International Journal of Physical Education and Sports
www.phyedusports.in
Volume: 3, Issue: 05, Pages: 10-16, Year: 2018
Impact Factor: 3.125 (RIF)

Recovery Blood Pressure Patterns following Standing to Lying Test (One of the Autonomic Testing Protocol) in Relation to Aerobic Fitness Levels

Sajjad Ahmad Bhat[1], Bharat Kumar[2], Dhananjoy Shaw[3]

[1]Assistant Students Welfare Officer, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir (SKUAST-K), Jammu and Kashmir, India.
[2]Senior Research Fellow (SRF), Department of Physical Education and Sports Sciences, University of Delhi, B-Block Vikas Puri, New Delhi, India.
[3]Principal, I.G.I.P.E.S.S. University of Delhi, B-Block Vikas Puri, New Delhi, India.

Received Apr 15, 2018; Accepted Apr 30, 2018; Published May 01, 2018

Abstract

The aim of the study was to compare the selected recovery blood pressure variables following lying to standing test between high fitness group (LFG) and low fitness group (LFG) of high altitude male youth. The high fitness (n1=35) and low fitness (n2=35) groups were determined by VO2max ranks of 242 healthy male youth samples of Kashmir (attitude: 6070 feet/1850 meters). The selected 70 samples out of 242 among which top 35 ranks were considered in HFG and bottom 35 ranks were considered in LFG. The age of the subjects ranged from 18 to 23 years. Data was collected using a standard mercury sphygmomanometer and a stethoscope was used to record the blood pressure of the subjects at various timings of lying to standing test (one of the autonomic testing protocol). The selected variables were age in years, body weight in kilograms (B.Wt.), height in centimeters (Ht.), resting heart rate (HRrest), Basal Blood Pressure (BslBP),pulse pressure (PP), mean arterial pressure (MAP), change of systolic blood pressure at 30 seconds of lying to standing test (LST30CSBP), change of systolic blood pressure at one minute of lying to standing test (LST1CSBP), change od systolic blood pressure at two minutes of lying to standing test (LST2CSBP), Systolic Blood pressure at 30 seconds of lying to standing test (SBP30LST), diastolic Blood pressure at 30 seconds of lying to standing test (DBP30LST), systolic Blood pressure at one minute of lying to standing test (SBP1LST), diastolic Blood pressure at one minute of lying to standing test (DBP1LST), systolic Blood pressure at two minute of lying to standing test (SBP2LST), diastolic Blood pressure at two minute of lying to standing test (DBP2LST), systolic blood pressure at two and half minute of lying to standing test (SBP2.5LST), diastolic Blood pressure at two and half minute of lying to standing test (DBP12.5LST), systolic Blood pressure at five minute of lying to standing test (SBP5LST) and diastolic Blood pressure at five minute of lying to standing test (DBP5LST).For statistical analysis the collected data was computed with mean, standard deviation, coefficient of variance and independent't' test. The major findings reflect significant difference between HFG and LFG in regard toVO2max (t= 47.66), (r=0.99);HRrest (t= -4.28), (r=0.46); LSTCSBP30Sec (t= -4.27), (r=0.46); LSTCSBP1Min(t=-4.22),(r=0.46); LSTCSBP2Min (t=3.89),(r=0.50); SBPLST30Sec(t=2.69), (r=0.31);SBPLST1Min(t=-3.49), (r=0.39);SBPLST2Min (t= -4.23), (r=0.46); DbpLST2Min (t=-2.98), (r=0.34); DBPLST2.5Min (t= -1.98), (r=0.23); and DBPLST5Min (t= -2.01), (r=0.24).The other variables have neither significant group difference nor their group difference effect size is conclusive. The recovery of blood pressure following lying to standing test was faster in HFG than that of LFG. The study concluded that HFG having better blood pressure recovery patterns following lying to standing test than that of LFG.

Key Words: Blood Pressure, Lying To Standing Test, Heart Rate, High Altitude, Kashmir.

