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Research Article

EFFICIENCY OF RECOVERY PULSE RATE AS AN INDEX OF PHYSICAL FITNESS

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ABSTRACT
Among life style modifications, regular exercise if incorporated as a routine, is known to have favourable influence on functioning of Cardio vascular system along with other organ systems as well. In the present study, an attempt has been made to compare resting cardiovascular state i.e. resting pulse rate in exercise trained and sedentary individuals of the same age group. 30 student volunteers whose main curriculum was exercise training were chosen as test group while, students whose curriculum did not include regular physical activity formed the control group. Resting heart rate was recorded, PFI was determined using Harvard step test. The results showed that there was significant decrease in resting pulse rate in test group which resulted in increased PFI. There was no significant change in control group. Exercise training improves the aerobic capacity of an individual, primarily by increasing cardio respiratory efficiency.

Keywords: *Physical Fitness Index (PFI); Harvard Step Test; Exercise Training; Resting Pulse Rate; Vagal Activity*

INTRODUCTION
Regular exercise has been known to have beneficial effects on the functioning of Cardio vascular system. It does so by expanding the reserve capacity for increasing the cardiac output.
Physical fitness is defined as ability to carry out daily tasks with vigor and alertness without undue fatigue with ample energy to enjoy leisure time pursuits to meet unusual situations and unforeseen emergencies (Khodnapur, 2012).
The present study aims to know the effect of Exercise training on Physical fitness Index.
The study was undertaken to assess the effects of Exercise training in students of physical education curriculum (CPEd) on cardiovascular system in age group of 18 – 27 years.

MATERIALS AND METHODS
30 students (15 girls and 15 boys of age group 18 to 27 yrs.) of a CPEd college formed the test group. They were chosen, as their main curriculum was Physical training of about 4 hrs per day in 2 sessions. It included sports i.e. Rhythmic activity games, Track events, Gymnastics etcfor a period of one year. Age and sex matched student volunteers whose curriculum did not include regular physical activity formed the control group.
After taking the consent, the first PFI findings were recorded before starting of exercise training and second phase recordings after 12 weeks of training. Resting heart rate was recorded before exercise because any form of physical activity can increase the same.
Harvard step is a heavily constructed wooden step consisting of a stepping platform 18 inches in height. PFI was determined by Harvard step test where the student stepped up and down at a rate of 30 times a minute, for a maximum of 5 minutes continuously unless he stops from exhaustion. The duration of his effort to the nearest second was noted.When the subject successfully completed the test, recovery time starts counting. He is made to sit quietly on a chair or lie on the cot. Beginning exactly one minute after he stops, the radial pulse was taken. Three pulse readings were taken during this recovery phase. The

readings were taken at 1 minute, 2 minutes and 3 minutes respectively from the beginning of the recovery phase.

$$\text{PFI} = \frac{\text{Duration of exercise in seconds X 100}}{\text{2 X Sum of 3 half minute recovery phase pulse counts}}$$

PFI score of less than 55 is considered as poor, 55-64 as low average, 65-79 as high average, 80-89 as good and above 90 as excellent. Keen and Sloan have correlated Harvard step test with pre exercise pulse (Keen, 1958).

RESULTS AND DISCUSSION

The Exercise training results showed that there was significant decrease in resting pulse rate in second phase reading of test group. Hence there was increase in PFI. There was no significant change in above said parameters of control group.

Table 1: Comparison of first and Second phase PFI readings in test and control groups

Group	Sex	n	Phase	
			First Mean±SD	Second Mean±SD
Test	Male	15	87.51±7.46	112.41±13.90
	Female	15	71.84±14.39	94.50±7.42
	Total	30	79.67±13.80	103.46±14.24
Control	Male	15	84.40±8.37	81.07±10.55
	Female	15	62.21±14.85	58.12±12.71
	Total	30	73.30±16.36	69.60±16.37

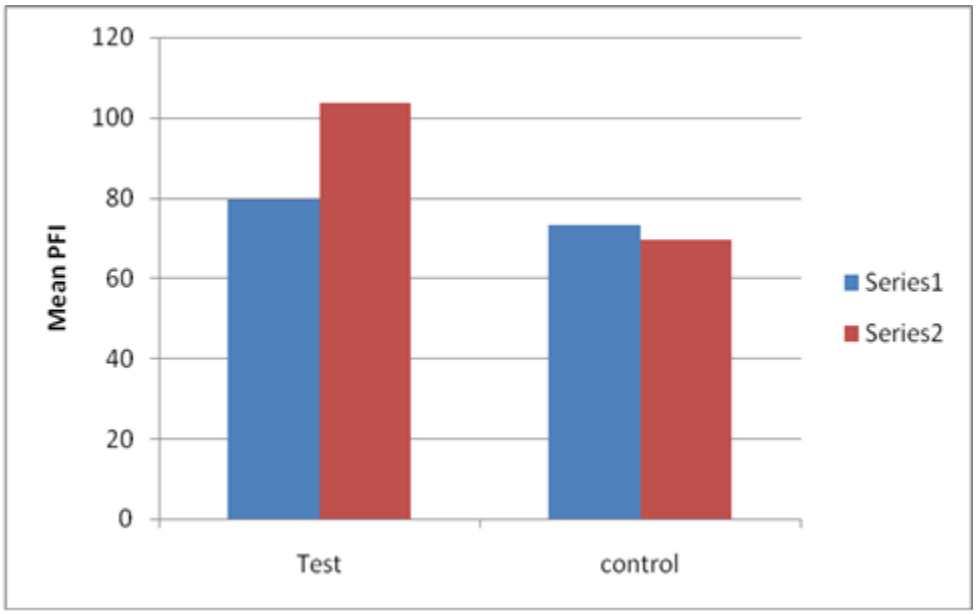

Figure 1: Comparison of first and second phase PFI readings in test and control groups

A significant increase in PFI was observed over first phase to second phase of readings in test group.

