

# A Comparative Study of Blood Pressure and Heart Rate Recovery after Submaximal Exercise in Sedentary and Regularly Exercising Healthy Adult Students

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## ABSTRACT

**Objective:** The present study was undertaken to compare the pattern of the blood pressure (BP) and the heart rate recovery (HRR) after a submaximal exercise on the treadmill, in sedentary and regularly exercising healthy adult students who were of the age range of 18-25 years.

**Materials and Methods:** 75 non-smoker students of the age group of 18-25 years, with sedentary lifestyle habits were selected as the subjects (group A). 75 non-smoker students of the age group of 18-25 years, who did regular physical exercises were also taken as the subjects (group B). The subjects who

were free from any cardiovascular abnormalities were taken up from the student community of Patiala. The blood pressure and the heart rate recovery patterns after submaximal exercises on the treadmill were compared between the two groups.

**Results:** From the present study, it was concluded that the heart rate recovery of the regularly exercising group was significantly higher than that of the sedentary group. In this study, it was also observed that the systolic blood pressure (BP) and the diastolic BP recovery of the regularly exercising group were significantly higher than those of the sedentary group in the first five minutes post exercise.

**Key Words:** Blood pressure recovery, Heart rate recovery, Treadmill, Submaximal exercise

## INTRODUCTION

A sedentary lifestyle can contribute to many preventable causes of death. A lack of physical activity is one of the leading causes of preventable death worldwide [1]. Many studies have proven sedentary lifestyles and lack of physical activity to be the risk factors for anxiety, cardiovascular disease, depression, diabetes, colon cancer, high blood pressure, obesity, osteoporosis, lipid disorders, kidney stones and many more diseases. Gallagher MJ et al [2] concluded that morbidly obese individuals had severely reduced cardiorespiratory fitness. Regular physical activity increases the exercise capacity and it plays a role in both the primary and the secondary prevention of cardiovascular disease [3]. Michael L et al [4] observed that exercise testing could be used to assess the prognosis, particularly when emphasis was placed on non-electrocardiographic measures such as exercise capacity, chronotropic response, heart rate recovery and ventricular ectopy. Both exercise training and weight loss have been shown to decrease the left ventricular mass and the wall thickness, reduce the arterial stiffness and improve the endothelial function [5].

The purpose of the present study was to establish the blood pressure and the heart rate recovery pattern in sedentary adult students after submaximal exercises on the treadmill and to compare the results with those from a group of young students who exercised regularly.

## MATERIALS AND METHODS

The present study was undertaken to compare the pattern of the blood pressure and the heart rate recovery after submaximal exercises on the treadmill in sedentary and regularly exercising healthy adult students who were of the age group of 18-25 years.

The students who did not participate in at least 30 minutes of moderate physical activity which did not make them sweat or breathe hard, such as fast walking, slow bicycling, skating, pushing a lawn mower, etc on 5 or more days/week or in at least 20 minutes of vigorous physical activity that made them sweat or breathe hard, such as basketball, soccer, running, swimming, fast bicycling, fast dancing etc, on 3 days or more/week were considered to have a sedentary lifestyle (inadequate participation in moderate and vigorous physical activity), while those students who participated in these activities were considered to be regularly exercising, healthy adult students.

75 non-smoker students of the age group of 18-25 years, with sedentary lifestyle habits, were selected as the subjects (group A). 75 non-smoker students of the age group 18-25 years, who did regular physical exercises were also taken as the subjects (group B). The subjects were taken up from the student community of Patiala. Individuals who were found to be free of any cardiovascular abnormalities were taken up for the study. The heart rate and the blood pressure was measured as per the standard procedures which were described by Nageswari and Sharma [6].

**Heart rate:** The heart rate in beats/minute was measured by radial artery palpation at the wrist.

**Blood pressure:** The blood pressure was measured by using the auscultatory method (for systolic and diastolic BP) with the subjects in the sitting posture. The blood pressure was measured in mm of mercury (mm of Hg). A standardized mercury sphygmomanometer and a stethoscope were used. The same instruments were used for recording the blood pressure of all the subjects.