1. Introduction:

Blood pressure (BP) is the lateral pressure exerted by blood on the vessel walls while flowing through it. (Lateral pressure is that pressure when force is exerted at right angles to the direction of follow at any point within a tube filled with a circulating fluid). (Chatterjee, 1951)

Systolic Pressure (S.P) is the maximum pressure during the systole. (Contraction of heart muscle is medically called as systole). (Chatterjee, 1951). Diastolic pressure (D.P) is the minimum pressure during the diastole. (Relaxing of heart muscle is medically called as diastole). (Chatterjee, 1951).Pulse Pressure (PP) is the difference between the systolic and accepted diastolic pressure. (Chatterjee, 1951)

Mean Arterial Pressure (MAP) is defined as the average pressure in subject's arteries during one cardiac cycle. It is considered a better indicator of perfusion to vital organs than systolic blood pressure. (Chatterjee, 1951)

A very recent reviewed study concluded that high-altitude exposure has been well recognized as a hypoxia exposure that significantly affects cardiovascular function. However, the pathophysiologic adaptation of cardiovascular system to high-altitude hypoxia (HAH) varies remarkably. It may depend on the exposed time and oxygen partial pressure

in the altitude place. In short-term HAH, cardiovascular adaptation is mainly characterized by functional alteration, including cardiac functional adjustments, pulmonary vascular constriction, transient pulmonary hypertension and changes in cerebral blood flow (CBF). These changes may be explained mainly by ventilatory acclimatization and variation of autonomic nervous activity. In long-term HAH, cardiovascular adaptation is mainly characterized by both functional and structural alterations. These changes include right ventricle (RV) hypertrophy, persistent pulmonary hypertension, lower CBF and reduced utero-placental/ fetal volumetric blood flows. (Wang et.al, 2017)

Altitude exposure is associated with major changes in cardiovascular function. The initial cardiovascular response to altitude is characterized by an increase in cardiac output with tachycardia, no change in stroke volume, whereas blood pressure may temporarily be slightly increased. After a few days of acclimatization, cardiac output returns to normal, but heart rate remains increased, so that stroke volume is decreased. Pulmonary artery pressure increases without change in pulmonary artery wedge pressure. This pattern is essentially unchanged with prolonged or lifelong altitude sojourns. Ventricular function is maintained, with initially increased, then preserved or slightly depressed indices of systolic function and an altered diastolic filling pattern. Filling pressures of the heart remain unchanged. Exercise in acute as well as in chronic high-altitude exposure is associated with a brisk increase in pulmonary artery pressure. The relationships between workload, cardiac output and oxygen uptake are preserved in all circumstances. Altitude exposure carries no identified risk of myocardial ischemia in healthy subjects but has to be considered as a potential stress in patients with previous cardiovascular conditions (Naeije, 2010).

High altitude exposure may induce important changes in blood pressure (BP) regulation, leading to significant increases in BP levels. By inducing atherosclerotic changes, stiffening of large arteries, renal dysfunction, and arterial baroreflex impairment, advancing age may induce progressive increases in systolic BP levels, promoting development and progression of arterial hypertension. It is also known, although mainly from studies in young or middle-aged subjects, that exposure to high altitude may influence different mechanisms involved in blood pressure (BP) regulation (i.e., neural central and reflex control of sympathetic activity), leading to important increases in BP levels. The evidence is less clear, however, on whether and to what extent advancing age may influence the blood pressure (BP) response to acute or chronic high altitude exposure (Parati et.al, 2015).

Lying to Standing Test (LST): one of the autonomic testing protocol

Haemodynamic responses to active standing are assessed during this test. Prior to the manoeuvre, the subject is rested in a supine position. Directly after assumption of the upright position a substantial amount of blood is redistributed to blood vessels of the lower extremities, which decreases venous return and cardiac stroke volume. In order to maintain adequate values of haemo-dynamic parameters, the organism initiates a physiological compensatory reaction. It can be divided into an immediate response with an abrupt fall in systolic and diastolic blood pressure and a visible acceleration of heart rate (first 30 seconds), a phase of early stabilization, which occurs after approximately one to two minutes and a response to prolonged orthostasis lasting for more than five minutes. Introduction of mechanisms compensating gravitational blood redistribution results during the phase of stabilization in acceleration of heart rate by about 10-15 beats per minute and a slight decrease in systolic blood pressure, while diastolic pressure increases by approximately 10 mmHg (Hilz et.al, 2006) and (Grubb, 1999).

