.76\pm 1.25$  years and  $19.95\pm 1.37$  years. There was no difference in the age of males and females' students ( $p=0.8552$ ).

The blood pressure was measured in all the recruited cases. The mean systolic and diastolic blood pressure during resting condition was found to be  $117.1\pm 7.74$  mmHg and  $78.3\pm 7.89$  mmHg respectively. After exercise, the mean systolic and diastolic blood pressure was found to be  $140.0\pm 13.9$  mm Hg and  $71.85\pm 7.96$  mm Hg respectively. The difference in the both systolic and diastolic blood pressure during resting condition and after exercise was found to be statistically significant ( $<0.0001$ ).

In this comparison authors have noticed an increase in the systolic blood pressure whereas decrease in the diastolic blood pressure after exercise in healthy young students. Further, authors have analyzed the differences in both systolic and diastolic blood pressure during resting condition and after exercise in males and females' students separately and found similar observations. The comparison of blood pressure between normal condition and after exercise among the healthy students was illustrated in (Table 1).

**Table 1: Comparison of blood pressure between normal condition and after exercise among the healthy students (n=150).**

	Normal condition (Mean±SD)	After exercise (Mean ±SD)	p value
<b>Total cases (n=150)</b>			
Systolic blood pressure (mm Hg)	117.1±7.74	140.0±13.9	<0.0001
Diastolic blood pressure (mm Hg)	78.3±7.89	71.85±7.96	<0.0001
<b>In males (n=92)</b>			
Systolic blood pressure (mm Hg)	118.04±8.04	145.24±8.0	<0.0001
Diastolic blood pressure (mm Hg)	79.15±7.95	72.63±9.04	<0.0001
<b>In females (n=58)</b>			
Systolic blood pressure (mm Hg)	115.62±7.05	133.38±12.3	<0.0001
Diastolic blood pressure (mm Hg)	76.93±7.65	70.62±5.69	<0.0001

Again, we have compared both systolic and diastolic blood pressure in males and females separately during normal conditions and after exercise. Here systolic blood pressure was significantly high in males compared to females both in resting condition ( $p=0.0387$ ) as well as after exercise ( $p<0.0001$ ). Although there was a decreased value in the diastolic blood pressure in females compared to males students both in resting condition

( $79.15\pm 7.95$  mmHg Vs  $76.93\pm 7.65$  mmHg) and after exercise ( $72.63\pm 9.04$  mmHg Vs  $70.62\pm 5.69$  mmHg), it did not reach to a statistical significant difference ( $p=0.0802$  and  $p=0.0988$ ). The comparison of both systolic and diastolic blood pressure in males and females during normal conditions and after exercise was shown in Table 2.

**Table 2: Comparison of blood pressure in males and females during normal conditions and after exercise (n=150).**

	Males (n=92) (Mean ±SD)	Females (n=58) (Mean±SD)	P value
Systolic blood pressure in normal condition	118.04±8.04	115.62±7.05	0.0387
Diastolic blood pressure in normal condition	79.15±7.95	76.93±7.65	0.0802
Systolic blood pressure after exercise	145.24±8.0	133.38±12.3	<0.0001
Diastolic blood pressure after exercise	72.63±9.04	70.62±5.69	0.0988

The systolic blood pressure was found to be increase in all the students. However, the diastolic blood pressure was found to be reduced in 124 cases after exercise, whereas in rest 26 students, it either remain the same or increases. The detail magnitude of changes in the diastolic blood pressure after exercise in healthy young adults has been depicted in (Table 3).

**Table 3: Magnitude of changes in the diastolic blood pressure after exercise in healthy young adults.**

	Magnitude of increase in diastolic blood pressure after exercise	Number of cases (%)
Less than resting stage	2 mmHg	124(82.66)
	4 mmHg	17(11.33)
More than resting stage	4 mmHg	5(3.33)
	6 mmHg	3(2.0)
	6 mmHg	1(0.67)

## DISCUSSION

During the study period, we have recruited 150 health students. The mean age of the students was  $19.8\pm 1.3$  years and 92 (61.33%) being males' students. The age of male and females' students was found to be comparable ( $p=0.8552$ ).

The analysis of blood pressure during resting condition and after exercise in healthy young adults in this study revealed a statistical difference in both the systolic and diastolic blood pressure after exercise. After exercise, the systolic blood pressure was found to be increase in all the recruited students which was found to be a normal phenomenon of healthy life. In contrast, the diastolic blood pressure was found to be reduced after exercise as a whole, but when we analyzed the students individually, this decrease in the diastolic blood pressure was inconsistency. This inconsistency in the diastolic blood pressure after exercise was also reported in various studies.<sup>4,6</sup> Although 9(6.0%) students in this study developed an increase in the diastolic blood pressure after exercise, this increase was considered normal as it was

less than  $\geq 15$  mmHg as per the guideline.<sup>10,11</sup> There are various remarks on the increase of the diastolic blood pressure after exercise such as impaired glucose tolerance, high cholesterol level in blood, insulin resistance.<sup>12,13</sup> The minimum increase in the diastolic blood pressure after exercise in these students may be due to the above said factors. Another factor may be the handling of sphygmomanometer by the students.

There are few limitations in this study. Author have only analyzed the effect of exercise on the blood pressure of the healthy young adults and not the factors associated with this relationship. The analysis of factors like glucose tolerance, cholesterol level and insulin resistance in this study could fill the further knowledge gap in this regard.

## CONCLUSION

In conclusion, this is the first study to evaluate the exercise hypertension in healthy young adults in Southern Odisha, India. Further, the normal systolic as well as diastolic blood pressure after exercise remarks for a better cardio-logical status in healthy young students.

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