International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2013): 6.14 | Impact Factor (2013): 4.438

Correlation between Blood Pressure Recovery After Shuttle Run Test and Resting BP in Collegiate Men

Kulandaivelan S[1], Vasu P[2], Ravish Garg[3], Kalindi[1], Sonu Punia[4]

[1] Assistant Professor, Department of Physiotherapy, GJUST, Hisar- 125 001. Haryana. India

[2] Clinical Therapist, Sai Sri Advanced Physiotherapy Hospital, Tirupati. AP. India

[3] Associate Professor, Department of Biomedical Engineering, GJUST, Hisar. Haryana. India

[4] Teaching Associate, Department of Physiotherapy, GJUST, Hisar, Haryana. India

Abstract: ***Introduction: Present literature supports that post exercise hypotensive effect was grade dependent with resting blood pressure (BP). But no study reports exact correlation between the two. Methodology: Study Design- Experimental study, Correlation design. Sample size: 100. Population: Young Collegiate men. Physical Characteristics: Sex- Male, Age- 21.57±2.27 yrs, Height- 169.20±5.57 cm, Weight- 65.71±8.89 Kg. Protocol: After passing inclusion and exclusion criteria, all subjects were provided with informed written consent, prior to participation. Next day morning after getting up from the bed resting BP was taken using standard procedure by an experienced Physiotherapist. This was followed by administration of 20m shuttle run test until exhaustion. After that subjects were asked to sit in a chair for 120 min and passive recovery blood pressure (RBP) was recorded at 60 min, 120 min intervals. Variables: Both systolic and diastolic BP (SBP and DBP respectively) at rest, 30 min, 60 min and 120 min. Statistics: Data collected was analyzed using IBM SPSS (21.0 version) software. Pearson's correlation coefficient (r) test was used to see the correlation between RBP at different intervals with resting BP. Results: There was a high negative correlation between RBP in SBP at 60 min, 120 min and resting SBP (r -0.760, -0.822 respectively). There was an excellent correlation between RBP in DBP at 60 min, 120 min and resting DBP (r -0.908, -0.926 respectively). All values were significant at p<0.001. Conclusion: There was an inverse association between resting BP and RBP. This effect was more pronounced in DBP than SBP.***

Keywords: Maximal exercise, Acute exercise, Passive recovery, Gender effect, Exhaustive exercise

1. Introduction

Hypertension, defined as elevated blood pressure, is rapidly increasing world wide. It is reported to be a leading cause for mortality, accounting 13% of global death (Lawes et al., 2008) Once considered as a disease of developed and industrialized nations, hypertension is rapidly increasing in developing countries now (Pereira et al., 2009). Meta analytical studies show that the prevalence of hypertension in India is between 20% and 40% (Midha et al., 2013; Anchala et al., 2014). Approximately 10% of death in India was attributable to high blood pressure (Patel et al., 2011). Recent report asserts that hypertension was the third leading risk factor for disease burden in both developed and developing nations worldwide (Ezzati et al., 2002) and it is one of the most common modifiable risk factor in CVD. According to SEEK study, ischemic heart disease, stroke and peripheral vascular diseases are significantly higher in hypertensive Indian population than control (Farag et al., 2014).

Literature, time and again says that blood pressure (BP) reduction after exercise was grade dependent meaning higher the resting BP greater the recovery BP (RBP). However, when we examined the literature, we could not find any article that examines this relation. So, the primary objective of the present study was to see the amount of correlation between resting BP and RBP. The secondary aim was to understand that if any difference exists between Systolic BP (SBP) and Diastolic BP (DBP), then how long does the reduction of BP lasts after a progressive maximal exercise. We hypothesized that BP reduce after a single bout of maximal exercise and that will lasts for several hours.

2. Methodology

Present study was a cross sectional experimental study with correlation design. 100 young collegiate men were selected from university through convenient random sampling method. The students living in the hostels of university were asked to participate in the study after signing an informed consent form. After getting the written consent, each student was gone through the questionnaire for the suitability to include in the present study. The main inclusion criterion was male student between 18 to 25 years of age. Main exclusion criteria were person with lower extremity injury in previous 6 months, surgeries in last one year, any positive response from Physical Activity Ready Questionnaire (PARQ), and any other contraindication to perform maximal exercise test as per ACSM guidelines. (ACSM, 2013).