Fluctuations of blood pressure are assessed based on somewhat later responses to standing (first 4 minutes) and they are expressed as the difference between the baseline supine and the minimal blood pressure after standing up. A decline in systolic blood pressure by more than 20 mmHg and by more than 10 mmHg for diastolic blood pressure is considered abnormal (Van den Berg et.al, 1997) and (Low, 2003).

Active standing is more suited than a head-up tilt test to assess responses during the initial phase of orthostatic challenge. It is the best test to diagnose idiopathic orthostatic hypotension (Hilz et.al, 2006).

The primarily heart rate (HR) peak (around three seconds) in response to standing is almost completely vagally mediated and secondary heart rate (HR) peak (around 15 seconds) is mainly but not exclusively vagally mediated; the enhanced sympathetic outflow to sinus node also contribute to the response. The relative bradycardia is the result a vagal reflex, which depends on the presence of recovery and over shoot of blood pressure (BP) mediated by sympathetically induced vasoconstriction (Wieling, 1992).

The Purpose of the study was to compare between the high fitness group (HFG) and low fitness group (LFG) in regard to recovery blood pressure patterns following lying to standing test of high altitude male youth.

2. Methodology:

2.1 Selection of Subjects:

The study was conducted on two hundred and forty two healthy male subjects of Kashmir (altitude: 6070 feet/1850 meters). The age of the subjects ranged from 17 to 23 years. The subjects were administered with submaximal bench step test (American College of Sports Medicine Protocol) to determine the VO2max by plotting HR-workload combinations calculated by Karvonen heart rate reserve method. Among the 242 subjects administered, top 35 as HFG and bottom 35 as LFG subjects on the basis of VO2max scores have been selected for the purpose of the study.

2.2 Selection of Variables:

The selected variables were as follows:

Table-1
Abbreviation and Description of Selected Variables

S.No	Abbreviation	Description
1	AGE	Age in years
2	HGT	Height in centimeters
3	WGT	Weight in kilograms
4	VO_2max	Maximal Oxygen Consumption
5	BslSBP	Basal systolic blood pressure
6	BslDBP	Basal diastolic blood pressure
7	MAP	Mean arterial pressure
8	PP	Pulse pressure
9	HR rest	Resting heart rate
10	LSTCSBP30Sec	Change of systolic blood pressure at 30 seconds of lying to standing test
11	LSTCSBP1Min	Change of systolic blood pressure at one minute of lying to standing test
12	LSTCSBP2Min	Change of systolic blood pressure at two minutes of lying to standing test
13	LSTSBP30Sec	Systolic blood pressure at 30 seconds of lying to standing test
14	LSTDBP30Sec	Diastolic blood pressure at 30 seconds of lying to standing test
15	LSTSBP1Min	Systolic blood pressure at one minute of lying to standing test
16	LSTDBP1Min	Diastolic blood pressure at one minute of lying to standing test
17	LSTSBP2Min	Systolic blood pressure at two minutes of lying to standing test
18	LSTDBP2Min	Diastolic blood pressure at two minutes of lying to standing test
19	LSTSBP2.5Min	Systolic blood pressure at two and half minutes of lying to standing test
20	LSTDBP2.5Min	Diastolic blood pressure at two and half minutes of lying to standing test
21	LSTSBP5Min	Systolic blood pressure at five minutes of lying to standing test
22	LSTDBP5Min	Diastolic blood pressure at five minutes of lying to standing test

Total 22 variables have been selected.

2.3 Administration of Test:

The subject were educated and instructed about the test. The test was conducted after twenty minutes of physical and mental rest. The subject was instructed to attain the standing position maintaining equal weight on both feet. The recordings were taken as per the protocol (Weling, 1992).

2.4 Collection of Data:

For the collection of data a sphygmomanometer(Omega Gold 2000) and a standard stethoscope were used to record the blood pressures of the subjects at various timings (0.5^{th}, 1^{st}, 2.5^{th} and 5^{th} minutes) of lying to standing test as per the standard autonomic protocol.

2.5 Statistical Analysis:

The collected data was computed with mean, standard deviation and coefficient of variance. Levene's test have been done for checking the homogeneity of group variances and the variables have been compared on the basis of independent sample "t" test using.

