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Comparative study of resting and post exercise pulse rates between students of medical education and physical education- a cross sectional study

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Introduction

Medical colleges in India have traditionally followed a curriculum stuffed with a large body of knowledge pertaining to basic sciences and clinical disciplines. With expanding body of knowledge, there is over-burdening of the student with content information.(1) Unfortunately, heavy academic workloads in medical school make it difficult for medical students to maintain a regular exercise program.(2) Research findings in the last three decades, have shown that physical inactivity and a negative life style has seriously threatened health and hastened the deterioration rate of human body.(3) On the other hand Physical Education (PE) is the course that encourages psychomotor learning in a play or movement exploration setting. Physical education class provides a great variety of activities and high intensity exercises for students.(4) It is well known that rigorous exercise training diminishes certain cardiovascular and hormonal responses to fixed amounts of exercise. Aerobic training is responsible for metabolic adaptations that allow more efficient adjustment of energy expenditure during exercise recovery.(5)

The response of cardiovascular system to standardized exercise is single and the best test for assessing the efficiency of the heart. This test is known as "Cardiac Efficiency Test" or "Stress Testing "or "Exercise Tolerance Test" for which several versions are available ranging from Harvard step test to Tread Mill Test.(6)

The Astrand-Ryhming Step Test (ARST) was developed as a sub maximal variation of the Harvard step test and has been shown to be valid and reliable.(7)

Hence the present study was conducted to compare Anthropometrical parameters including BMI, resting, peak exercise, 5min after exercise pulse rates and pulse rate recovery following ARST, between students of Medical Education and Physical Education.

Materials and Method

Study was conducted on 50 healthy male medical students and 50 healthy age matched male physical education students after completion of 9 months of course in the college. Sample size calculation was done by using formula $n=4\sigma^2/E^2$. It is type of cross sectional study. Study was conducted at S.N. Medical College, Bagalkot. Permission to conduct the study was obtained from the institutional ethical committee and principals of both colleges.

Inclusion Criteria:

- Healthy male students of medical and physical education.
- Aged between 18-25 years after completion of 9 months study course.

Exclusion Criteria:

Subjects with

- Cardiovascular diseases
- Respiratory diseases
- Musculoskeletal, Neuromuscular, Endocrine disorders.
- Allergic disorders.
- Alcoholism/smoking habit.
- Chronic infection /disease.
- Acute illness at the time of study.

Details of study were explained and a written consent was taken from subjects.

All the study parameters in both the groups were recorded during morning hours between 9 am to 11 am at room temperature to avoid any possible diurnal variation effect. Subjects were told to report an hour before experiment. They were asked to refrain from heavy meal or drinking coffee/tea, at least for an hour and allowed to take rest for half an hour before the experiment.

Recording of Anthropometrical Parameters: The following parameters were recorded in each subject:

1. **Height (in centimeters):** This was measured with subject standing without his shoes, nearest to 0.1centimeters.
2. **Weight (in Kilograms):** The subjects were weighed in standardized machine with minimum clothing, nearest to 0.1kilograms.
3. **Body Mass Index (Kilogram/meter^2):** This was calculated for each subject from his height and weight as BMI=weight in kg/ height in meter^2.

Astrand-Rhyming Step test (ARST):[7]

ARST for men requires subjects to step up and down on a 40 cm (16 inch) bench for 5 min at rate of 90 steps/min (22.5 cycles of stepping) or until exhaustion. The procedure of exercise test was explained to the subjects and demonstrated before hand and subjects were made to take a pre test to allay apprehension.[8]

Pulse rate was recorded by right radial pulse palpation, before, immediately from 15 seconds to 30 seconds after the step test and at 5 minutes after Astrand-Ryhming Step test. Pulse rates were recorded as Resting pulse rate (PRR), Peak Exercise pulse rate (PRE) and Pulse rate after 5 minutes of exercise (PR5) respectively. Recovery pulse rate is the pulse rate measured at a fixed period after ceasing the activity. Percent recovery pulse rate at the end of 5 min recovery was calculated by using the formula,[9]

Percent recovery pulse rate= (PRE-PR5)x 100
PRE-PRR

Statistical Analysis: Data was analyzed by following statistical methods.