## Treadmill Exercise

The subjects were asked to perform the exercises on the treadmill and the following guidelines were followed:

- The treadmill slant was the same (0°) for all the subjects and at all the speeds.
- The room temperature was in the range of 20-25°C.
- The subjects were given instructions about the proper method of using the treadmill for the required exercises.
- During the exercise, the heart rate was monitored by using the electronic display device which was inbuilt in the treadmill machine, which showed the pulse rate of the exercising subjects. The exercise was stopped immediately when the heart rate crossed the predefined endpoint value. The end point heart rate was taken as 170 beats/minute for males and 160 beats/minute for females.
- The subjects were made to run on the treadmill at a speed of 3km/hr for 60 seconds.
- Then, the treadmill speed was increased to 4.5 km/hr and this speed was maintained for 45 seconds. Thereafter, the treadmill speed was increased in steps of 1.5km/hr after every 45 seconds till the endpoint was reached. The maximum speed which was used in this study was 10.5 km/hr. There was no time limit for this speed and the subjects exercised till the endpoint was reached.
- When the end point heart rate was reached, as was shown by the display device on the treadmill machine, the exercise was stopped and the time was noted.
- The subjects were immediately shifted to chairs and they were allowed to relax in a sitting position.
- The required observations and readings were taken.

The data was statistically evaluated to know the differences between the blood pressure and the heart rate recovery patterns of the two groups.

	GROUP	N	Mean	SD	Range (beats/min)	't' value	'p' value
H.R.R.-1	GROUP A	75	34.44	7.225	22-58	4.087	<.001***
	GROUP B	75	39.71	8.504	17-57		
H.R.R.-2	GROUP A	75	51.91	6.301	36-70	6.357	<.001***
	GROUP B	75	59.63	8.421	43-79		
H.R.R.-3	GROUP A	75	61.20	4.885	50-74	3.461	.001**
	GROUP B	75	64.67	7.168	49-83		
H.R.R.-4	GROUP A	75	67.07	5.036	58-82	3.119	.002**
	GROUP B	75	70.44	7.898	55-95		
H.R.R.-5	GROUP A	75	73.71	6.503	62-89	1.479	.141 <sup>NS</sup>
	GROUP B	75	75.51	8.291	58-94		

**[Table/Fig-1]:** Comparison of Heart Rate Recovery among Two Groups  
H.R.R.–Heart rate recovery after 1 minute, 2 minutes, 3 minutes, 4 minutes, 5 minutes.  
<sup>NS</sup> p>0.05; Not Significant; \*\*p<0.01; Significant at 1% Significance level; \*\*\*p<0.001; Highly Significant

This data showed a significant intergroup difference in the heart rate recovery in the two groups in the first four minutes. The results showed that the H.R.R. of the regularly exercising group (group B) was significantly higher than that of the sedentary group (group A) in the first four minutes.

	Group	No.	Mean	SD	Range	't' value	'p' value
BP Rec-1 Systolic	Group A	75	20.67	5.456	8-36	5.301	<.001***
	Group B	75	25.71	6.166	8-44		
BP Rec-2 Systolic	Group A	75	28.61	6.600	14-40	8.209	<.001***
	Group B	75	37.73	7.001	20-50		
BP Rec-3 Systolic	Group A	75	39.71	5.796	26-56	5.576	<.001***
	Group B	75	45.57	7.031	30-60		
BP Rec-4 Systolic	Group A	75	46.51	7.182	28-60	5.151	<.001***
	Group B	75	52.27	6.496	38-64		
BP Rec-5 Systolic	Group A	75	52.80	6.584	38-66	3.415	.001**
	Group B	75	56.51	6.707	40-72		

**[Table/Fig-2]:** Comparison of Systolic BP Recovery among Two Groups  
Systolic Blood pressure recovery after 1 minute, 2 minutes, 3 minutes, 4 minutes, 5 minutes.  
\*\*p<0.01; Significant at 1% Significance level; \*\*\*p<0.001; Highly Significant.