3. Result & Findings of the Study:

Table-2

Descriptive Statistics of Selected Variables of High and Low Fitness Groups (High Altitude Kashmiri Male Youth)

S.no	Variable	HFG			LFG		
		Mean	SD	CV	Mean	SD	CV
1.	AGE	18.94	0.91	4.78	18.74	0.82	4.36
2.	HGT	172.23	5.68	3.30	170.43	6.50	3.81
3.	WGT	55.16	6.20	11.24	53.56	8.62	16.09
4.	VO_2max	60.57	1.29	2.12	45.64	1.33	2.92
5.	BLSBP	112.51	9.96	8.85	110.20	14.98	13.60
6.	BLDBP	66.09	8.66	13.10	65.74	9.96	15.15
7.	MAP	81.14	7.85	9.67	80.54	10.73	13.33
8.	PP	46.43	9.70	20.89	44.46	10.06	22.63
9.	HRrest	63.03	8.37	13.27	73.77	12.28	16.64
10.	LSTCSBP30Sec	9.89	6.69	67.59	18.00	9.03	50.18
11.	LSTCSBP1Min	8.54	5.77	67.59	16.86	10.12	60.04
12.	LSTCSBP2Min	8.37	5.66	67.65	17.63	12.91	73.21
13.	SBPLST30Sec	118.57	15.08	12.71	128.11	14.62	11.41
14.	DBPLST30Sec	77.43	13.00	16.79	79.40	9.27	11.67
15.	SBPLST1Min	114.86	11.60	10.10	125.63	14.12	11.24
16.	DBPLST1Min	74.00	9.85	13.31	77.66	9.34	12.03
17.	SBPLST2Min	111.80	10.86	9.71	125.57	15.90	12.66
18.	DBPLST2Min	71.26	9.91	13.90	78.03	9.08	11.63
19.	SBPLST2.5Min	114.46	11.86	10.36	117.14	11.32	9.67
20.	DBPLST2.5Min	69.37	11.62	16.75	75.37	13.61	18.05
21.	SBPLST5Min	117.09	11.94	10.20	118.37	12.34	10.43
22.	DBPLST5Min	74.20	10.31	13.89	78.69	8.31	10.56

N_1= 35; N_2= 35; N_1+N_2 = 70;

Where N_1= Number of subjects in high fitness group (HFG); N_2= Number of subjects in low fitness group (LFG);

Blood Pressure is expressed in mmhg.

Table-3

Comparison between Selected Variables of High and Low Fitness Groups in regard to Recovery Blood Pressure Patterns Following Lying to Standing Test. (High Altitude Kashmir Male Youth)

S.No	Variable	Levene's Test	t-test for Equality of Means				Effect Size
		F	T	Df	Mean Difference	Std. Error Difference	r
1	Age	0.06 NS	0.97 (NS)	68	0.2	0.21	0.12
2	Height	2.01 NS	1.23 (NS)	68	1.8	1.46	0.15
3	Weight	0.45 NS	0.89 (NS)	68	1.6	1.79	0.11
4	VO_2max	0.00 NS	**47.66***	68	14.93	0.31	0.99
5	BLSBP	**6.73***	0.76 (NS)	59.13	2.31	3.04	0.1
6	BLDBP	3.09 NS	0.15 (NS)	68	0.34	2.23	0.02
7	MAP	**5.26***	0.27 (NS)	62.26	0.6	2.25	0.03
8	PP	0.00 NS	0.84 (NS)	68	1.97	2.36	0.1
9	HR rest	0.65 NS	**-4.28***	68	-10.74	2.51	0.46
10	LSTCSBP30Sec	**3.85***	**-4.27***	68	-8.11	1.9	0.46
11	LSTCSBP1Min	1.78 NS	**-4.22***	68	-8.31	1.97	0.46
12	LSTCSBP2Min	**4.02***	**-3.89***	46.62	-9.26	2.38	0.5
13	SBPLST30Sec	0.03 NS	**-2.69***	68	-9.54	3.55	0.31
14	DBPLST30Sec	1.46 NS	-0.73 (NS)	68.00	-1.97	2.7	0.09
15	SBPLST1Min	1.35 NS	**-3.49***	68	-10.77	3.09	0.39
16	DBPLST1Min	0.11 NS	-1.59 (NS)	68.00	-3.66	2.3	0.19
17	SBPLST2Min	3.69 NS	**-4.23***	68	-13.77	3.25	0.46
18	DBPLST2Min	0.89 NS	**-2.98***	68	-6.77	2.27	0.34
19	SBPLST2.5Min	0.36 NS	-0.97 (NS)	68.00	-2.69	2.77	0.12
20	DBPLST2.5Min	0.69 NS	**-1.98***	68	-6	3.03	0.23
21	SBPLST5Min	0.00 NS	-0.44 (NS)	68.00	-1.29	2.9	0.05
22	DBPLST5Min	1.45 NS	**-2.01***	68	-4.49	2.24	0.24

