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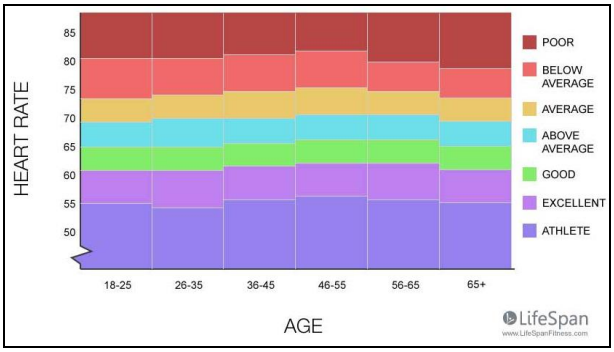
Grading scale of selected aerobic fitness (Physiological) variables of high altitude male youth of Kashmir

Sajjadh Ahmad Bhat and Dhananjoy Shaw

Abstract
The aim of the study was to grade scale selected aerobic fitness (Physiological) variables of high altitude male youth of Kashmir. The study was conducted on two hundred forty two healthy male youth of Kashmir (attitude: 6070 feet/1850 meters). The age of the subjects ranged from 18 to 23 years. The physical variables of the subjects like age, body weight and height were noted down. For selected physiological variables youth were administered submaximal bench step test (American College of Sports Medicine Protocol) for six minutes. To determine the VO2 max., plotting HR-workload combinations calculated by Karvonen heart rate reserve method was adopted. Data was collected using Cardio-Sport heart rate monitor and step test protocol. The selected variables were Resting Heart Rate = RHrest, Target Heart Rate = THR, Maximal Heart Rate = HRmax., Heart Rate at Two minutes of step testing with cadence 15 steps/min = ExHR2min, Heart Rate at Four minutes of step testing with cadence 20 steps/min = ExHR4min, Heart Rate at Six minutes of step testing with cadence 30 steps/min = ExHR6min, recovery heart rate at one minutes of rest = RcvyHR1min, recovery heart rate at two minutes of rest = RcvyHR2min, recovery heart rate at third minute of rest = RcvyHR3min and VO2 max.(As per the formula advocated by American College of Sports Medicine). The collected data was computed with mean, standard deviation, six sigma scale and chi square using SPSS. The study concluded that the developed grade scales of selected physiological variables are good normative in reference to Kashmir youth in regard to their Aerobic fitness evaluation.

Keywords: Resting heart rate, exercise heart rate, recovery heart rate, maximal oxygen consumption, step testing, high altitude, physiological variables, aerobic fitness

Introduction
Heart rate is the number of cardiac contractions in one minute. The number of contraction range from 60-80 bts/min. The rate and intensity of the cardiac contractions is affected by exercise, long term training, age, sex, disease, stress, environmental temperature, altitude etc. However 72 beats per minute (bts/min) is generally considered as a normal heart rate. A lower resting heart rate is recorded in trained individuals then that of untrained. Although one of the hallmark of the endurance athlete is a slower heart rate at rest (Bradycardia). The lower heart rate may be caused by any combination of three factors, a reduction in the intrinsic rate of heart, decreased sympathetic tone and increased parasympathetic tone.



Source: www.LifeSpanFitness.com

Fig 1: The Resting Heart Rate Chart (Pulse Rate Chart) Shows the Normal Range According to Age

Heart rate is arguably a very easy cardiovascular measurement, especially in comparison to the invasive or noninvasive procedures used to estimate stroke volume and cardiac output. Consequently, measurement of heart rate is routinely used to assess the response of the heart to exercise, or the recovery from exercise, as well as to prescribe exercise intensities. Autonomic Nervous System controls the working of heart during exercise. It is known that increase in heart rate during mild to moderate level of exercise is due to withdrawal of Parasympathetic nervous system activity (PNS).The rise in heart rate during strenuous exercise is mediated through sympathetic activity. Given that the increase in heart rate during incremental exercise mirrors the increase in cardiac output, maximal heart rate is often interpreted as the upper ceiling for an increase in central cardiovascular function. Indeed, research for the last 100 years has demonstrated that heart rate does in fact have a maximal value; one that cannot be surpassed despite continued increases in exercise intensity or training adaptations (Robert 2008) [8].

The regular exercise leads to adoptive changes in cardiac and physical performance and oxygen uptake capacity. Physically trained individuals are found to have maximum oxygen uptake capacity than physically untrained ones (Heyward, 1997) [9]. The requirement or adaptation of VO2 Max. for different games and sports or physical activity are different.

