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Study on Post-Exercise Blood Pressure Recovery Time in Individuals with Normal and High Body Mass Index

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Abstract: *Post-exercise blood pressure change and its recovery time are considered to be an indicator of cardiovascular* ***health.*** *Obesity and hypertension are leading co morbidities associated with adverse cardiovascular events. The aim of this study is to analyze the post-exercise blood pressure recovery* ***time*** *in normal weight and overweight individuals, with or without hypertension. Two-hundred subjects (all adult male only) belonging to age groups between 20 years to 50 years were selected after informed consent of the participants. The total study sample included 100 hypertensive and 100 normotensive subjects. Each group included 50 overweight individuals and 50 subjects within normal Body Mass Index (BMI). All participants were asked to perform jogging for five minutes, at the rate of 100 steps per minute. The blood pressures were recorded before and after the procedure, and the time taken for recovery of systolic blood pressure back to resting value was noted. Statistical analysis was performed using Microsoft Excel 2007 and the software SPSS-20. The systolic blood pressure (SBP) increased after exercise in all four groups. However the rise was more predominant among the hypertensive population. The diastolic blood pressure decreased after exercise in normotensive, normal weight individuals; but increased in all other groups. The post-exercise blood pressure recovery time was shortest for normotensive, normal-weight subjects, and longest for hypertensive, overweight subjects. There was a strong positive correlation between body mass index and post-exercise blood pressure recovery time [R = 0.92; p < 0.00001]. In this study, we found a longer recovery time in hypertensive and overweight / obese individuals. This might be due to a raised sympathomotor or reduced vagal response in these; consistent with higher prevalence of adverse cardiovascular outcomes in these subjects.*

Keywords: *Blood Pressure Recovery Time, Exercise, Body Mass Index, Hypertension.*

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I. Introduction:

Hypertension is defined conventionally as a sustained increase in blood pressure over 140/90 mm Hg, a criterion that characterizes a group of patients whose risk of hypertension-related cardiovascular disease is high enough to merit medical attention [1]. Actually, the risk of both fatal and nonfatal cardiovascular disease in adults is lowest with systolic blood pressures of <120 mm Hg and diastolic blood pressures <80 mm Hg; these risks increase progressively with higher systolic and diastolic blood pressures. Recognition of this continuously increasing risk provides a simple definition of hypertension [1, 2].

Exercise has both long-term and short-term influence on blood pressure. At the onset of exercise, there is a significant rise in sympathetic outflow from the brain. This results in vasoconstriction of the arterioles in most tissues of the body except the contracting muscles, increased cardiac contractility, and increase in venous return [3]. These effects, working together, almost always increase the blood pressure during exercise. This increase can be as little as 20 mm Hg or as great as 80 mm Hg, depending on the nature of the exercise and the environmental conditions [3].

Global obesity rates have been on the rise in both developed and developing countries over the past few decades. This poses a huge medical and economic burden to the society [4, 5]. Obesity poses a greater risk towards development of cardiovascular diseases, including hypertension.

II. Aims and Objectives:

Post-exercise blood pressure change and its recovery time are considered to be an indicator of cardiovascular heath [6, 7, 8]. The changes vary according to the nature and intensity of exercise [3, 9, 10]. This study is aimed at understanding the difference in blood pressure changes and recovery times in normal and over-weight subjects after isotonic exercise (jogging).

III. Materials and Methods

The subjects were taken from consenting staffs of KPC Medical College and Hospital. 200 subjects (all adult males only) belonging to age groups between 20 years to 50 years were selected after informed consent of the participants. The total study sample included 100 hypertensive and 100 normotensive subjects. Each group included 50 overweight subjects and 50 subjects within normal Body Mass Index (BMI).

The subjects were distributed into four groups (A-D). The distribution of the participants was as follows:

- **Group A** consisted of 50 normotensive subjects with BMI < 25 kg/m^2.
- **Group B** consisted of 50 hypertensive subjects with BMI < 25 kg/m^2.
- **Group C** consisted of 50 normotensive subjects with BMI ≥ 25 kg/m^2.
- **Group D** consisted of 50 hypertensive subjects with BMI ≥ 25 kg/m^2.

Exclusion Criteria:

1. History of active sports training.
2. Previous experience of exercise training.
3. Resting systolic blood pressure greater than and equal to 140 mm of Hg.
4. Any abnormalities in resting Electrocardiogram (ECG).
5. Hypertension not adequately controlled with medication.
6. History of active medical illness such as recent acute coronary syndrome, tuberculosis, chronic lung disease like chronic obstructive pulmonary disease, interstitial lung disease, symptomatic ischemic heart disease.
7. History of major surgery in the recent past.
8. Any vertebral deformities like kyphosis or scoliosis.
9. Intake of any kind of drugs other than antihypertensives.