General characteristics (mean ± SD) of the sample were age 21.57 ± 2.27 years, height 169.20 ± 5.57 cm, weight 65.71 ± 8.89 Kg.

Protocol

After passing inclusion and exclusion criteria, all subjects were provided with informed written consent to participate in the present study. Next day morning after getting up from the bed resting BP was taken using standard procedure by an experienced Physiotherapist. This was followed by administration of 20m shuttle run test until exhaustion. After that subjects were asked to sit in a chair for 120 min and

passive BP was recorded at 60 min, 120 min intervals. We defined Recovery BP (RBP) as BP at particular time interval – resting BP. For example, Recovery SBP (RSBP) at 60 min will be calculated by SBP at 60 min post exercise – resting SBP. Independent variable was Shuttle Run Test and dependent variables were resting BP, RBP at 60 min, RBP at 120 min for both SBP and DBP.

3. Procedure

3.1 Blood pressure Measurement

BP was measured through standard procedure using mercury sphygmomanometer and stethoscope (Frese et al., 2011). In simple, subjects were asked to sit quietly in a chair with back support, both feet flat on the floor and arms at heart level, for at least 5 minutes prior to obtaining a measurement.They were instructed to relax as much as possible and to remain silent during the measurement procedure. The blood pressure cuff placed on the patient's bare arm and inflated 30 mmHg above disappearance of brachial pulse. Then cuff was deflated at recommended rate of 2 mm Hg per second. SBP was recorded at the point in which auscultatory pulsations (Korotkoff phase I) appeared and the disappearance of the auscultatory pulsations (Korotkoff phase V) was recorded as DBP. The whole procedure was repeated again. If the difference between the two readings is more than 5 mm Hg, one more readings was obtained, and the average of the three readings was used for analysis. The therapist who recorded the BP for this study was trained in physiotherapy OPD for three months prior to the study and recorded the BP of all visiting patients. His BP readings were well correlated with experienced therapist with ICC 0.99 and no significant difference between them.

3.2 Shuttle run test

Developed by Leger in 1982 shuttle run test, also known as Beep Test, indirectly measures aerobic capacity in children and young adult population (Leger and Lambert, 1982). This test involves continuous running between 2 lines 20 meter apart in time to recorded beeps. The subject stands behind one of the lines facing the second line and begin running when instructed by the recording. The speed in the starting will be quite slow (8-8.5 $Km.h^{-1}$). The subject was continuously running between the 2 lines, turning when singled recorded beeps. After about one minute, a sound indicates and speed increased by 0.5 $Km.h^{-1}$ and the beeps will be closer to each other. This continues each minute (0.5 $Km.h^{-1}.min^{-1}$) If the line is reached before the beep sound, the subject must wait until the beep sound before continuing. If the line is not reached before the beep sound, the subject is given a warning and must continue running to the line then turn and try to catch up with the pace within 2 more beeps. The test is stopped if the subject fails to reach the line for two consecutive ends after a warning. It has good test-retest reliability in young adults (r 0.95) (Leger et al., 1988).

3.3 Statistics:

Data collected was analyzed using IBM SPSS (21.0 version) software. Pearson's correlation coefficient (r) test was used to see the correlation between RBP at different intervals with resting BP. The correlation coefficient 'r' was classified into, up to 0.35 as weak, 0.36-0.67 as moderate, 0.68-0.89 as high and 0.90-1.0 as excellent correlation (Mason et al., 1983).

4. Results

Table 1 shows SBP at different time intervals along with 95% confidence interval (CI) in young collegiate male students. The initial (resting) 129.54 mmHg in SBP was reduced to 126.42 mmHg after one hour post shuttle run test (mean difference (MD) -3.13 mmHg with 95% CI ranges -5.23 to -1.03 mmHg). This was further reduced after two hour post shuttle run test (124.71 mmHg) with MD -4.83 mmHg (95% CI ranges -6.43 to -3.24 mmHg) (Table 2). Table 2 shows there is a high correlation in Recovery SBP (RSBP) at 60 min (r -0.760, $p<0.001$) and RSBP at 120 min (r -0.822, $p<0.001$).

