Original Research Article

Cardiovascular response to exercise in young healthy medical students

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Abstract

Background: With the advent of remote culture, we are becoming physically inactive and becoming prone to cardiovascular disease. Exercise is often used to evaluate the function of cardiovascular system.

Objectives: The study aimed to assess the cardiovascular response to exercise in young healthy medical students.

Materials and methods: On the basis of physical activity performed subject were categorized into 3 category light, moderate, vigorous exerciser. Cardiovascular response was assessed by using treadmill exercise as per bruce protocol. Pulse rate, B.P., E.C.G were recorded before and after undergoing the treadmill test.

Results: Data were analyzed using the paired t-test. The resting heart rate and systolic blood pressure was significantly lower in vigorous group of exerciser. During exercise heart rate, B.P. increased significantly during peak of exercise and recovery occurs within 6 min but recovery was faster in vigorous group of exerciser.

Conclusion: It was observed in the study that vigorous exerciser had better parasympathetic tone than moderate and light exerciser.

Key words

Treadmill exercise test, Heart rate, Systolic blood pressure, Diastolic blood pressure, ECG.

Introduction

When most people think of physical fitness things like running, teamwork, yoga, pilates and power walking comes to the mind. Physical exercise is a manual activity that develops or maintains physical fitness and overall health. It is often practiced to strengthen cardiovascular

system. Physical inactivity deprives of benefits of exercise.

Exercise is a stressful condition which produces marked changes in body function specially cardiovascular, respiratory and nervous activities. It has been a means of finding out the physical capabilities and physiological responses of an individual [1]. Dynamic exercise is often used to evaluate the backlog functions of cardiovascular system [2], and the treadmill test is a commonly used dynamic exercise protocol.

Materials and methods

A group of 30 healthy students (18-19 years) took part in the present study conducted at Dept. of Physiology, Baroda Medical College, Vadodara. Detailed procedure was explained to the participants and informed written consent was collected from the participants. Height and weight of each participant were measured. In order to exclude the condition that might affect the result following criteria was required. No history of hypertension, diabetes mellitus, heart failure, coronary artery disease, heart failure, not suffering from respiratory disease or any acute or chronic disease and not taking any drug that could affect the result.

All the subjects were grouped into 3 category light, moderate, vigorous depending on intensity of exercise according to British Heart Foundation Fact file (September 2008) as per **Table – 1**.

Table - 1: British Heart Foundation Fact file (September 2008).

Intensity of exercise	Type of exercise	Examples
Light	Aerobic	Normal walking, walking downstairs, bowling, general housework: vacuum cleaning carpets, mopping floors
Moderate	Aerobic	Brisk walking (3- 4.5 mph), lawn mowing, cycling (5-9 mph), low impact aerobic dance, social dancing, swimming
Vigorous	Aerobic for some, anaerobic for others	Fast walking >=5mph; cycling >=10mph; high impact aerobics, playing competitive sports, circuit weight training, heavy digging for others or yard work; heavy housework, moving furniture

Anthropometric variables like height and weight were obtained and BMI and BSA were calculated. Height was measured to nearest of 0.1 cm and weight was measured to nearest of 0.1 kg with minimum of clothes and no shoes.

BMI was calculated by formula = weight (kg)/ height (m^2)

BSA was calculated by formula = $0.0001*71.84$ (weight in kg)$^{0.425}$*(height in cm)$^{0.725}$

Treadmill test

Cardiovascular response was assessed by using a computerized treadmill. The treadmill was programmed to increase in slope and speed every 3 minutes in seven stages according to bruce protocol [3].

Subjects were instructed to avoid strenuous exercise a day prior to tests. They were asked to wear light clothes and to have breakfast about 1 hour before the test. The procedure was conducted in the morning. The subjects were demonstrated for treadmill test before actual performance. The temperature of room was around $30^0 \pm 2^0$C. Resuscitative measures like appliances for O_2 administration, Emergency drugs, Ambu bags, Defibrillator etc. were kept ready. Participants were asked to lie down in supine position for at least 10 min before exercise.

Resting heart rate, SBP and DBP were recorded. For recording BP manual mercury sphygmomanometer was used. After skin

preparation disposable electrodes were attached at proper position for continuous monitoring of ECG. Treadmill exercise was explained and demonstrated to participants regarding most comfortable gait and safety devices. They were instructed not to tightly hold the side rails to avoid isometric element. Heart rate, SBP and DBP were measured at 1 minute (R1), 3 minute (R3) and 6 minute (R6) of recovery manually by mercury manometer. End point of the test was achievement of 85% of target heart rate (220 - age in years = 200/min) [1] or the test was planned.

Results

Statistical analysis was done using paired t-test at level of significance $p<0.001$. Age wise distribution was as per **Table – 2**. Comparison of heart rate during rest and recovery at 1 min (R1), 3 min (R3) and 6 min (R6) according to grading of exercise was as per **Table – 3**. There was significantly lower resting heart rate in vigorous group as compared to moderate and light exerciser. Heart rate increased gradually till target heart rate achieved and there was statistically significant decrease in heart rate during 6 min of recovery and heart rate recovery was faster in vigorous group than light and moderate group of exerciser.

Comparison of systolic blood pressure in 3 group of exerciser was as per **Table – 4**. Comparison of diastolic blood pressure in 3 group of exerciser was as per **Table – 5**. Resting S.B.P was significantly lower in vigorous group of exerciser. Rose significantly during exercise and recovery was faster in vigorous group of exerciser. D.B.P. had significantly no correlation.