This data showed a significant intergroup difference in the systolic BP recovery in the two groups in the first five minutes. The results showed that the systolic BP recovery of the regularly exercising group (group B) was significantly higher than that of the sedentary group (group A) in the first five minutes post exercise.

	Group	No.	Mean	SD	Range	't' value	'p' value
BP Rec-1 Dias	Group A	75	1.87	.890	0-8	3.374	.001**
	Group B	75	2.40	1.040	0-20		
BP Rec-2 Dias	Group A	75	3.81	.586	0-18	2.951	.004**
	Group B	75	4.21	1.017	0-24		
BP Rec-3 Dias	Group A	75	5.89	.649	2-24	1.256	.211 <sup>NS</sup>
	Group B	75	6.08	1.112	4-26		
BP Rec-4 Dias	Group A	75	7.73	.759	4-26	2.939	.004**
	Group B	75	8.19	1.099	8-26		
BP Rec-5 Dias	Group A	75	7.87	.684	6-28	.971	.333 <sup>NS</sup>
	Group B	75	8.03	1.252	10-28		

**[Table/Fig-3]:** Comparison of Diastolic BP Recovery among Two Groups  
Diastolic Blood pressure recovery after 1 minute, 2 minutes, 3 minutes, 4 minutes, 5 minutes.  
<sup>NS</sup> p>0.05; Not Significant; \*\*p<0.01; Significant at 1% Significance level

The table shows the comparison of the diastolic BP recovery in the first five minutes post exercise between groups A and B. On comparing the statistical analysis, a better diastolic BP recovery in the group B in the first, second and fourth minutes post exercise was observed. In the third and fifth minutes, there was a non significant intergroup difference in the diastolic BP recovery.

## DISCUSSION

In the present study, it was observed that the resting H.R. of the regularly exercising group was significantly lower than that of the sedentary group. Similar results were reported by various other studies [7]. They found that the resting heart rate of the athletes was lower than that of the sedentary controls.

In the present study, it was observed that the heart rate recovery of the regularly exercising group was significantly higher than that

of the sedentary group in the first four minutes after the exercise. In the fifth minute, the difference became non significant. Similar results were reported by Wilmore JH et al [8]. They stated that the heart rate of the athletes returned to the pre-exercise levels more quickly as compared to that in the sedentary individuals. Morshedi-Meibodi et al [9] also conducted a study on the heart rate recovery after treadmill exercise testing and on the risk of cardiovascular disease events. They observed that a very rapid heart rate recovery immediately after the exercise was associated with a lower risk of cardiovascular events.

The present study also demonstrated that the systolic BP recovery of the regularly exercising group was significantly higher than that of the sedentary group in the first five minutes post exercise. Dimkpa U and Ugwu AC [10] concluded that the higher physical activity level of the subjects was associated with a faster systolic blood pressure recovery to normal. This could have been due to the effect of the exercise training in improving the vascular endothelial functions and the vasodilatory capabilities; hence a decrease in the systemic vascular resistance.

This study also showed that the diastolic BP recovery of the regularly exercising group was significantly higher than that of the sedentary group in the first, second and fourth minutes post exercise. In the third and fifth minutes, there was a non significant intergroup difference in the diastolic BP recovery. In present study, the better diastolic BP recovery in the exercising group was possibly due to their better cardiorespiratory fitness as compared to that in the sedentary subjects. Hagberg JM et al [11] observed that aerobic exercise added an independent blood pressure-lowering effect in certain hypertensive groups, with a decrease of 8 to 10 mm Hg in both the systolic and the diastolic blood pressure measurements.

## CONCLUSION

The present study highlighted the fact that the heart rate recovery of the regularly exercising group was significantly higher than that

in the sedentary group. In this study, it was also observed that the systolic BP and the diastolic BP recovery of the regularly exercising group were significantly higher than those of the sedentary group in the first five minutes post exercise.

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