Table 1: Mean SBP with 95% confidence interval (CI) at different time intervals (n=100)

SNo	Variable	Mean	95% CI
1	SBP at Rest (in mmHg)	129.54	127.57-131.51
2	SBP at 60 min (in mmHg)	126.42	125.01-127.83
3	SBP at 120 min (in mmHg)	124.71	123.64-125.78

Table 2: Recovery SBP (RSBP) mean difference with 95% CI along with correlation (r) (n=100)

SNo	Variable	Mean Difference (MD)	95% CI of MD	Correlation (r)
1	RSBP at 60 min (in mmHg)	-3.13±10.33	-5.23- (-1.03)	-0.760***
2	RSBP at 120 min (in mmHg)	-4.83±7.83	-6.43- (-3.24)	-0.822***

*** indicates values are highly significant at $p<0.001$

Table 3: Mean DBP with 95% confidence interval (CI) at different time intervals (n=100)

SNo	Variable	Mean	95% CI
1	DBP at Rest (in mmHg)	91.04	89.02-93.06
2	DBP at 60 min (in mmHg)	81.96	81.09-82.83
3	DBP at 120 min (in mmHg)	81.25	80.45-82.05

Table 4: Recovery DBP mean difference with 95% CI along with correlation (r) (n=100)

S No	Variable	Mean Difference (MD)	95% CI of MD	Correlation (r)
1	RDBP at 60 min (in mmHg)	-9.08±9.36	-10.94- (-7.22)	-0.908***
2	RDBP at 120 min (in mmHg)	-9.79±8.64	-11.50- (-8.08)	-0.926***

*** indicates values are highly significant at $p<0.001$

Table 3 shows DBP at different time intervals along with 95% CI in young collegiate male students. The initial (resting) 91.04 mmHg in DBP was reduced to 81.96 mmHg after one hour post shuttle run test (MD -9.08 mmHg with 95% CI ranges -10.94 to -7.22 mmHg). This was further marginally reduced after two hour post shuttle run test (81.25 mmHg) with MD -9.79 mmHg (95% CI ranges -11.50 to -8.08 mmHg) (Table 2). Table 2 shows there is a

excellent correlation in Recovery DBP (RDBP) at 60 min (r -0.908, p<0.001) and RDBP at 120 min (r -0.822, p<0.001).

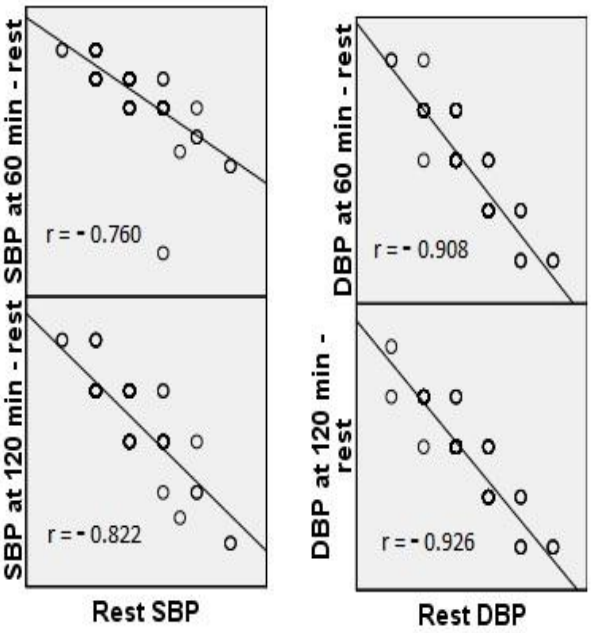

Figure 1: Correlation between recovery blood pressure and resting blood pressure for both SBP and DBP (n=100)

Figure 1 diagrammatically represents the relationship between RBP and resting BP in both SBP and DBP along with 'r' values. 'r' values in DBP were higher than SBP and RBP at 60 min were lower than RBP at 120 min.

5. Discussion

The aims of the present study were to find the extent of correlation between resting BP and RBP after a single bout of maximal exercise, correlation difference between SBP and DBP, duration of BP reduction after a single bout maximal exercise. The results confirm that high to excellent negative correlation does exist after maximal exercise, correlation was more pronounced in DBP than SBP values, and BP reduction after shuttle run test starts at 60 min and continues till 120 min. The reduction was higher in DBP than SBP. This indirectly indicates that after a single bout of maximal exercise, the pulse pressure will increase which would improves the myocardial perfusion.