Table - 2: Age wise distribution of 3 groups.

Groups	Sample (n=30)	Age (Years)
Light	9	18 ± 0.8 (17 - 19)
Moderate	11	18 ± 0.5 (18 - 19)
Vigorous	10	18 ± 0.8 (17 - 19)

Table - 3: Comparison of heart rate during rest and recovery at 1 min (R1), 3 min (R3) and 6 min (R6) according to grading of exercise.

Exercise groups	Heart Rate {Mean + SD (Range Significance)}			
	At rest	R1	R3	R6
Light	92 ± 6 (78 - 98)	134 ± 10 (119 - 150)	122 ± 9 (105 - 135)	110 ± 10 (92 - 125)
Moderate	87 ± 4 (82 - 94)	137 ± 9 (125 - 153)	120 ± 5 (113 - 131)	106 ± 8 (97 - 126)
Vigorous	85 ± 4 (80 - 94)	125 ± 7 (114 - 134)	109 ± 6 (100 - 116)	105 ± 6 (94 - 113)

Table - 4: Comparison of systolic blood pressure in 3 group of exerciser.

Exercise groups	Systolic blood pressure {Mean + SD (Range Significance)}			
	At rest	R1	R3	R6
Light	121 ± 6 (110 - 132)	139 ± 10 (126 - 160)	132 ± 9 (120 - 150)	124 ± 5 (120 - 132)
Moderate	119 ± 5 (110 - 124)	140 ± 5 (130 - 152)	131 ± 3 (130 - 138)	122 ± 6 (110 - 130)
Vigorous	116 ± 5 (110 - 122)	143 ± 6 (130 - 150)	127 ± 6 (120 - 136)	118 ± 6 (110 - 130)

Discussion

Resting heart rate was observed lower in vigorous exerciser as compared to moderate and light exerciser. Studies have suggested that well trained or physically well-fit (aerobically) individuals present with a lower resting heart rate, suggestive of higher parasympathetic activity and lower sympathetic activity [4]. During exercise the heart rate progressively

increases owing to an increase in intensity of sympathetic nervous system, increased venous return and withdrawal of parasympathetic inhibition.

Table - 5: Comparison of diastolic blood pressure in 3 group of exerciser.

Exercise groups	Diastolic blood pressure {Mean + SD (Range Significance)}			
	At rest	R1	R3	R6
Light	82 ± 4 (80 - 90)	80 ± 6 (70 - 90)	82 ± 5 (74 - 90)	83 ± 5 (80 - 90)
Moderate	85 ± 5 (80 - 90)	82 ± 6 (74 - 90)	84 ± 5 (78 - 90)	84 ± 5 (80 - 90)
Vigorous	83 ± 6 (70 - 90)	82 ± 8 (70 - 90)	83 ± 6 (70 - 90)	82 ± 6 (70 - 90)

Similar findings were reported by many workers, Lars Hermansen, et al. [5]; Shephard Roy, et al. [6]; Kotchen Theodore, et al. [7]; Wolthuis Roger, et al. [8].

In vigorous exerciser heart rate was significantly lower than moderate and light exerciser at 1 min, 3 min and 6 min of recovery. A faster heart rate recovery may therefore be a function of increase in vagal activity or reduction in sympathetic activity.

In the present study systolic blood pressure increased to mean value of 141±7.31 mmHg from resting mean value of 118±7.31 mmHg at 1 min of recovery. Thereafter, a gradual decrease was observed at 3 min and reached to resting value at 6 min of recovery.

In a similar study reported by Guo Y, et al. [2]; systolic blood pressure increased gradually until peak exercise was achieved while the mean systolic blood pressure at maximal exercise increased by 38.6 percent compared to resting level in boys and 34.4% in girls respectively.

The study reported by Susma pande, et al. [9] in 2012, showed systolic blood pressure rose by 53 mm of mercury during exercise from resting value, which is comparable to findings of Becker, et al. [10] and Ahmed, et al. [11].

Similar increase in systolic blood pressure during exercise were reported by Wolthuis Roger, et al. [8]; Sharma Rajesh, et al. [12]; Monica de morasses [13] also reported similar increase in systolic blood pressure during exercise.

In present study systolic pressure returns almost to normal value at the end of 6 minutes minute comparable to Becker, et al. (2007) [10] similar to study done by Guo Y, et al. (2003) [2] and Sushma Pande (2012) [9].

In present study, among all 3 groups of exercisers, light exerciser were having higher resting SBP with significantly lesser gradual decline from resting level at 3 min and 6 min of recovery. A slower decline of SBP in light exerciser may therefore be a function of decrease in vagal activity or increase sympathetic activity.

In the present study, there was no significant change in diastolic blood pressure during exercise in various groups. This result is consistent with the work done by Fraser Robert, et al. [14]; Biswas Dalia, et al. [15] and Bhave, et al. [16].

Conclusion

Comparing the three groups of exercisers, Vigorous exerciser had lower resting systolic blood pressure than moderate and light exerciser. Systolic blood pressure was higher in light exerciser among all 3 groups at 3 min, 6 min of recovery and recovery occur slowly in light exerciser as compared to moderate and light exerciser. It suggests that vigorous exerciser had better parasympathetic tone than moderate and light exerciser. There was no significant change in diastolic blood pressure.

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