Instruments Required:

1. Mercury Sphygmomanometer (Dynosure DOCTOR DT Mercurial Sphygmomanometer, MODEL DT 11, made in Japan, imported by Dynamic Tracom Private Limited).
2. Stethoscope (H. Mukherjee & Sons).
3. Stopwatch.
4. Weighing Machine (Virgo Manual Weighing Scale-V-9811Bblue2).
5. Stadiometer (Seca 213 Portable Stadiometer).

Procedure:

Each subject was separately explained about the study procedure and written consent was obtained from him. Weight and height of the subjects were recorded with subjects wearing light clothing and no shoes. Weight was measured using balance scale to within 100 grams. Height was measured to the nearest 0.5 cm using a Stadiometer. BMI was computed as weight (mass in kilograms) divided by the square of the subject's height in meter.

The participants were required to attain a calm and quiet posture for 10 minutes before the procedure. Thereafter, their blood pressures were measured using a mercury sphygmomanometer from the left arm in a sitting position. The first phase of Korotkoff sounds was recognised as systolic blood pressure and the fifth phase as diastolic blood pressure.

The subjects were then made to perform an isotonic exercise (jogging 100 steps per minute) for 5 minutes. After performing the exercise for 5 minutes, the heart rate and blood pressure of the subjects were measured immediately. Then blood pressures were measured at intervals of 1 minute until resting systolic blood pressure was reached.

Source of finance:
The study was funded by researchers.

Statistical Methods:

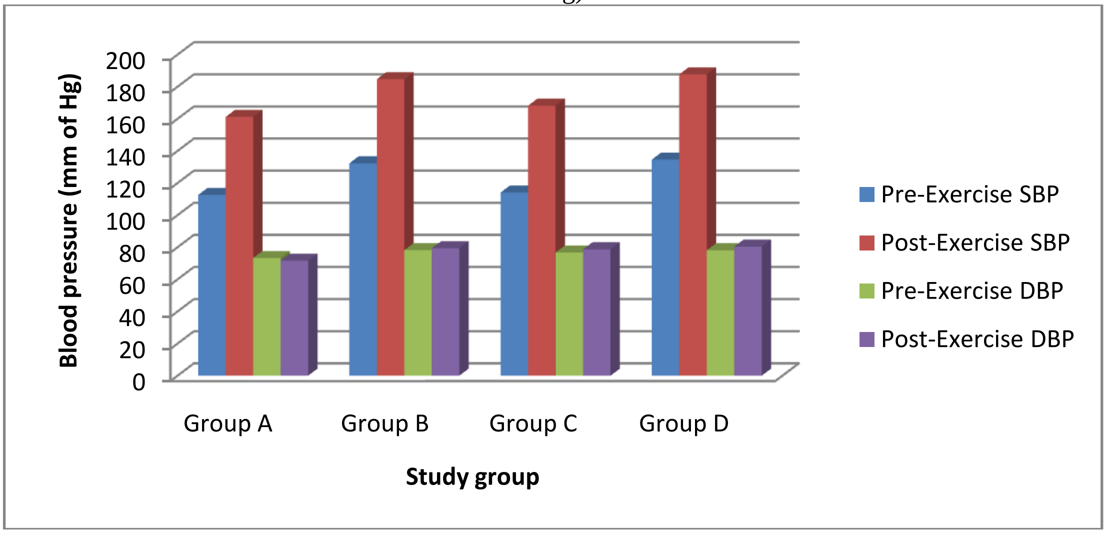
For each group, the Mean ± SD of different parameters like age, height, weight, body mass index (BMI), resting and post-exercise systolic blood pressure (SBP), resting and post-exercise diastolic blood pressure (DBP) and post-exercise blood pressure recovery time were calculated. The mean pre-exercise and post-exercise blood pressures, and blood pressure recovery times of each study group were compared using bar-diagram. Correlation between body mass index and blood pressure recovery time was studied using Pearson's Correlation Coefficient. The data were analyzed using Microsoft excel 2007 and SPSS-20.

IV. Observations and Results

Table 1: Mean ± SD of different study parameters in individuals of Groups A-D.