Following two articles supports that BP reduction after exercise is grade dependent. A meta-analysis of randomized controlled trials has shown that aerobic endurance training reduces resting SBP and DBP by -3.0/-2.4 mmHg overall and reductions were greater in hypertensive subjects (systolic BP, −6.9 mmHg; diastolic BP, −4.9 mmHg) than in pre-hypertensive (systolic BP, −3.1 mmHg; diastolic BP, −1.7 mmHg) and normotensive (systolic BP, −2.4 mmHg; diastolic BP, −1.6 mmHg) subjects (Cornelissen and Fagert, 2005). Recently another meta-analysis showed hypertensive status influences the magnitude of clinic SBP and DBP fall after aerobic training. The effect of endurance training on SBP and DBP was greatest in hypertensive participants (-8.3 [-10.7 to -6.0]/-5.2 [-6.9 to -3.4] mm Hg) compared with groups with participants with pre-hypertension (-4.3 [-7.7 to -0.90]/-1.7 [-2.7 to -0.68] mm Hg) or normal BP (-0.75 [-2.2 to +0.69]/-1.1 [-2.2 to -0.068] mm Hg) (Cornelissen and Smart, 2013). In these articles and other meta-analytical studies that start as early as mid 90s supports that BP reduction was maximum in hypertensive patients followed by pre-hypertensive subjects, normal subjects. Similar to these studies present study shows a negative correlation meaning greatest reduction in maximal BP.

Another important finding from the present study is approximate mean reduction of 3.5 mmHg in SBP and 9.0 mmHg in DBP after one hour that continues until two hours. The significance of this is explained by following two articles. It has been estimated that as little as a 2 mmHg reduction in population average resting systolic BP can reduce mortality from coronary heart disease (CHD), stroke, and other causes by 4%, 6% and 3%, respectively (Stamler et al., 1989). Later, another study reported 3.0 mmHg rise in SBP and a 2.3 mmHg rise in DBP translates into an estimated 12% increased risk for CHD and 24% increased risk for stroke (Poirier et al., 2006). This clinical significance is more important because of the fact that the subjects exercise approximately 4-10 min only. One of the main reason people don't do exercise because lack of time in their mechanical life style. Currently all health organizations advocate 30-45 min moderate intensity exercise for health benefits, where as this study says 3-10 min of progressively high intensity exercise that challenge both aerobic and anaerobic metabolic pathways results in clinically significant health improvement.

6. Conclusion

Present study can be concluded with following points: After a single bout of maximal exercise, there is a high to excellent negative correlation between RBP and resting BP. This is more pronounced in DBP than SBP and at 120 min than 60 min. Reduction in BP lasts until 120 min. These results confirm that BP reduction after exercise is grade dependent.

7. Acknowledgment

We would like to thank Prof S. K. Singh, Chairman, Dept. of Physiotherapy, GJUST, Hisar, Haryana. India, for providing logistical and technical support to conduct this experiment. We also would like to acknowledge that this paper was presented in International Scientific Conference "Modern Trends in Rehabilitation, Physical Culture and Adapted Physical Education and Activity" on April 23rd 2015, Russia as virtual oral presentation and published in Conference Proceeding as well.

References

[1] ACSM. 2013. ACSM's Guidelines for Exercise Testing and Prescription (9th Edt) –Philadelphia: Lippincott Williams & Wilkins. 19-52.
[2] ANCHALA, R., KANNURI, N. K., PANT, H., KHAN, H., FRANCO, O. H. & PRABHAKARAN, D. 2014. Hypertension in India: A systematic review and meta-