Recovery heart rate is simply your pulse rate after exercise. Some fitness specialists refer to it as post-exercise heart rate. The pulse number is used for different reasons in different settings. Recovery heart rate is also used in popular fitness tests like the YMCA Submaximal Step Test. During the fitness assessment, an exerciser steps up and down on a 12-inch box at a rate of 24 steps per minute. The test lasts for three minutes. Recovery heart rate is measured for one full minute immediately following the test.

"Recovery heart rate" refers to the heart's ability to return to normal levels after physical activity. Fitness level and proper function of heart are measured by the recovery phase. A heart that is healthy will recover at a quicker rate than one that is not healthy or is not accustomed to regular exercise. If one's heart does not recover in reasonable time, one may have a heart problem.

First Minute of Recovery

The first minute of recovery is the most crucial. After exercise, heart rate experiences an abrupt drop during the first minute. This recovery period can indicate fitness level and give an early warning of potential heart problems. In a recent study performed by the Cleveland Clinic Foundation classified a heart rate decrease of 12 beats or less in the first minute as abnormal. The study also reported that people with an abnormal decline in heart rate had a greater chance of mortality in the subsequent six years due to heart problems. (The New England Journal of Medicine, October 1999).

Two-Minute Recovery

The heart rate two minutes after exercise is referred to as the recovery heart rate. This is the most common measurement in determining cardiovascular fitness. To test for improvements, record the working heart rate during exercise, then record recovery heart rate at the two-minute mark. Subtract the two-minute recovery rate from the working heart rate to determine a baseline for improvement. For example, if working levels were 150 beats per minute and the two-minute recovery rate was 95, then 55 is the recovery heart rate.(Apr. 23,2015)

Table 1: Ratings of Recovery Heart Rate for Men (Based on Age)

	18-25	**26-35**	**36-45**	**46-55**	**56-65**	**65+**
Excellent	50-76	51-76	49-76	56-82	60-77	59-81
Good	79-84	79-85	80-88	87-93	86-94	87-92
Above Average	88-93	88-94	92-88	95-101	97-100	94-102
Average	95-100	96-102	100-105	103-111	103-109	104-110
Below Average	102-107	104-110	108-113	113-119	111-117	114-118
Poor	111-119	114-121	116-124	121-126	119-128	121-126
Very Poor	124-157	126-161	130-163	131-159	131-154	130-151

Source: Age-adjusted standards based on guidelines published by YMCA.

VO_2 max. also known as maximal oxygen consumption/ maximal oxygen uptake/ peak oxygen uptake or maximal aerobic capacity is the maximum rate of oxygen consumption as measured during incremental exercise, most typically on a motorized treadmill or on a bench step test (Dlugosz 2013). Maximal oxygen consumption reflects the aerobic physical fitness of the individual and is an important determinant of their endurance capacity. The name is derived from V = volume, O_2 =oxygen, max = maximum.

VO_2 max is expressed either as an absolute rate in (for example) liters of oxygen per minute (L/min) or as a relative rate in (for example) millilitres of oxygen per kilogram of body mass per minute (e.g. ml/(kg/min). The latter expression is often used to compare the performance of endurance sports athletes. However, VO_2 max generally does not vary linearly with body mass. (Wikipedia, July 2017).

VO_2 max is the very important determinant of cardio-respiratory fitness and aerobic performance.VO_2 max (ml/min/kg) is a measure of the maximum amount of oxygen that one use during intense physical activity. This measurement determines fitness level by calculating how efficiently cells use oxygen for energy (Tipton, 1977) [4]. There are several methods one can use to measure VO_2 max, but many require sophisticated equipment such as a treadmill or a specially calibrated exercise cycle with calorimetry/ spirometry /gas analyzer. The step test with heart rate recordings is quickest, easiest and safest as well as feasible way to measure ones VO_2 max for basic calculation after taking in consideration the Karvonen formula for a step testing protocol and sub maximal exercise heart rate (Practical Math for Health Fitness Professionals, 1996).

