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Research Article

Effect of Aerobic Exercise on Cardiovascular Parameters in Untrained and Trained Subjects

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Abstract: Physical fitness is required not only by athletes for better performance but also by non-athletes in order to maintain good physical and mental health. The aim of the study was to assess the role of aerobic exercise on cardiovascular parameters among untrained and trained subjects. The study was conducted in the Department of Physiology, Dr. S.N. Medical College, Jodhpur after getting the ethical approval. Written informed consent was obtained from all the subjects included. A total of 200 male subjects were included. They were further divided in two groups. Group I included 100 randomly selected untrained male subjects (medical students) at the beginning of their training period. Group II included the same 100 healthy medical students, as in group I, but after their training period of 3 months duration and Group III included 100 randomly selected male trained athletes participating in city/district/state competition. The cardiovascular parameters measured were pulse rate (PR), systolic blood pressure (SBP), diastolic blood pressure (DBP), pulse pressure, mean arterial pressure (MAP), before and after training. Values obtained were compared with data obtained from athletes. Results were presented as Mean ± SD. For statistical analysis students –t test was used. The untrained group showed a highly significant ($p<0.0001$) improvement in resting heart rate, mean arterial pressure (MAP), resting systolic blood pressure, resting diastolic blood pressure, pulse pressure and post exercise fluctuation in all these parameters showed improvement except pulse pressure in untrained group after 3 months of aerobic exercise. Trained groups resting and post exercise (cardiovascular parameters) value were significantly less than untrained. A significance level of $p< 0.05$ was chosen. Thus, our finding showed that regular practice of aerobic exercise for three months improves cardiovascular functions by decreasing sympathetic activity or by increasing vagal tone in medical students.
Keywords: Aerobic exercise, Medical education group, Cardiovascular parameters.

INTRODUCTION

Aerobic exercise is physical exercise of relatively low intensity that primarily depending on the aerobic energy-generating process [1]. Aerobic denotes "with oxygen" referring to the use of oxygen in order to adequately meet energy demands during exercise through aerobic metabolism [2]. Aerobic exercise improves oxygen consumption by the body. Cooper KH, an exercise physiologist and Col. Potts P, a physical therapist, both in the United States Air Force developed the term and the specific exercise methods [3].

Regular physical activity is an essential component of a healthy lifestyle that helps to keep fitness of the body [4]. Probably because of heavy academic demands of medical college, most of medical students lead a physically inactive life. It may cause medical students exhausted or may have no time to exercise [5].

Scientific and technological advances have almost completely eliminated the necessity for physical exertion in daily life that has been especially true in the past few generations [6].

On the other hand athletes lead a physically active life as their academic curriculum itself includes daily physical exercise and outdoor games [5]. It has been documented physical inactivity as a major health problem [7] and regular exercise is important for health and well being [8]. Physical inactivity is contributing factor in several chronic diseases and conditions [9, 10].

Physiology of Exercise offers the student an opportunity to observe the effect of training and helps

to evaluate the Cardio- vascular system. This has created a great enthusiasm in our mind to undergo this study. The present study was undertaken to investigate effect of aerobic exercise on Cardio-vascular parameters in trained and untrained exercise performers.

METHODOLOGY

Design of the study

The present study was conducted to assess and compare important cardiopulmonary fitness parameters between students of Medical College and Athletes of Sports Authority of India.

In the present study, none of the ME students gave history of regular physical exercise in the past 9 months where as all the athletes gave history of regular exercise for about 2- 4 hours/day for six days a week.

Exclusion Criteria

Subjects suffering from asthma, chronic bronchitis, tuberculosis, muscular, neurological disorder and cardiovascular disease were excluded from the study.

At the onset of study written informed consent was obtained from the participating subjects after explaining the purpose of the study and outcome.

The present study was carried out in the Department of Physiology, Dr. S. N. Medical College Jodhpur on 200 volunteers in the age group 18-26, on male subjects. All the subjects were then divided into three groups.

Group I: It included 100 randomly selected untrained male subjects (medical students) at the beginning of their training period.

Group II: It included the same 100 healthy medical students, as in group I, but after their training period of 3months duration.

