ORIGINAL ARTICLE

Effect of Exercise on Blood Pressure in Athletes and Untrained Individuals

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Abstract

Background: *Physical exercise is known to increase heart rate and thus also causes proportionate changes in Blood Pressure. In the present study we tried to evaluate the changes occurring in Systolic Blood Pressure and Diastolic Blood Pressure in Trained and untrained individuals for a given amount of exercise.* ***Methods****: Male Trained Athletes were selected based on the criteria of 3-4 years of regular aerobic training and they were compared with untrained normal individuals. Exercise performance test was done as per Mc Ardle Step test this is performed with a stool with a height of 16.25 inches the test was done for duration of 5 minutes at the rate of 24 cycles per minute.* ***Results****: The mean SBP, DBP and Heart Rate in untrained individuals before exercise was 121.44 ± 2.04, 79.04 ± 2.16 and 76.64 ± 1.35 after 5 minutes of aerobic exercise was 157.04 mmHg, 82.4 mmHg and 132.72 per min. The value of parameters recorded similarly in Trained Athletes before exercise were SBP, DBP and HR were 124.64 ± 2.21, 81.68 ± 1.60 and 60.4 ± 2.0 and after exercise the values were 155.92 ± 4.35, 84.01 ±1.60 and 112.96 ± 2.16 per minute after exercise. Statistically significant differences were observed in SBP and Heart Rate before and after Exercise.* ***Conclusions****: The cardiovascular response in trained individuals was different from untrained individuals when subjected to exercise. The Trained Athletes were able to increase their SBP with relatively lower heart rates as compared to untrained individuals.*

Keywords*: Exercise, Systolic Blood Pressure [SBP], Diastolic Blood Pressure [DBP], Heart Rate [HR]*

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Introduction

Exercise is a physical activity that is planned, structured and repetitive for the purpose of conditioning of any part of the body. [1] Exercise is one of the important tools used to diagnose and understand functions of cardiovascular system. Exercise causes increase in cardiovascular function to deliver required oxygen and other nutrients to the exercising muscles and muscle blood flow increases drastically during exercise.[2] The purpose of cardiovascular regulation post-exercise period is to maintain adequate pressure for adequate tissue perfusion. However little is known about blood pressure regulation immediately after exercise cession and relative importance of regulation of resting blood pressure. [3-5]It has been found that individuals with a high level of physical fitness (athletes) are to have lower heart rates at sub-maximal workloads, higher maximal oxygen consumptions and quicker drops in the recovery rate than sedentary individuals. [6]Studies have found that recovery heart rates return to near basal levels faster in individuals who are physically fit. The rate of change towards basal levels is also dependent upon the integrity of the cardiovascular system and the health of the individual. [7] It is generally agreed that training induced Bradycardia is a form of adaptation. With this background we tried to evaluate the effects of exercise on Blood Pressure and heart

rates between Trained Athletes and Untrained Individuals for a given amount of exercise.

Materials and Methods

The study was conducted on 50 healthy male subjects of (20 -25 yrs) age group. The trained Athletes (n=25) were involved regularly in sports for 3–4 years continuously. The Untrained subjects (n=25) were not involved in any regular recreational activities and mostly lead sedentary life styles. Blood pressure measurements were initially taken after rest of 10 minutes with Standard Mercury Sphygmomanometer and BP was measured using the Auscultatory Method (Littman stethoscope). Heart rate was measured with estimation of radial pulse for 1 minute.

Exercise performance test was Mc Ardle Step test [8] this is performed with a stool with a height of 16.25 inches the test was done for duration of 5 minutes at the rate of 24 cycles per minute at standard Room temperature. Measurements of BP and Heart Rate were done immediately after exercise, after 5 minutes of exercise and 10 minutes after exercise.

The study was approved by Ethical Committee of Mamata Medical College Khammam. Written consent was obtained from all the participants. Data was analyzed using the SPSS 17 Version software.