Table 2: VO2 Max. Norms Chart

AGE	Women	Low	Fair	Avg.	Good	High	Athletic	Olympic
AGE	20-29	<20	29-34	35-43	44-48	49-53	54-59	60+
	30-39	<27	28-33	34-41	42-47	48-52	53-58	59+
	40-49	<25	26-31	32-40	41-45	46-50	51-56	57+
	50-65	<21	22-28	29-36	37-41	42-45	46-49	50+
	Men							
	20-29	<38	39-43	44-51	52-56	57-62	63-69	70+
	30-39	<34	35-39	40-47	48-51	52-57	58-64	65+
	40-49	<30	31-35	36-43	44-47	48-53	54-60	61+
	50-59	<25	26-31	32-39	40-43	44-48	49-55	56+
	60-65	<21	22-26	27-35	36-39	40-44	45-49	50+

Note: VO2 is expressed as milliliters of oxygen per kilogram of body weight per minute
Source: VO2 max. norms were adopted from Astrand: ACTA Physiol Scand.49(Suppl):169,1960

Healthy high altitude dwellers show excellent adaptation to their environment. These adaptations are likely to be associated with altered gene expression as the expression of genes associated with vascular control and reactions to hypoxia have been found to be high in altitude dwellers (Appenzeller 2006) [1]. Blood volumes are larger in high altitude dwellers. This is due to a large packed cell volume whereas at sea levels plasma volume was found to be large. Probably as the result of the large blood volumes, tolerance to orthostatic stress was greater than that in sea-level residents (Claydon, 2005) [3].

It is summarized that at altitudes over 5000 feet (1524 meters), the ability to perform physical work is decreased due to hypoxia (lowered PO_2). However, physical performance at moderate altitude may sometimes be improved with continued stay at altitude due to the acclimatization process. This involves: (1) increased pulmonary ventilation (hyper ventilation); (2) increased red blood cells and hemoglobin concentrations; (3) elimination of bicarbonate (HCO_3) in the urine; and (4) in those chronically exposed to altitude, tissue level changes. Increased physical fitness does not alone acclimatize the individual to altitude (Houmard, 1991) [7].

The Kashmir Valley being at high altitude with mountainous environment around demands a great deal of physical efficiency to survive and to live a graceful and healthy life. Kashmiri has to perform best in different changing altitudes, time and again, with or without any acclimatization for the life and social requirements because of the very nature of its geographical, political, social, administrative, vocational requirement/s. It has been observed that Kashmiri youth is a habitat of high altitude, but they interact with rest of India (low altitude), whether it is games/sports (nationals, inter-university, senior nationals, junior nationals, rural nationals etc.) or cultural exchange programs, education etc. Hence grading scale for selected physiological variables as an indicator of aerobic fitness suitable to them becomes imperative and need of the hour.

The Purpose of the study was to grade-scale selected aerobic fitness (Physiological) variables of high altitude male youth of Kashmir valley which will be useful for evaluation, grading, grouping and monitoring the aerobic fitness for Kashmiri male youth.

Methodology

The study was conducted on two hundred and forty two healthy male subjects of Kashmir valley (altitude: 6070 feet/1850 meters). The age of the subjects ranged from 17 to 23 years. The youth were administered submaximal bench step test to record certain physiological variables and to determine the VO2 max. by plotting HR-workload combinations calculated by Karvonen heart rate reserve method. The following cardio-circulatory variables were selected for grade scaling the selected aerobic physiological fitness variables: Resting Heart Rate= RHrest, Target Heart Rate= THR, Maximal Heart Rate= HRmax., Heart Rate at two minutes of step testing with cadence 15 steps/min= ExHR2min , Heart Rate at four minutes of step testing with cadence 20 steps/min= ExHR4min, Heart Rate at six minutes of step testing with cadence 30 steps/min= ExHR6min, recovery heart rate at one minutes of rest= RcvyHR1min, recovery heart rate at two minutes of rest= RcvyHR2min, recovery heart rate at third minute of rest= RcvyHR3min and maximal oxygen consumption= VO2max.(As per the formula advocated by American College of Sports Medicine).

Submaximal exercise testing can be used for predicting VO2 max by taking advantage of linear relationship between heart rate responses and workload VO2 values. This linear relationship was taken in consideration by plotting HR-workload combinations calculated by Karvonen heart rate reserve method. (Practical Math for Health Fitness Professionals, 1996).

Statistical Analysis

The statistical analysis were descriptive statistics (Mean and standard deviation), 6 sigma scale and chi-square using SPSS.