Group III: 100 randomly selected male Athletes participating in city/district/state competition constituted the trained group.

Trained group (Athletes) performed daily, sports activity and untrained group performed aerobic exercise for one hour under the guidance of qualified instructors for three months.

All the subjects in both the group were subjected to various anthropometric measurements and cardiovascular parameters were recorded (BP by mercury sphygmomanometer and pulse by radial method) prior to exercise and immediately after exercise. After completion of training, in untrained group the same parameters were recorded again. Based on observations obtained before and after training, statistical analysis was done and a comparison was done between trained and untrained group (after 3 months of aerobic exercise) to assess, impact of aerobic exercise on untrained subjects (medical students).

RESULTS

The present study was conducted in three groups. Group I: (n=100) randomly selected untrained male subjects (medical students) at the beginning of their training period and Group II included the same 100 healthy medical students, as in group I, but after their training period of 3months duration. Group III (n=100) randomly selected male Athletes.

Table 1 show the comparison of mean values of various cardiovascular parameters in resting and after three months of physical activity in untrained subjects and obtained values are compared with the data obtained from the trained subjects.

Results were presented as Mean ± SD. For statistical analysis students –t test was used. A significance level of $p< 0.05$ was chosen.

Table 1: Comparison of cardiovascular parameters in untrained and trained subjects

Parameters		G-I (n=100) Initial	G-II (n=100) After 3 months	G-III (n=100)	p value		
					GI & GII	GI & GIII	GII & GIII
PR /HR (Beats/min)	Pre	85.74±9.02	76.03±8.00	68.9±5.52	<0.0001	<0.0001	<0.0001
	Post	117.32±9.57	105.06±7.51	87.76±6.54	<0.0001	<0.0001	<0.0001
SBP (mmHg)	Pre	132.26±10.36	122.75±8.16	118.75±8.16	<0.0001	<0.0001	0.0006
	Post	142.24±10.75	132.76±7.20	125.45±8.43	<0.0001	<0.0001	<0.0001
DBP (mmHg)	Pre	82.94±8.20	76.51±7.33	69.39±5.82	<0.0001	<0.0001	<0.0001
	Post	79.61±11.22	71.04±7.26	63.05±5.55	<0.0001	<0.0001	<0.0001
PP (mmHg)	Pre	49.32±9.30	46.24±11.01	49.36±10.10	0.02	0.97	0.03
	Post	62.63±10.55	61.72±9.97	62.4±9.84	0.47	0.87	0.62
MAP (mmHg)	Pre	99.38±7.84	91.92±5.57	85.84±4.70	<0.0001	<0.0001	<0.0001
	post	100.48±9.40	91.61±5.50	83.85±4.76	<0.0001	<0.0001	<0.0001

Note: All values are showed as Mean + SD ; p value >0.05 (NS) *, p<0.05 (S)**,p<0.01 (HS)*** ; Abbreviation: PR- pulse rate, SBP- Systolic Blood Pressure, DBP- Diastolic Blood Pressure, PP- Pulse Pressure (SBP-DBP), MAP- Mean arterial Pressure (DBP+1/3PP)

DISCUSSION

Inadequate physical activity and low levels of fitness in adults contribute to the development of obesity, type-2 diabetes mellitus, hypertension, metabolic syndrome, hypercholesterolemia, myocardial infarction, osteoporotic fractures and depression. Heavy academic workloads in medical college make it difficult for medical students to maintain a regular exercise program. So, the present study was undertaken to investigate effect of aerobic exercise on Cardio-vascular parameters in trained and untrained exercise performers.

In our study the all the resting cardiovascular parameters were significantly ($p<0.0001$) less in case of trained subjects as compared to untrained subjects. Our study revealed highly significant ($p<0.0001$) decrease in resting cardiovascular parameters and post exercise fluctuation, in untrained group after 3 months of aerobic exercise except pulse pressure.