N_1= 35; N_2= 35; N_1+N_2 = 70; *= significant at 0.05 levels of significance, NS= insignificant
Blood pressure is expressed in mmHg.

Table-3 documents the F- statistic of Levene's Test for checking the assumption of homogeneity of group variances. On the basic of Levene's test appropriate t-statistic (t-statistic with Equal variance assumed when Levene's test is not significant and t-statistic with equal variance not assumed when Levene's test is significant) has been selected and it was found to be statistically significant between HFG and LFG in regard to VO_2max (t = 47.66), (r=0.99); HR rest (t = -4.28), (r=0.46); LSTCSBP30Sec (t = -4.27), (r=0.46); LSTCSBP1Min (t = -4.22), (r=0.46);LSTCSBP2Min (t= -3.89), (r=0.50);SBPLST30Sec (t= -2.69), (r=0.31); SBPLST1Min (t= -3.49), (r=0.39); SBPLST2Min (t= -4.23), (r=0.46)DBPLST2Min (t= -2.98) , (r=0.334); DBPLST2.5Min (t= -1.98), (r=0.23) and BDBPLST5Min (t= -2.01), (r=0.24). The other variables have neither significant group difference nor their group difference effective size is conclusive.

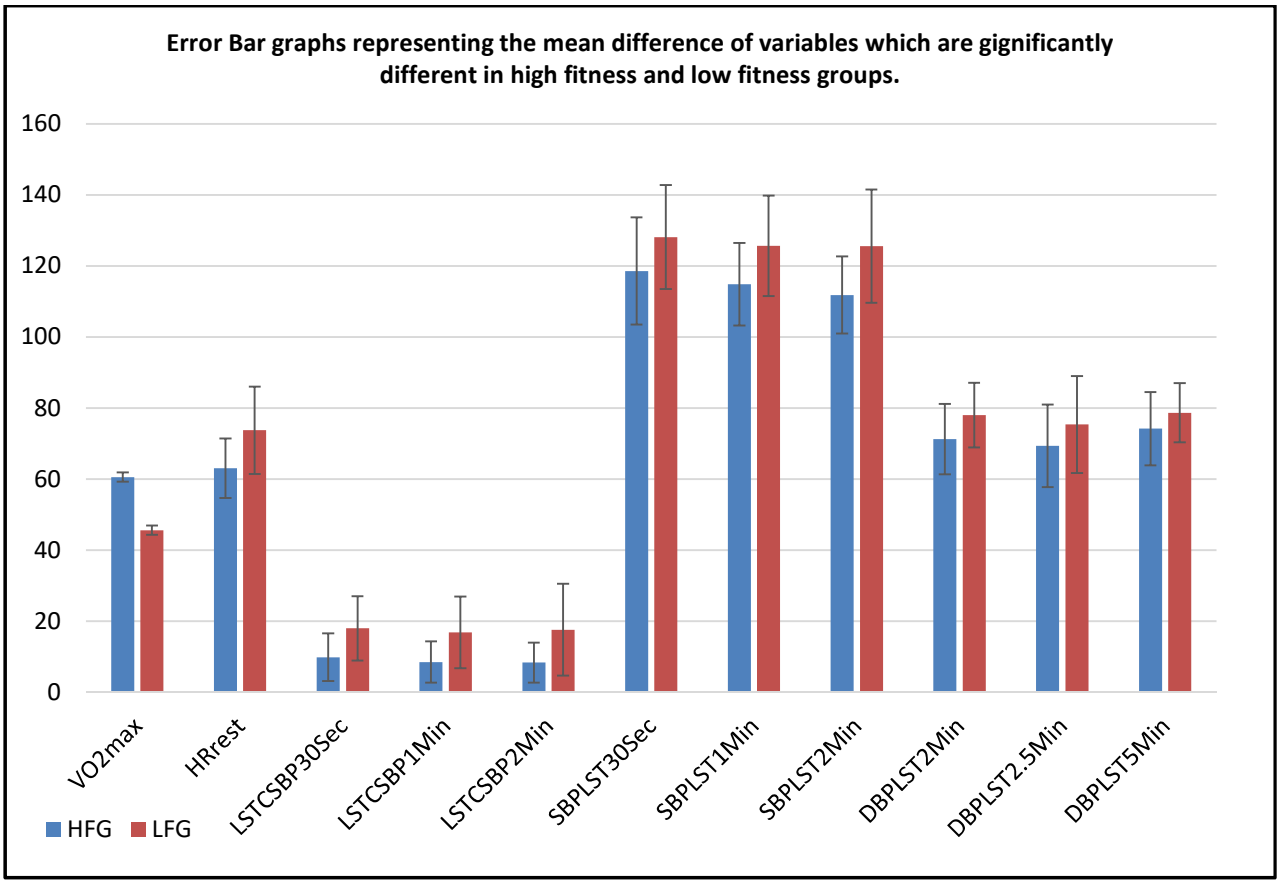

Figure 1. Showing the Difference in Mean Scores of HFG and LFG

4. Discussion of Findings:

The analysis of the table-2 reveals that the recovery blood pressure patterns following lying to standing test was faster in HFG than that of LFG.

5. Conclusion:

It is concluded that HFG having better recovery blood pressure patterns than that of LFG following laying to standing test which corroborates the existing theories.

6. References:

[1]. Center, Room B143, The University of New Mexico, Albuquerque, NM 87131-1258, Phone: (505) 277-2658, FAX: (505) 277-9742;