Findings

Table 3: Descriptive Statistics of Physical data of the subjects (High Altitude Kashmiri Male Youth)

Age (Yrs)*	Weight(Kg)*	Height(cm)*
18.75±1.01	54.53±6.88	171.97±6.02

N=243 * the numbers are expressed as mean±SD

Table 4: Descriptive Statistics of Selected Aerobic Fitness Variables of High Altitude Kashmiri Male Youth

S. No.	Variables	Mean	SD
1	VO2 max.*	53.20	05.11
2	HRrest	63.25	10.10
3	ExHR2Min	144.95	09.22
4	ExHR4Min	176.67	10.86
5	ExHR6Min	197.47	06.65
6	RcvyHR1Min	156.15	10.85
7	RcvyHR2Min	135.14	10.13
8	RcvyHR3Min	117.70	10.42

N=242, * VO2max is expressed as milliliters of oxygen per kilogram of body weight per minute (ml/kg/min),Heart Rate is expressed as beats per minute (bts/min)

Table 5: Grading of Maximal Oxygen Uptake (VO2 max.) in Six Sigma of Habitat of High Altitude Kashmiri Male Youth

Grade	Minimum Value	Maximum Value	Frequency Distribution	Chi-square
Excellent	62.40	68.53	2	44.48*
Good	56.26	62.39	75	14.61*
Average	50.13	56.25	88	32.4*
Poor	44.00	50.12	72	15.89*
Worst	37.87	39.99	5	38.91*

N=243 *significant at .05 level

According to table-6, a subject score VO2 max between 62.40 and 68.53 will be considered as Excellent, a subject score VO2 max between 56.26 and 62.39 will be considered as above average, a subject score VO2 max between 50.13 and 56.25 will be considered as Average, a subject score VO2 max between 44.00 and 50.12 will be considered as Below average and a subject score VO2 max between 37.87 and 39.99 will be considered as poor. The chi square demonstrated asymmetric distribution among the grades supporting normal distribution. Highest frequency was observed at average grade descending towards both ends. The findings have been graphically illustrated in figure-2.

Table 6: Grading of Resting Heart Rate (RHrest) in six sigma of Habitat of High Altitude Kashmiri Male Youth

Grade	Minimum Value	Maximum Value	Frequency Distribution	X^2
Excellent	33	45	6	37.14*
Good	46	57	68	7.93*
Average	58	69	114	88.91*
Poor	70	81	46	0.11*
Worst	82	94	9	32.07*

N=242

According to table-6, a subject score RHrest between 33 bts/min and 45 bts/min will be considered as Excellent, a subject score RHrest between 46 bts/min and 57 bts/min will be considered as good, a subject score RHrest between 58 and 69 will be considered as Average, a subject score RHrest between 70 bts/min and 81 bts/min will be considered as Bad and a subject score RHrest between 82 bts/min and 94 bts/min will be considered as poor. The chi square (X2) demonstrated asymmetric distribution among the grades. Highest frequency was observed at average grade followed by good, poor, worst and excellent. The findings have been graphically illustrated in figure-3

Table 7: Grading of Exercise Heart Rate at Two Minutes (ExHR2Min)) in Six Sigma of Habitat of High Altitude Kashmiri Male Youth

Grade	Minimum Value	Maximum Value	Frequency Distribution	Chi-square
Excellent	117	127	7	35.41*
Good	128	139	63	4.40*
Average	140	149	108	73.39*
Poor	150	161	52	0.26*
Worst	162	172	12	27.37*

N=242

According to table-7, a subject score ExRH2Min between 117 bts/min and 127 bts/min will be considered as Excellent, a subject score ExRH2Min between 128 bts/min and 139 bts/min will be considered as good, a subject score ExRH2Min t between 140 and 149 will be considered as Average, a subject score ExRH2Min t between 150 bts/min and 161 bts/min will be considered as Poor and a subject score ExRH2Min between 162 bts/min and 172 bts/min will be considered as Worst. The chi square (X2) demonstrated asymmetric distribution among the grades. Highest frequency was observed at average grade followed by good, poor, worst and excellent. The findings have been graphically illustrated in figure-4

Table 8: Grading of Exercise Heart Rate at Four Minutes (ExHR4Min)) in Six Sigma of Habitat of High Altitude Kashmiri Male Youth

Grade	Minimum Value	Maximum Value	Frequency Distribution	Chi-square
Excellent	142	154	1	46.42*
Good	155	167	92	39.27*
Average	168	180	73	12.50*
Poor	181	193	68	7.93*
Worst	194	207	8	33.72*

N=242

According to table-8, a subject score ExRH4Min between 142 bts/min and 154 bts/min will be considered as Excellent, a subject score ExRH4Min between 155 bts/min and 167 bts/min will be considered as good, a subject score ExRH4Min t between 168 and 180 will be considered as Average, a subject score ExRH4Min t between 181 bts/min and 193 bts/min will be considered as Poor and a subject score ExRH4Min between 194 bts/min and 207 bts/min will be considered as Worst. The chi square (X2) demonstrated asymmetric distribution among the grades. Highest frequency was observed at good grade followed average, poor, worst and excellent. The findings have been graphically illustrated in figure-5.