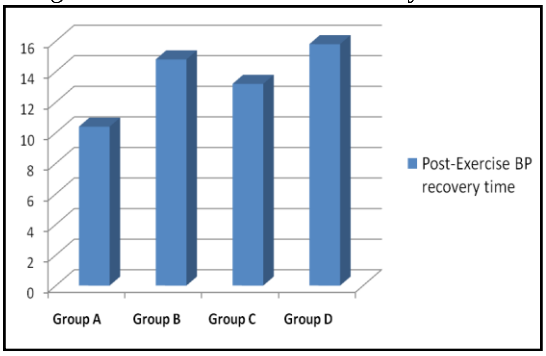
Group	Age (years)	Height (m)	Weight (kg)	BMI (kg/m^2)	Resting SBP (mm Hg)	Resting DBP (mm Hg)	Post-exercise SBP (mm Hg)	Post-exercise DBP (mm Hg)	Post-exercise BP recovery time (min)
A [n = 50]	34.6 ± 7.4	1.60 ± 0.3	58.8 ± 3.7	22.7 ± 1.6	112.6 ± 3.5	73.7 ± 3.1	161.2 ± 8.4	71.6 ± 4.2	10.4 ± 4.3
B [n = 50]	35.2 ± 6.9	1.62 ± 0.4	57.2 ± 6.5	23.1 ± 1.4	132.3 ± 7.8	78.2 ± 5.7	184.7 ± 10.1	79.4 ± 4.9	14.8 ± 7.2
C [n = 50]	36.1 ± 7.3	1.61 ± 0.3	64.2 ± 7.4	29.8 ± 3.6	114.1 ± 5.8	76.7 ± 7.1	168.2 ± 6.3	78.7 ± 5.3	13.2 ± 5.1
D [n = 50]	35.2 ± 6.9	1.62 ± 0.4	64.2 ± 7.4	29.8 ± 3.6	134.6 ± 8.2	78.1 ± 7.7	187.7 ± 9.5	80.4 ± 5.4	15.8 ± 6.9

Chart 1: Bar diagram showing mean Pre-Exercise and Post-Exercise blood pressures in different groups (in mm of Hg).



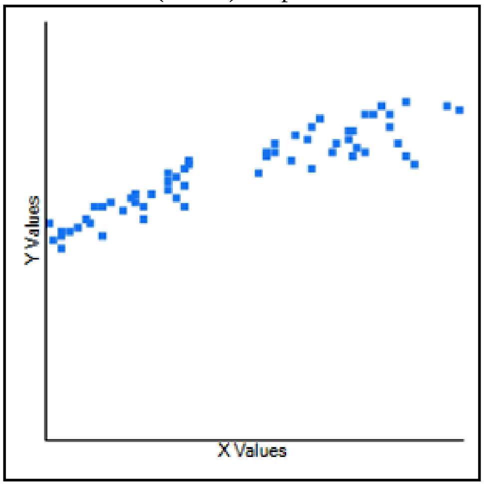
In our study, the systolic blood pressure (SBP) increased after exercise in all four groups. However the rise was more prominent among the hypertensive population (Groups B and D). The diastolic blood pressure decreased after exercise in normotensive, normal weight individuals (Group A); but increased in all other groups.

Chart 2: Bar diagram showing mean Post-Exercise BP recovery time in different groups (in minute).



The post-exercise blood pressure recovery time was shortest for Group A (normotensive, normal-weight), and longest for Group D (hypertensive, overweight).

Chart 3: Correlation between BMI (x-axis) vs. post-exercise BP recovery time (y-axis):



The value of R is 0.9233. This is a strong positive correlation, which means that high X variable scores go with high Y variable scores (and vice versa). The value of R^2, the coefficient of determination, is 0.8525. The P-Value is < 0.00001. The result is highly significant.

V. Discussion

We found a greater rise in the systolic blood pressure after exercise in hypertensive subjects (Groups B and D), compared to normotensive subjects (Groups A and C). The subjects with BMI ≥ 25 kg/m^2 (Groups C and D) had a higher post-exercise SBP compared to the subjects with BMI < 25 kg/m^2 (Groups C and D) *[Vide table 1 and Chart 1]*. Paired Student's T-tests were performed with the pre- and post-exercise SBP values for each group. In all groups, the differences were *statistically significant* ($p < 0.05$).

Table 1 and *Chart 1* also demonstrate a fall in the mean diastolic blood pressure of the normotensive normal weight subjects (Group A). The mean DBP rises after exercise in individuals of groups B, C and D. The rise in DBP is marked in subjects with BMI > 25 kg/m^2 (Groups C and D) as compared to Group A. The rise in DBP was slightly higher in known hypertensive subjects (Groups B and D) compared to normotensive subjects (Groups A and C). Paired Student's T-tests were performed with the pre- and post-exercise DBP values for each group. In all groups, the differences were *statistically significant* ($p < 0.05$).