1. Unpaired 't' test.
2. Chi-square test.

All the statistical operations were done through SPSS for Windows (Version 16. Chicago). P>0.05 was considered statistically not significant (NS) and P<0.05 was considered statistically significant (S). P<0.001 was considered statistically highly significant.

Results

1. **Anthropometrical parameters:** Table 1 show the comparison of anthropometrical parameters between students of medical education (ME) and physical education (P.E)

The mean age in years ±1SD of ME students was 20.2±1.4 and that of PE students was 19.6±1.7. The difference in the age between two groups was statistically not significant.

The mean height in cm±1SD of ME students was 170.1±6.0 and that of PE students was 171.7±4.9. The difference in the height between two groups was also statistically not significant.

The mean weight in kg ±1SD of PE students (68.5±6.3) was more than that of ME students (62.99±7.38) and the difference was statistically highly significant. PE students also showed statistically significant increase in mean BMI±1SD value (23.3±2.2 kg/m^2) when compared to ME students (21.80±6.0 kg/m^2).

Table 1: Comparison of Anthropometrical parameters between students of medical and physical education

Parameter	Medical Education Mean ± SD	Physical Education Mean ± SD	t value	p value	Remarks
Age(years)	20.2±1.4	19.6±1.7	1.92	0.07	NS
Height(cm)	170.1±6.0	171.7±4.9	1.51	0.13	NS
Weight(kg)	62.99±7.38	68.5±6.3	4.01	<0.001	HS
BMI(kg/m2)	21.80±6.0	23.3±2.2	3.19	0.002	S

S-significant, HS-Highly significant, NS-Not significant

2. **Pulse rate:** Pulse rates at rest, peak exercise and 5 min after ARST are shown in Table 2. All the pulse rates were lower in PE students when compared to ME students and all the differences were statistically highly significant (p<0.001)

Table 2: Comparison of pulse rates between students of medical and physical education

Pulse rate (beats/min)	Medical Education Mean ± SD	Physical Education Mean ± SD	t value	p value	Remark
PRR	77.5±5.5	73.1±4.7	4.28	<0.001	HS
PRE	147.8±10.9	131.2±6.4	9.25	<0.001	HS
PR5	98.2±10.1	80.9±5.0	10.84	<0.001	HS

HS-Highly significant

Table 3, show that the increase in pulse rate at the end of ARST over pre test was significantly lower in PE students (58.1±6.3 bpm) than ME students (70.3±12.2 bpm). The rise in pulse rate after exercise was less in PE students than ME students. Percent recovery pulse rate after 5 min of ARST was significantly higher in PE students (86.58%) than ME students (70.55%). The recovery of pulse rate was faster in PE students than ME students.

Table 3: Comparison of increase in pulse rate at the end of ARST and Percent recovery pulse rate (Percent RPR) at the end of 5 min recovery after ARST over pre - test between students of medical and physical education

Increase in pulse rate at the end of ARST over pre –test pulse rate in bpm					Percent recovery pulse rate at the end of 5 minutes recovery after ARST over pre- test pulse rate				
Medical Education (PRE-PRR)	**Physical Education (PRE-PRR)**	**t**	**P**	**Remark**	**Medical Education (Percent RPR)**	**Physical Education (Percent RPR)**	**t**	**p**	**Remark**
70.3±12.2	58.1±6.3	6.26	<.001	HS	70.55%	86.58%	9.53	<0.001	HS

HS-Highly significant

Discussion

Most of medical students lead a physically inactive life, on the other hand physical education students lead a physically active life as their academic curriculum itself includes daily physical exercise and outdoor games.

In the present study, there was no statistical difference in the age and height of the two study groups since the two groups were age and gender matched and a training period of only nine months was considered. BMI of both groups were in the normal range for adults (18.5-24.9).[10] The mean weight of PE students (68.5kg) was more than that of ME students (62.99kg) and the difference was statistically highly significant. BMI of PE students (23.3 kg/m^2) was also higher than that of ME students (21.80 kg/m^2) and this difference was also statistically significant. The findings of the present study indicate an increase in weight and BMI in physically trained subjects compared to untrained subjects. Similar observation of increase in body weight and BMI after physical training is reported by Dashar JA et al[11] among first year students of physical education after a training period of 4 months and by Khodnapur JP et al[12] among residential school children when compared to non residential school children. Contrary to this, Christon DD et al,[13] and Rimmele U et al[14] have reported no significant difference between BMI of trained men and untrained men. Patil RB et al[9] and Azad A et al[15] have reported a significant decrease in BMI among 20-30 years males and overweight students respectively following physical training. The variations in the observations of different studies can be explained by the fact that BMI is not a direct measure of body fatness and that BMI is calculated form an individual's weight, which includes both muscle and fat mass.[16] A high BMI can be because of fat mass or muscle mass.