Table 9: Grading of Exercise Heart Rate at Six Minutes (ExHR6Min)) in Six Sigma of Habitat of High Altitude Kashmiri Male Youth

Grade	Minimum Value	Maximum Value	Frequency Distribution	Chi-square
Excellent	177	184	7	35.41*
Good	185	192	63	4.40*
Average	193	200	108	73.39*
Poor	201	208	52	0.26*
Worst	209	217	12	27.37*

N=242

According to table-9, a subject score ExRH6Min between 177 bts/min and 184 bts/min will be considered as Excellent, a subject score ExRH6Min between 185 bts/min and 192 bts/min will be considered as good, a subject score ExRH6Min t between 193 and 200 will be considered as Average, a subject score ExRH6Min t between 201 bts/min and 208 bts/min will be considered as Poor and a subject score ExRH6Min between 209 bts/min and 217 bts/min will be considered as Worst. The chi square (X2) demonstrated asymmetric distribution among the grades. Highest frequency was observed at average grade, followed by good, poor, worst and excellent. The findings have been graphically illustrated in figure-6.

Table 10: Grading of Resting Heart Rate at One Minute (RcvyHR1Min)) in Six Sigma of Habitat of High Altitude Kashmiri Male Youth

Grade	Minimum Value	Maximum Value	Frequency Distribution	Chi-square
Excellent	123	135	13	25.89*
Good	136	148	42	0.84*
Average	149	161	113	86.22*
Poor	162	174	72	11.50*
Worst	175	188	2	44.48*

N=242

According to table-10, a subject score RcvyHR1Min between 123 bts/min and 135 bts/min will be considered as Excellent, a subject score RcvyHR1Min between 136 bts/min and 148 bts/min will be considered as good, a subject score RcvyHR1Min between 149 and 161 will be considered as Average, a subject score RcvyHR1Min between 162 bts/min and 174 bts/min will be considered as Poor and a subject score RcvyHR1Min between 175 bts/min and 188 bts/min will be considered as Worst. The chi square (X2) demonstrated asymmetric distribution among the grades. Highest frequency was observed at average grade, followed by poor, good, excellent and worst. The findings have been graphically illustrated in figure-7.

Table 11: Grading of Resting Heart Rate at Two Minutes (RcvyHR2Min)) in Six Sigma of Habitat of High Altitude Kashmiri Male Youth

Grade	Minimum Value	Maximum Value	Frequency Distribution	Chi-square
Excellent	104	115	11	28.9*
Good	116	128	52	0.26*
Average	129	140	104	63.87*
Poor	141	152	72	11.50*
Worst	153	165	3	42.58*

N=242

According to table-11, a subject score RcvyHR2Min between 104 bts/min and 115 bts/min will be considered as Excellent, a subject score RcvyHR2Min between 116 bts/min and 128 bts/min will be considered as good, a subject score RcvyHR2Min between 129 and 140 will be considered as Average, a subject score RcvyHR2Min between 141 bts/min and 152 bts/min will be considered as Poor and a subject score RcvyHR2Min between 153 bts/min and 165 bts/min will be considered as Worst. The chi square (X2) demonstrated asymmetric distribution among the grades. Highest frequency was observed at average grade, followed by poor, good, excellent and worst. The findings have been graphically illustrated in figure-8.

Table 12: Grading of Resting Heart Rate at Third Minute (RcvyHR3Min)) in Six Sigma of Habitat of High Altitude Kashmiri Male Youth

Grade	Minimum Value	Maximum Value		Frequency Distribution	Chi-square
Excellent	86	97		11	28.9*
Good	98	110		57	1.5*
Average	111	122		109	75.87*
Poor	123	135		55	0.9*
Worst	136	148		10	30.46*

N=242

According to table-12, a subject score RcvyHR3Min between 86 bts/min and 97 bts/min will be considered as Excellent, a subject score RcvyHR3Min between 98 bts/min and 110 bts/min will be considered as good, a subject score RcvyHR3Min between 111 and 122 will be considered as Average, a subject score RcvyHR3Min between 123 bts/min and 135 bts/min will be considered as Poor and a subject score RcvyHR3Min between 136 bts/min and 148 bts/min will be considered as Worst. The chi square (X2) demonstrated asymmetric distribution among the grades. Highest frequency was observed at average grade, followed by good, poor, excellent and worst. The findings have been graphically illustrated in figure-9.