Results

The Table-1 shows all the mean values recorded before starting of exercise test. P values were significant for Heart Rate. The values of Mean arterial pressure were also found to be significant in untrained individuals.

After Mc Ardle Step test the mean values of SBP were higher in trained Athletes 155.92 ± 4.35 as compared to the untrained individuals were it was mean values of 149.04 ± 5.38 the calculated p values were found to be significant. The Heart Rate in untrained individuals was found to be increased significantly 132.72 ± 2.07 as compared to the trained Athletes it was 112.96 ± 2.16 the calculated p values were found to be significant. The rate Pressure product in untrained individuals was 19817.44 ± 190.8 and athletes it was 17360.23 ± 175.6 it was found to be significant (Table-2).

Table 1: Comparison of different parameters before start of exercise

	Untrained		**Athletes**			
	Mean	**SD**	**Mean**	**SD**	**t**	**p**
Systolic BP	121.44	2.04	124.64	2.21	5.25	>0.05
Diastolic BP	79.04	2.16	81.68	1.60	3.63	>0.1
Pulse Pressure	42.4	3.36	42.96	3.70	1.91	>0.05
Mean Arterial Pressure	92.84	2.31	98.12	2.78	9.68	<0.01*
Heart Rate	76.64	1.35	60.4	2.00	26.10	<0.01*
Rate pressure Product (RPP)	8824.56	59.8	7609.72	45.9	2.56	>0.1

* Significant

Table 2: Comparison of different parameters after Mc Ardle Step test

	Untrained		**Athletes**			
	Mean	**SD**	**Mean**	**SD**	**t**	**p**
Systolic BP	149.04	5.38	155.92	4.35	15.54	<0.001*
Diastolic BP	82.4	1.96	84.01	1.60.	6.1	>0.1
Pulse Pressure	67.64	2.80	70.24	7.44	0.98	>0.1
Mean Arterial Pressure	105.92	1.60	108.88	2.78	6.04	<0.01*
Heart Rate	132.72	2.07	112.96	2.16	16.31	<0.01*
Rate pressure Product (RPP)	19,817.44	190.8	17360.23	175.6	11.56	<0.05*

* Significant

The table 3 shows the values of parameters recorded 5 minutes after stopping of exercise. The Blood pressure values decreases in both Athletes and untrained individuals. The Athletes values shows that the values nearly reached to their basal values at the end of 5 minutes the SBP in the Athletes was 126.92 ± 7.35 and that of the untrained individuals it was 131.04 ± 5.3 the p values were significant.

The Table 4 values were recorded 10 minutes after the stop of exercises most of the values recorded were found to be near the baseline values in both the groups comparatively however the p values were found to be

significant for the Heart Rate in the Athletes the heart rates were 62.5 and the untrained individuals it was 80.36. The other values were found to be not significant.

Table 3: Comparison of different parameters 5 Minutes after stopping of Exercise

	Untrained		Athletes			
	Mean	**SD**	**Mean**	**SD**	**t**	**p**
Systolic BP	131.04	5.3	126.92	7.35	61.54	<0.01
Diastolic BP	81.0	1.76	83.68	1.60.	6.1	>0.01
Pulse Pressure	50.5	7.30	76.24	7.44	0.98	>0.1
Mean Arterial Pressure	97.84	2.60	110.88	2.78	6.04	<0.05*
Heart Rate	92.72	2.54	75.56	2.16	16.31	<0.01*
Rate pressure Product (RPP)	12183.5	178.9	9576.72	156.9	11.23	<0.01*

* Significant

Table 4: Comparison of different parameters 10 minutes after stopping of Exercise