The fall in DBP after mild jogging is a normal finding, caused by vasodilatation induced by exercise. The DBP had a rising response after exercise in hypertensive and / or high BMI individuals. This finding points towards a decreased vasodilator tone in hypertensive and overweight/obese individuals, consistent with the increased prevalence of coronary and peripheral vascular disease in these populations.

Chart 2 demonstrates a greater post-exercise BP recovery time in hypertensive subjects (Groups B and D) compared to normotensive subjects (Groups A and C). The subjects with BMI ≥ 25 kg/m^2 had a comparatively greater post-exercise BP recovery time than those with BMI < 25 kg/m^2. Unpaired Student's T-tests were performed with the post-exercise BP recovery time between Group A and each of Groups B, C and D. In all cases, the differences were *statistically significant* ($p < 0.05$).

Body mass index had a strong positive correlation with post-exercise blood pressure recovery time [R = 0.92; p < 0.00001].

VI. Conclusion

Post-exercise BP recovery time is an important predictor of cardiovascular disorders [11-15]. In this study, we found a longer recovery time in hypertensive and overweight / obese individuals. This might be due to a raised sympathomotor or reduced vagal response in these subsets; consistent with higher prevalence of adverse cardiovascular outcomes in these subjects.

References

[1] Chobanian AV, Bakris GL, Black HR, *et al*. Seventh report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure. *Hypertension*, **2003**, *42:*1206–1252.

[2] Weber MA, Materson BJ: Hypertension guidelines: A major reappraisal critically examines the available evidence. J Clin Hypertens (Greenwich) 12:229, 2010

[3] John E Hall. Guyton & Hall Textbook of Medical Physiology: 12th Edition, 2013. Chapter 84. Elsevier, India.

[4] Sonya Jagadesan, Ranjani Harish, Priya Miranda, Ranjit Unnikrishnan, Ranjit Mohan Anjana and Viswanathan Mohan. Prevalence of Overweight and Obesity Among School Children and Adolescents in Chennai. Ind Pediatr. 2014; 51: 544-549

[5] Thang Nguyen, David C.W. Lau. The Obesity Epidemic and Its Impact on Hypertension. Canadian Journal of Cardiology. 2012; 28(3): 326–333

[6] Tanji JL, Ghamplin JJ, Wong GY, Lew EY, Brown TC, Amsterdam EA. Blood pressure recovery curves after submaximal exercise: a predictor of hypertension at ten-year follow-up. American journal of hypertension. 1989 Mar 1;2(3_Pt_1):135-8.
[7] Terziotti P, Schena F, Gulli G, Cevese A. Post-exercise recovery of autonomic cardiovascular control: a study by spectrum and cross-spectrum analysis in humans. European journal of applied physiology. 2001 Mar 1;84(3):187-94.
[8] Pescatello LS, Fargo AE, Leach CN, Scherzer HH. Short-term effect of dynamic exercise on arterial blood pressure. Circulation. 1991 May 1;83(5):1557-61.
[9] Brown SP, Clemons JM, He Q, Liu SU. Effects of resistance exercise and cycling on recovery blood pressure. Journal of sports sciences. 1994 Oct 1;12(5):463-8.
[10] Forjaz CL, Matsudaira Y, Rodrigues FB, Nunes N, Negrão CE. Post-exercise changes in blood pressure, heart rate and rate pressure product at different exercise intensities in normotensive humans. Brazilian Journal of Medical and Biological Research. 1998 Oct;31(10):1247-55.
[11] Hashimoto M, Okamoto M, Yamagata T, Yamane T, Watanabe M, Tsuchioka Y, et l. Abnormal systolic blood pressure during exercise recovery in patients with angina pectoris. J Am Coll Cardiol 22: 659-664, 1993.
[12] Kurl S, Laukkanen JA, Rauramaa R, Lakka TA, Sivenius J, Salonen JJ. Systolic blood pressure response to exercise stress test and risk of stroke. Stroke 32: 2036-2041, 2001.
[13] Laukkanen JA, Kurl S, Salonen R, Lakka TA, Rauramaa R, Salonen JT. Systolic blood pressure during recovery from exercise and the risk of acute myocardial infarction in middle aged men. Hypertension 44: 820-825, 2004.
[14] McHam SA, Marwick TH, Pashkow FJ, Lauer MS. Delayed systolic blood pressure recovery after graded exercise: an independent correlate of angiographic coronary disease. J Am Coll Cardiol 34: 754-759, 1999
[15] Singh JP, Larson MG, Manolio TA, O'Donnell CJ, Lauer M, Evans JC et al. Blood pressure response during treadmill testing as a risk factor for a new newonset hypertension. The Framingham heart study. Circulation 99:1831-1836, 1999.

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