Figures showing Plotting of Different Physiological Variable frequencies in Selected Grades

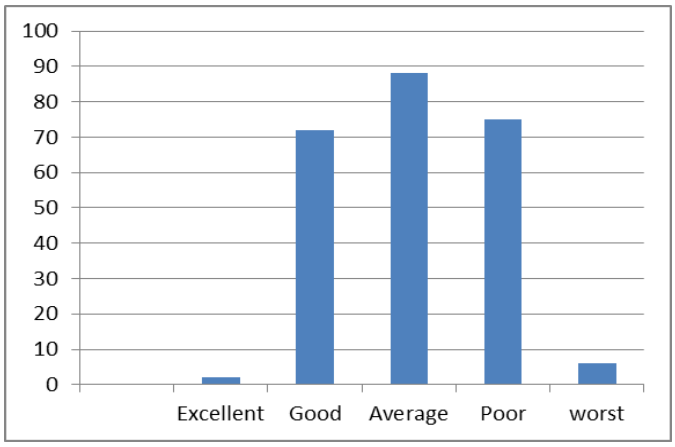


Fig 2: Plotting of VO2 max.

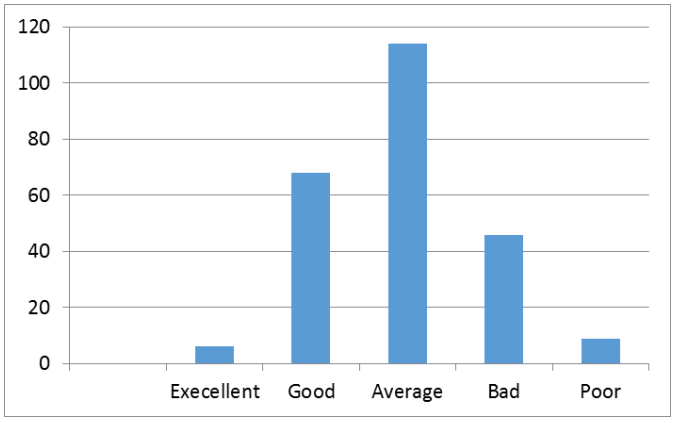


Fig 3: Plotting of HR rest

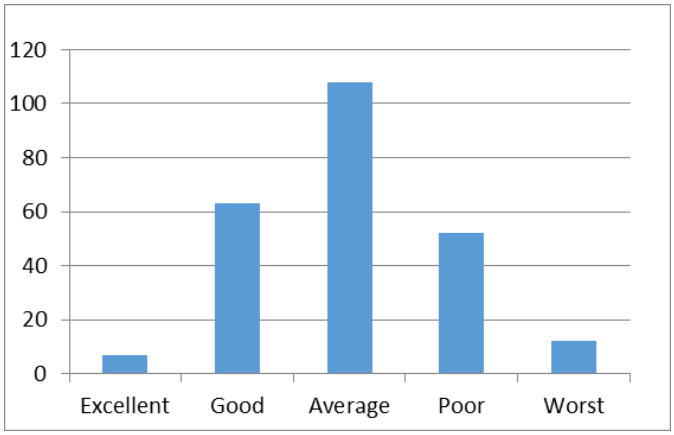


Fig 4: ExHR2min

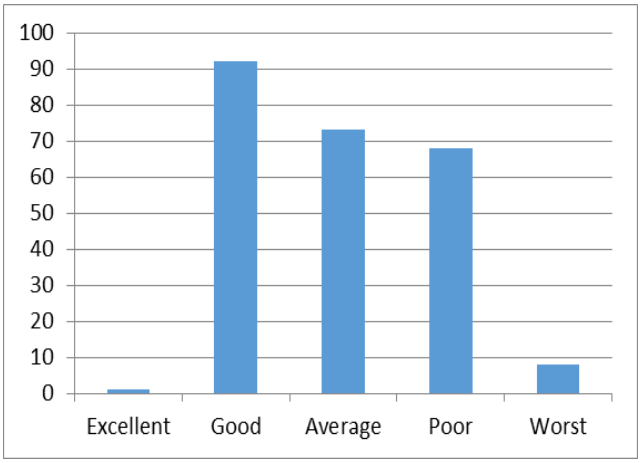


Fig 5: ExHR4min

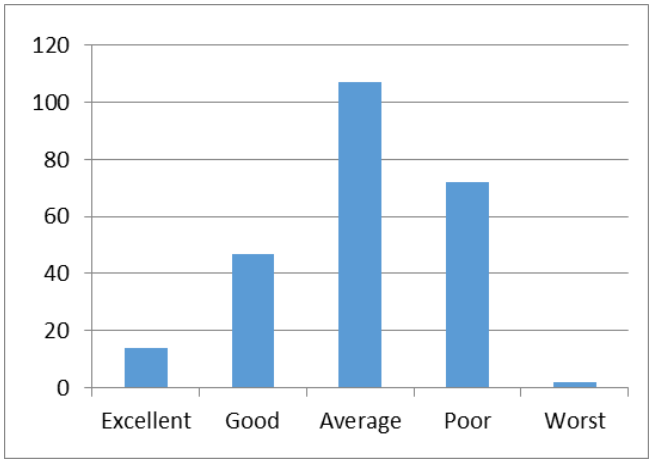


Fig 7: RcvyHR1min

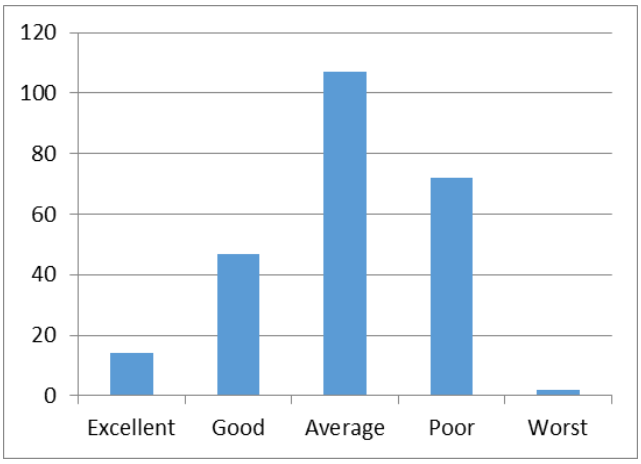


Fig 6: ExHR6min

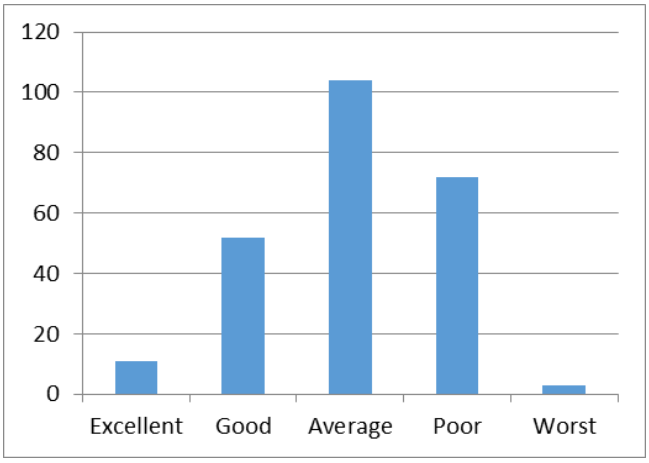


Fig 8: RcvyHR2min

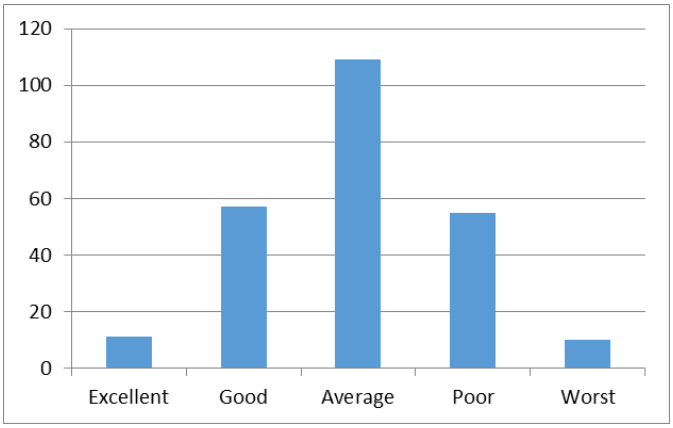


Fig 9: RcvyHR3min

Table 13: Ranking of Selected Aerobic fitness Variables of High Fitness Group of Kashmiri Male Youth (Habitat of High Altitude)

Subject S. No	VO2 max.	HRrest	ExHR 2min	ExHR 4min	ExHR 6min	RcvryHR 1min	RcvyHR 2min	RcvyHR 3min
1	1	122	9	1	64	76	59	43
2	2	109	50	3	29	41	41	67
3	3	190	123	5	3	59	5	33
4	3	19	123	5	12	111	41	25
5	3	171	71	5	29	27	6	67
6	3	13	40	10	38	78	76	33
7	3	1	196	10	134	76	41	6
8	3	74	88	5	48	59	76	67
9	3	19	113	10	160	128	111	33
10	10	50	113	3	210	76	128	54
11	11	50	5	12	64	5	6	30
12	12	109	37	10	182	111	111	99