[2]. Chatterjee C.C. (1951). Human Physiology, *Calcutta; Medical Allied Agency: Vol-1:* 297-299.
[3]. Fox, E.L. (1973). A simple, accurate technique for predicting maximal aerobic power. J Appl Physiol, 35,914–916.
[4]. Froelicher, V.F. & Myers, J.N. (2000). Exercise and the heart. 4th ed. Philadelphia: W.B. Saunders Company.
[5]. Heyward V. H. (1997). Advanced fitness assessment and prescription. 3rd ed. Human Kinetics, Champaign Illinois.
[6]. Ke J., Wang L. and Xiao D. (2017). Cardiovascular Adaptation to High-Altitude Hypoxia, *In Hypoxia and Human Diseases*; *InTech.*
[7]. Naeije R. (2010). Physiological adaptation of the cardiovascular system to high altitude. *Progress in cardiovascular diseases*, *52 (6),* 456-466.
[8]. Parati G, Ochoa, J. E., Torlasco C., Salvi P., Lombardi C., & Bilo G. (2015). Aging, high altitude, and blood pressure: a complex relationship'. *High altitude medicine & biology*, *16* (2), 97-109.

[9]. Swain, D. P., Abernathy, K.S., Smith, C.S., Lee, S.J., Bunn, S.A. (1994). Target heart rates for the development of cardiorespiratory fitness. Med Sci Sports Exerc*,* 26 (1):112-116.

[10]. Tipton C.M.and Scheuer J. (1977). Cardiovascular adaptation to physical training. Annu.Rev.Physiol, 39, 221-251.

[11]. V_{O2} max. norms were adopted from Astrand:ACTA Physiol Scand.49(Suppl):169,1960

[12]. Weling W., Non-Invasive Continuous Recording of Heart Rate and Blood Pressure in the Evaluation of Neurocardiovascular Control', In: Bannister R, Mathias CJ, Eds, 'Autonomic Failure: A Text Book of Clinical Disorders of the Autonomic Nervous System.

Corresponding Author:
Dhananjoy Shaw,
Principal,
I.G.I.P.E.S.S.
University of Delhi,
B-Block Vikas Puri, New Delhi, India.
Email: dhananjoyshaw@gmail.com