	Untrained		Athletes			
	Mean	**SD**	**Mean**	**SD**	**t**	**p**
Systolic BP	123.04	4.38	124.29	3.75	7.99	>0.01
Diastolic BP	80.67	1.14	83.37	1.60.	6.1	>0.1
Pulse Pressure	42.90	3.30	42.9	7.44	0.98	>0.1
Mean Arterial Pressure	95.34	1.60	96.67	2.78	6.04	>0.1
Heart Rate	80.36	2.07	62.5	2.16	16.31	<0.01*
Rate pressure Product (RPP)	9840.67	59.8	7750.31	49.5	4.34	>0.1

* Significant

Discussion

Acute sub-maximal exercise can cause changes in cardiovascular dynamics. It is generally agreed that Systolic Blood Pressure [SBP] increases due to exercise however there is controversial reports regarding the changes in Diastolic Blood Pressure [DBP]. In our study we found that the pre exercise resting Heart Rate of the athletes was significantly lower (60.4 ± 2.0) as compared to the untrained individuals (76.64 ± 1.35) Quaan HL et al have found that physically fit individuals for exercise have lower resting heart rate. These individuals might therefore be expected to be in better physical condition.[9] The Systolic Blood Pressure [SBP] increases after 5 minutes of given exercise in both the groups however there was more increase in SBP in the Athletes (155.92 ± 4.35) as compared to untrained individuals (149.04 ± 5.38) probably due to better cardiac conditioning. The Diastolic Blood Pressure [DBP] did not show major change after the exercise although it did increased slightly in both the Athletes and untrained individuals the values were 84.01 ± 1.6 and 82.04 ± 1.96 respectively. Christensen found that systolic pressure is increased, reaching a constant level by the end of five minutes of exercise, and that diastolic pressure also showed increases which ranging from 13 to 38 per cent depending on the rate of work. [10] Simonson and Enzer found that diastolic pressure remains constant or increases slightly during exercise. [11] Others have reported that it shows no change. [12, 13] Eskildsen and co-workers made studies on blood pressure changes in exercise by measuring intra-arterially and concluded that Systolic Blood Pressure [SBP] rises rapidly after start of work, Systolic Blood Pressure falls rapidly immediately after cessation of work sometimes reaches below the resting values by 4-5 minutes. They found that diastolic pressure changes very little and follow the systolic changes on a minor scale. [14] In our study we found a fall of systolic blood pressure after stopping of exercise however it did not fall below the resting values however we found that Diastolic Pressure changed on a minor scale similar to Systolic Pressure the point in conformation with the study on diastolic blood pressure. A similar study by Clausen JP et al; between trained Athletes and untrained individuals found that the athletes have lower heart rates and greater end systolic volumes and greater stroke volume at rest. [15] A similar observation is found in the present study. Studies on changes in pulse rate with exercise have been studied by Bierring et al, they found that pulse rate increases linearly with increase in

work and decreases during recovery to constant level which is somewhat above the resting rate. [16] An exactly similar observation is seen in the present study. The rate of change towards basal levels is also dependent upon the integrity of the cardiovascular system and the health of the individual. The Rate Pressure Product [RPP] which is a surrogate marker of myocardial work load or hemodynamic response serves as a simple and reliable method to cardiovascular dynamics. In our investigation we found that hemodynamic response was low intermediate as the RPP was in the range of 15000 to 1999. Some investigators have found that the Rate Pressure Product is very well correlated to myocardial oxygen consumption in young healthy subjects as well as in cardiac patients. [17, 18] RPP is well known to alter with several factors including psychological stress, age, gender and BMI. However it is still used clinically to determine efficiency of cardiac performance during stress and exercise.

Conclusion

The Trained Athletes were able to increase their SBP with relatively lower heart rates as compared to untrained individuals which may be probably due to their increase in stroke volume as compared to untrained individuals. Athletes were also having much lower resting heart rates and their heart rates reached to basal levels more quickly than the untrained individuals. The diastolic response between the trained athletes and untrained did not differ much although it shows changes in DBP were similar to SBP on a smaller scale. This shows that regular training has beneficial effect on body by making it better adapt to situations of demand like exercise.

Conflict of Interest: *None declared*
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