Physical training reduces body fat mass and increases muscle mass. The studies which have shown significant decrease in BMI were conducted on older subjects or overweight subjects in whom fat mass is more. The loss of fat mass was more than gain in muscle mass leading to fall in weight & BMI values. But the present study was conducted on young males, 18-25 yrs and their fat mass is less. Physical training in these subjects caused less fat mass decrease but a more muscle mass gain leading to an increase in weight & BMI.

During the first few seconds of exercise there is a rapid heart rate increase, exclusively mediated by vagal (parasympathetic) inhibition, regardless of exercise intensity. As exercise continues, there is increasing sympathetic activity proportional to the intensity of exercise, which progressively accelerates the pulse rate. Other factors contributing elevation of pulse rate during exercise are increase in levels of serum norepinephrine, increase in venous return leading to sinus node distension, increased body temperature and acidity of blood. Immediately after exercise, a final decreasing pulse rate response is observed due to vagal reactivation and a reduction in the sympathetic stimulation with the latter contributing more effectively to the recovery of pulse rate.[9]

Resting, peak exercise, 5 min after the exercise pulse rates and increase in pulse rate at the end of 5 min after ARST were significantly low in PE students than ME students. Percent recovery pulse rate was significantly high in PE students when compared to ME students.

Similar to findings of present study, majority of studies have reported significant reductions in resting pulse rates (resting bradycardia) in response to physical training.[17,6,18,13,19] Only few studies have reported no significant reduction in pulse rate in response to physical training.[9,20]

Significant less rise in peak exercise pulse rate in trained subjects compared to sedentary subjects observed in the present study is also in agreement with reports in the studies done by Patil RB et al,[9] Alpert JS et al,[20] Almeida MB et al,[21] De AK et al,[22] and Verma Sk et al.[23]

Present study finding is also in agreement with reports of studies done by Short KR et al,[5] De AK et al,[22] Patil RB et al,[9] Verma Sk et al,[23] Almeida MB et al,[21] Buchheit M et al,[24] who have shown faster recovery of pulse rate following exercise in trained men.

Because it is easy to measure heart rate (pulse rate) behavior, it has been extensively studied under different exercise related types and conditions. Pulse rate is primarily controlled by direct activity of the autonomic nervous system, through its actions on its sympathetic

and parasympathetic branches on the sinus node autorhymicity. Studies suggest that well trained individuals present a lower resting pulse rate, suggestive of higher parasympathetic activity or lower sympathetic activity in them. Exercise induced resting bradycardia can be due to intrinsic adaptation of the sinus node. A lower pulse rate at rest can be due to other factors as a consequence of training like increase of venous return and stroke volume.[21]

Post exercise heart rate recovery is a powerful and independent predictor of cardiovascular and all cause mortality in healthy adults and in those with cardiovascular diseases.[25] Training improves cardiovascular, pulmonary and muscular adaptations to exercise by alterations in the balance between sympathoadrenal acceleratory activity and vagally mediated deceleration, increased VO_2 max, increased muscle blood flow accompanied by elevated cardiac output and increased capillarization of muscle tissue and better substrate utilization.[23,24] These changes lead to less elevation of pulse rate during exercise and faster recovery of post exercise pulse rate in trained subjects.

According to Centers for Disease Control and prevention (CDC)[26] and The American College of Sports Medicine (ACSM),[27] physical activity need not be strenuous to be beneficial. Moderate amounts of daily physical activity are recommended for people of all ages, which provide substantial benefits across a broad range of health outcomes for sedentary people. Regular physical activity is an essential part of the healthy life style and also has positive associations with academic performance. This information should prompt medical educators to promote exercise and corporate physical fitness program into medical school curriculum.

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