Training improves cardiovascular, pulmonary and muscular adaptations to exercise by alterations in the balance between sympathoadrenal acceleratory activity and vagally mediated deceleration, increased VO2 max, increased muscle blood flow accompanied by elevated cardiac output and increased capillerization of muscle tissue and better substrate utilization [11, 12]. These changes lead to less elevation of pulse rate during exercise and faster recovery of post exercise pulse rate in trained subjects. In our study as shown in Table 1, the rise in heart rate with exercise was more marked in untrained as compared to trained person**.** Similar to findings of present study, majority of studies have reported significant reductions in pulse rates in response to physical training **[**13-25].

The resting blood pressure of untrained subjects though falls within normal range but it was slightly towards upper limit. Our study showed that aerobic exercise has an impressive blood pressure–lowering effect ($p<0.0001$) in case of untrained after three months of aerobic exercise (Table 1). The mechanisms of physical training induced reduction in BP are related to hemodynamic, humoral and neural factors like reduction in cardiac debt, a drop in total peripheral resistance due to increase in cross sectional area of vascular beds, particularly of skeletal muscles and vasodilatation caused by low levels of norepinephrine, plasma renin activity and a reduction in sympathetic activity [26-28].

As shown in Table 1 SBP increased at peak exercise in both groups and the increase was more marked ($p<0.0001$) in medical students than in athletes and with regular aerobic execise, post exercise fluctuation, decreased in untrained group after 3 months of aerobic exercise. Exercise induced rise in systolic blood pressure reflects the normal sympathetic drive on cardiovascular system which enables the heart to pump more blood to the active tissues in the body.[22] While resting diastolic blood pressure and post exercise fluctuation decreased significantly ($p<0.0001$) in untrained group after 3 months of aerobic exercise. Trained groups resting DBP and post exercise DBP was significantly less than untrained as shown in Table 1.

The fall of DBP in moderate to severe exercise is due to decrease in peripheral resistance caused by vasodilatation, in turn caused by activation of sympathetic cholinergic nerves supplying skeletal blood vessels, metabolic products due to exercise and increased body temperature [29]. These findings of the present study are in accordance with the findings of Johncy SM *et al*. [30, 31], Choudhary S *et al*. [32] and Grassi *et al*. [33]. Several studies have reported an inverse and independent relationship between blood pressure and physical activity or fitness [34, 35].

In the present study, we found significant decrease in resting value of pulse pressure ($p<0.02$) in untrained after three months of training. In our study reduction in resting value of systolic and diastolic blood pressure was seen, leading to reduction in pulse pressure. The reduction of blood pressure indirectly indicates vasorelaxation, as regular exercise can restore the loss of endothelium-dependent vasodilation [36]. Suggesting that the optimum amount of regular exercise, should be incorporated into strategies for improving cardio-respiratory fitness and has effects that would reduce the possibility of subsequent development of cardiovascular disease. While non significant change in pulse pressure was noted after exercise as the SBP increases while the DBP falls progressively.

Aerobic exercise played an important role in decreasing the resting mean arterial blood pressure and post exercise fluctuation, in untrained group after 3 months. Trained groups resting MAP and post exercise MAP was significantly less ($p<0.0001$) than untrained (GI & II). Exercise might exert its hypotensive effects directly through hemodynamic mechanisms. A lowering of resting blood pressure must result from a decrease in CO, TPR, or both, as we found significant reduction ($p<0.0001$) in MAP at the end of our study [37-44].

Baroreceptors are located in the aorta and carotid bodies. With an increase in MAP, these receptors cause a reflex decrease in MAP through a decreased HR (and thus decreased cardiac output). The decrease in HR is mediated through an increased parasympathetic outflow and a simultaneous decrease in sympathetic outflow to the heart. This reflex control of BP is called the baroreceptor reflex. If something causes the resting BP to be elevated, the baroreceptors fire for about 24 hours in an effort to bring down the MAP.

CONCLUSION

So, it can be concluded that regular aerobic exercise improves cardiac efficiency and can be

considered an important component of lifestyle modification for prevention and treatment of high blood pressure in healthy adolescents. Practice of aerobic exercise would benefit the young population as it would prepare them in overcoming stress by modulating and optimizing sympathetic activities in stressful situations thereby immediately restoring equilibrium

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