Table 2: Comparison of first and Second phase resting pulse (beats / min) readings in test and control groups

Group	Sex	n	Phase	
			First Mean±SD	Second Mean±SD
Test	Male	15	76.06±6.13	68.46±4.12
	Female	15	83.40±5.06	67.46±6.44
	Total	30	79.73±6.66	67.96±5.34
Control	Male	15	73.20±6.09	75.86±6.01
	Female	15	78.73±5.82	82.33±4.77
	Total	30	75.96±6.49	79.10±6.26

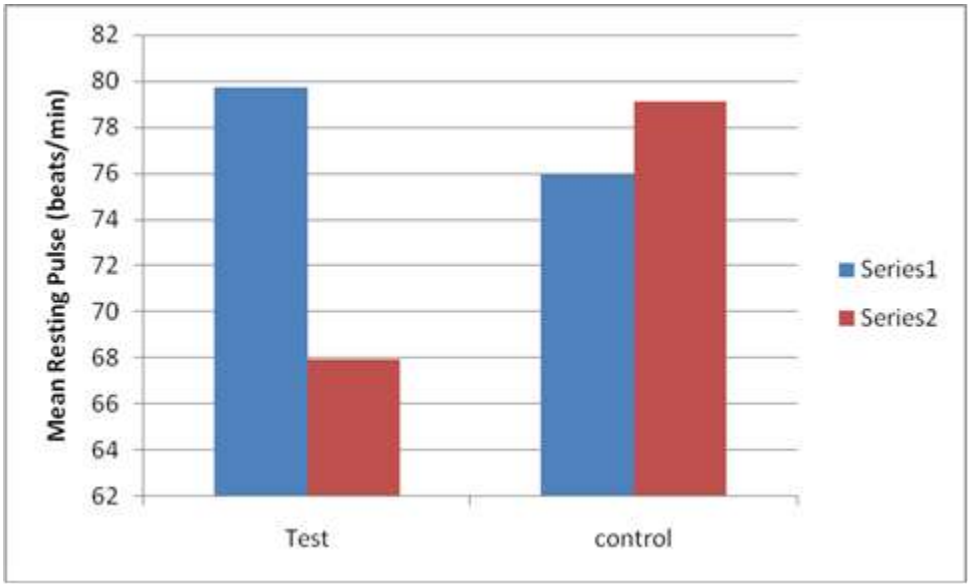

Figure 2: Comparison of first and second phase resting pulse (beats/min) readings in test and control groups

A significant decrease in resting pulse (beats per min) was observed over first phase to second phase of readings in test group.

Discussion

Measurement of heart rate following a bout of exercise has been used to estimate one's cardiovascular fitness (Dipayan *et al.*, 2002). Pulse rate is mainly the function of sinus node auto rhythmicity which is controlled by sympathetic and parasympathetic branches of ANS. Studies suggest that well trained individuals present a lower resting pulse rate indicating higher parasympathetic activity or lower sympathetic activity. Resting bradycardia can be due to intrinsic adaptation of the sinus node and also other factors like increase of venous return and stroke volume (Badami 2013).

The time duration by which a person recovers from given exercise or an activity is recovery time. PFI also increases due to early recovery of pulse after exercise. As a result of training, there is faster ATP generation, elimination of lactic acid and diffusion rate of gases (Pansare *et al.*, 1980).

Hammond said that endurance athletes have lower resting and exercise heart rates which may be due to down regulation of cardiac β adrenergic receptors secondary to repeated and prolonged episodes of sympathetic stimulation during exercise (Hammond 1987).

Gupta (1967) stated that PFI is related to recovery pulse rate. The reason for this may be recovery pulse in early phase after severe exercise is a function of hemodynamics and is beyond voluntary control (Gupta 1967). Berne has quoted low resting pulse rate is due to higher vagal tone and decreased sympathetic tone.

For a given age and sex, all individuals have same maximum heart rate, but trained subjects attain maximum heart rate later compared to untrained subjects (Robert 2001).
It has been suggested by Bolts CP that bradycardia with training results from decrease in intrinsic firing of SA node and increase in tonic vagal cardio inhibitory activity.
The changes that lead to less elevation of pulse rate during exercise and faster recovery of post exercise pulse rate in trained subjects can be explained as follows. Training improves cardio respiratory and muscular adaptation to exercise by alteration in the balance between sympatho adrenal acceleratory activity and vagally mediated deceleration with increased cardiac output with better substrate utilization (Badami 2013).
It was previously not agreed, that there was correlation between resting pulse rate and PFI. Subjects with PFI of 52 and slightly above showed higher post exercise pulse count and there was a greater rise of post exercise pulse count than in those subjects with PFI above 65.
The negative correlation between PFI and initial pulse rate was observed by Elbel (1958).
A study by Pansare MS (1980) showed one month training is sufficient to bring about increase in PFI.

Conclusion

Similar to the findings of the present study, majority of studies have reported resting bradycardia in response to physical training. Stress in the form of regular exercise produces marked change in CVS functioning like decreased pulse rate, increase in PFI along with beneficiary actions on other systems.
The present study is of immense use to evaluate the effect of exercise training and to modify the Physical training schedule.

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