analysis of prevalence, awareness and control of hypertension. J. Hypertens, 32(6), 1170-77.
[3] CORNELISSEN, V. A. & FAGARD, R. H. 2005. Effects of endurance training on blood pressure, blood pressure-regulating mechanisms and cardiovascular risk factors. Hypertension, 46, 667–75.
[4] CORNELISSEN, V. A. & SMART, N. A. 2013. Exercise training for blood pressure: a systematic review and meta-analysis. J. Am. Heart Assoc, 2, ID 004473.
[5] EZZATI, M., LOPEZ, A. D., RODGERS, A., VANDER HOORN, S. & MURRAY, C. 2002. Selected major risk factors and global and regional burden of disease. Comparative Risk Assessment Collaborating Group. Lancet, 360(9343), 1347-60.
[6] FARAG, Y. M. K., MITTAL, B. V., KEITHI-REDDY, S. R., ACHARYA, V. N., ALMEIDA, A. F., ANIL, C., BALLAL, H. S., GACCIONE, P., ISSACS, R., JASUJA, S., KIRPALANI, A. L., KHER, V., MODI, G. K., NAINAN, G., PRAKASH, J., RAJAPURKAR, M. M., RANA, D. S., SREEDHARA, R., SINHA, D. K., SHAH, B. V., SUNDER, S., SHARMA, R. K., SEETHARAM, S., RAJU, T. R. & SINGH, A.K. 2014. Burden and predictors of hypertension in India: Results of SEEK (Screening and Early Evaluation of Kidney Disease) Study. BMC Nephrology, 15, 42.
[7] FRESE, E. M., FICK, A. & SADOWSKY, H. S. 2011. Blood pressure measurement guidelines for physical therapists. Cardiopulm. Phys. Ther. J, 20(2), 5-12.
[8] LAWES, C. M. M., VANDER HOORN, S. & RODGERS, A. 2001. International Society of Hypertension. 2008. Global burden of blood-pressure-related disease. Lancet, 371(9623), 1513-18.
[9] LEGER, L. A. & LAMBERT, J. 1982. A maximal multi-stage 20m shuttle run test to predict VO_2 max. Eur. J. Appl. Physiol, 49, 1-12.
[10] LEGER, L. A., GADOURY, C. & LAMBERT, J. 1988. The multistage 20 meter shuttle run test for aerobic fitness. J. Sports Sci, 6, 93-101.
[11] MASON, R. O., LIND, D. A. & MARCHAL, W. G. 1983. Statistics: An introduction. New York: Harcourt Brace Jovanovich Inc, 368-83.
[12] MIDHA, T., NATH, B., KUMARI, R., RAO, Y. K. & PANDEY, U. 2013. Prevalence of hypertension in India: A meta-analysis. World J. Meta-anal, 1(2), 83-89.
[13] PATEL, V., CHATERJI, S., CHISHALM, D., EBRAHIM, S., GOPALAKRISHNA, G., MATHERS, C., MOHAN, V., PRABHAKARAN, D., RAVINDRAN, R. D. & REDDY, K. S. 2011. India: Towards universal health coverage 3. Chronic diseases and injuries in India. Lancet, 377, 413-28.
[14] PEREIRA, M., LUNET, N., AZEVEDO, A. & BARROS, H. 2009. Differences in prevalence, awareness, treatment and control of hypertension between developing and developed countries. J. Hypertens, 27(5), 963-75.
[15] POIRIER, P., GILES, T. D., BRAY, G. A., HONG, Y., STERN, J. S., PI-SUNYER, F. X. & ECKEL, R. H. 2006. Obesity and cardiovascular disease: pathophysiology, evaluation, and effect of weight loss: An update of the 1997 American Heart Association Scientific Statement on Obesity and Heart Disease from the Obesity Committee of the Council on Nutrition, Physical Activity, and Metabolism. Circulation, 113, 898–918.
[16] STAMLER, J., ROSE, G., STAMLER, R., ELLIOTT, P., DYER, A. & MARMOT, M. 1989. INTERSALT study findings. Public health and medical care implications. Hypertension, 14(5), 570-7.

Authors Profile

Kulandaivelan S completed his PhD in Sports Sciences, currently working as a Assistant Professor in Dept. of Physiotherapy, GJUST, Hisar. His research area includes Epidemiology of sports injuries and chronic diseases, Public Health, Exercise management of chronic diseases.

Vasu P, is currently working in Sai Sri Advanced Physiotherapy Hospital as Clinical Therapist. He did his PG from Dept. of Physiotherapy, GJUST, Hisar.

Ravish Garg working as an Associate Professor in Dept. of Bio-Medical Engineering, GJUST, Hisar. His research interest includes Epidemiology and exercise management in Hypertension.

Kalindi, pursuing her PhD in "Effect of Garlic and Exercise in Hypertension", she currently working as Assistant Professor in Dept. of Physiotherapy, GJUST, Hisar.

Sonu Punia, working as a Teaching Associate in Dept. of Physiotherapy, GJUST, Hisar. Her research interests include cerebrovascular accidents (Stroke) risk factors, causes, mechanisms and management.