13	13	57	128	12	173	1	1	11
14	13	46	113	12	122	59	146	73
15	15	19	59	12	210	5	18	64
16	15	122	37	12	64	41	27	90
17	17	36	9	18	182	59	153	178
18	18	22	50	18	129	100	111	73
19	19	6	71	21	231	153	164	90
20	19	131	30	21	48	41	27	73
21	19	95	128	21	20	22	18	43
22	19	27	128	21	173	128	237	113
23	19	34	18	18	108	111	27	25
24	19	9	77	21	210	141	146	73
25	19	57	77	21	229	78	59	30
26	26	86	22	18	82	76	51	113
27	27	74	99	21	210	59	111	99
28	28	50	144	26	182	93	141	73
29	29	50	113	26	108	100	111	54
30	29	74	88	26	210	76	111	130
31	29	74	30	26	173	59	41	30
32	29	27	77	26	160	111	27	25
33	29	34	144	26	160	41	41	54
34	29	34	117	26	160	128	111	73
35	29	13	5	26	38	40	100	54
36	29	50	88	26	173	119	100	33
37	37	34	176	34	218	128	93	73
38	37	74	99	34	182	162	59	67
39	37	86	59	34	82	128	76	153
40	37	57	77	34	93	153	153	153

Table 14: Ranking of Selected Aerobic fitness Variables of Low Fitness Group of Kashmiri Male Youth (Habitat of High Altitude)

Subject S. No	VO2 max.	HRrest	ExHR 2min	ExHR 4min	ExHR 6min	RcvryHR 1min	RcvyHR 2min	RcvyHR 3min
242	242	210	240	242	231	151	194	231
241	237	210	40	235	210	141	206	214
240	237	109	196	235	182	164	201	206
239	237	190	99	242	231	153	231	225
238	237	210	236	203	108	189	226	227
237	237	131	215	239	182	201	214	178
236	236	210	241	239	140	164	228	214
235	235	131	144	205	93	59	146	198
234	233	159	113	230	173	206	164	178
233	233	231	50	175	62	218	233	237
232	229	190	37	237	131	59	105	142
231	229	159	217	237	214	212	236	238
230	229	236	169	225	214	186	197	227
229	229	131	176	225	108	153	206	227
228	227	159	176	230	147	197	201	206
227	227	224	118	230	234	118	194	227
226	221	190	169	225	182	206	212	178
225	221	122	236	225	210	197	238	238
224	221	203	144	225	173	164	242	230
223	221	240	176	221	198	155	127	178
222	221	231	97	221	131	197	238	241
221	221	224	144	225	160	164	226	233
220	219	238	24	221	173	119	216	178
219	219	227	196	205	210	240	197	198
218	217	190	128	210	214	141	100	156
217	217	220	176	210	182	76	179	206
216	216	218	234	210	231	123	123	113
215	215	227	113	210	198	237	164	199
214	214	227	207	189	131	141	164	130
213	211	231	234	205	173	201	206	231
212	211	220	242	205	38	76	146	176
211	211	231	236	205	93	201	233	198
210	210	220	234	189	210	27	119	156
209	202	239	113	205	131	128	111	153
208	202	227	176	205	64	138	214	198
207	202	220	234	203	147	216	233	137

206	202	231	234	203	93	242	201	220
205	202	241	221	205	64	76	76	90
204	202	220	176	203	182	193	151	178
203	202	227	196	203	197	201	226	237

Conclusion

A grade scale with grades as Excellent, Good, Average, Poor and worst has been developed for Kashmiri youth in reference to selected variables namely Resting Heart Rate (RHrest), Heart Rate at two minutes of step testing with cadence 15 steps/min (HR2min) , Heart Rate at four minutes of step testing with cadence 20 steps/min (HR4min), Heart Rate at six minutes of step testing with cadence 30 steps/min (HR6min), recovery heart rate at one minutes of rest (HRrcvy1min), recovery heart rate at two minutes of rest (HRrcvy2min), recovery heart rate at third minute of rest (HRrcvy3min) and maximal oxygen consumption (VO2max.). The determined high fitness group and low fitness group has been well supported by the above mentioned physiological (fitness) variables.

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