Original Article

Effect of physical training on heart rate to graded exercise load in males and females

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Abstract

Autonomic nervous system is the prime mediator of favourable cardiovascular changes, which occurs through physical training, the paper reports the heart rate and blood pressure variation in 30 male and 30 female subjects of age group 18-25years, who underwent 4 weeks of moderate physical training under supervision. Heart rate and systolic blood pressure response to exercise are monitored. All the parameters are compared before and after physical training of 4 weeks.
Keywords: Heart rate, systolic blood pressure. Exercise.

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INTRODUCTION

The autonomic nervous system establishes and maintains a dynamic adaptive state, allowing an organism to respond to internal and external demands, it mediates changes in heart rate (HR), blood pressure (BP) in responses to daily changes, Bernston ac, *et al* [1994][1] suggested that HR is regulated by a complex set of interactions between vagal and sympathetic control. The effects of the two autonomic divisions on the heart can vary reciprocally, independently or coactively, they further suggested that the two autonomic divisions exert opposing control over the heart; a given increase in HR may arise from distinct autonomic origins. Levy mov *et al* [1969][2] documented that cardiac chronotropic response per sec does not provide specific information on either the vagal or sympathetic control of the heart. Loewy AD [1990][3] mentioned that the increase in HR with inspiration and decrease in HR with expiration are mediated by reflex changes in the vagal discharge to the sinoatrial node. Further he suggested that central as well as peripheral mechanisms play a role in generating the physiological mechanisms, villareal Rp *et al* [2001][4] suggested that resting HR is lower in men than women, which may be explained by several factors including differences in autonomic HR control, instrinsic properties of the sinoartrial mode and aerobic fitness. O' leary DS *et al* [1993][5] and Rowell LB *et al* [1990][6] mentioned that skeletal muscle metaboreflex and mechanoreceptors become activated due to the accumulation of metabolites and increase in muscle tension, eg, during exercise and may induce an increase in sympathetic activity. The present study is an attempt to evaluate the effect of short duration of physical training on cardiovascular parameters.

MATERIALS and METHODS

30 female and 30 male healthy, non-athletic, young individuals from various socioeconomic groups residing near by residential layouts of Khaja Bande Nawaz Institute of Medical Sciences, kalaburgi belonging to age group of 18-25yrs

The study was approved by the Ethical clearance committee of Khaja Bande Nawaz Institute of Medical Sciences, Gulbarga.

Informed consent for the test protocol was obtained from the volunteers subjects of study before the start of the study.

Weighing Machine

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Measuring Tape
Digital Electronic Blood Pressure Monitor
Stop Watch
Bicycle Ergometer (Martin)
Digital Electronic Blood Pressure Monitor
Manufactured by Kawamoto Corporation, Osaka – Japan. Model No: KBM-125
Specifications of the instrument are as follows
Measurement range
Cuff pressure: 0 to 300mm of Hg Pulse: 30 to 220pulse/min
Accuracy
Cuff pressure: ±3mmHg Pulse: ±5% of reading
Operating temperature: $+10^0$C to $+40^0$C
Humidity: 85%Rh or below
Power supply: 9 Volt battery
Exhaust Valve: Manual
Cuff: Standard Adult size (cover range arm circumference 23 to 32cm)

Bicycle Ergometer (Martin)

A Bicycle frame is supported by a wooden stand, from the front of which two uprights ascend and carry a desk and cross piece, which provide for the attachment directly in front of the subject of the tension balances and other piece of apparatus.

A cast iron wheel measuring five and half feet (165cm/1.65m) in circumference, weighing 22 kilo and mounted on ball bearing is substituted for the back wheel. This wheel has slightly beveled edges and is turned true. The circumference of this, a stout calico is applied and the two ends of the band are attached to the spring balances of six lbs range attached to a board at the top of the uprights. The cords from calico band to the balance pass round adjustable pulley in order to give them the right deviation. An adjustable record counter records the revolution of the wheel.

The purpose and importance of the study was explained to the subjects, the procedure was explained in detail before starting the recording, to the best of their understanding

Subjects were asked attend the Human Research Lab at 8:30am in morning with light breakfast and avoid any beverages and vigorous physical exercise for past forty eight hours before the test, a thorough and detailed physical examination was performed before subjecting for test. All test were performed in the Human Research Lab in quiet laboratory (28^0C -34^0C) between 9:00am to 11:30am. Body weight and height was measured without shoes and minimum clothing to the nearest 0.1kg and 0.5cm respectively. Subjects were made to relax in supine position for 15min before the start of procedure. In the supine position systolic blood pressure, diastolic blood pressure and pulse rate were recorded and continuous standard lead II ECG was recorded for five minutes in eyes closed relaxed state. The data was later computed and analyzed automatically using the software ECG V; 52 to obtain the cardiac autonomic activity tone under standard conditions.

After five minutes of rest the subject on the same day were tested for graded exercise response on bicycle ergometer, the subject were asked to pedal the bicycle against no resistance for first two minutes than increment in load of the magnitude of 25 watt after every 2min for a total duration of 6min was performed

Simultaneously recording of the blood pressure for every one minute using digital electronic blood pressure monitor during exercise as well as one minute after recovery was done, the subjects were asked to pedal at a constant speed and maintain a revolutions of 90-100 per minute, the subjects were instructed to report immediately if they feel any discomfort, fatigue, heaviness of chest, dizziness, breathing difficulty, nausea, vomiting, burning sensation in chest or restlessness.

Physical Training

All the individuals were subjected to physical training for four weeks in early morning hours in the campus of KBNIMS, kalaburgi, for duration of forty five minutes for five days in a week.

OBSERVATIONS AND RESULTS

All the parameters were measured and analyzed before and after the physical training programme expressed in terms of mean ± SD. The standard statistical tests used in this study were, Student's t-test was applied to analyze the changes in the cardiovascular parameters during exercise and recovery.. P value less than or equal to 0.05 (5%) were considered statistically significant. Data analyses were conducted using SPSS (version 11.0). Heart rate response to graded exercise on bicycle ergometer showed a significant decrease at 3^{rd} minute, 4^{th} minute, 5^{th} minute and 6^{th} minute after physical training [$p<0.05$] in males as shown in Table -1.. The systolic blood pressure response to graded exercise on bicycle ergometer showed a significant decrease at 4^{th} minute, 5^{th} minute and 6^{th} minute after physical training [$p<0.05$] in males as shown in Table -2. Heart rate response to graded exercise on bicycle ergometer showed a significant decrease at 2^{nd} minute, 3^{rd} minute 4^{th} minute, 5^{th} minute and 6^{th} minute after physical training [$p<0.05$] in females as shown in Table-3. The systolic blood pressure response to graded exercise on bicycle ergometer showed a significant decrease at 4^{th} minute, 5^{th} minute and 6^{th} minute after physical training[$p<0.05$] in females as shown in Table-4.

Table 1: Effect of physical training on heart rate to graded exercise load [Male]

Characteristics	n	Resting HR	1st min	2nd min	3rd min	4th min	5th min	6th min	Recovery HR
Pre training	50	72.38±3.67	91.44±3.56	99.68±4.16	108.46±4.68	114.88±5.12	122.86±5.42	129.40±6.39	87.18±4.69
Post training	50	72.16±3.45	91.10±3.67	99.40±3.91	107.74±4.35	114.20±5.13	121.94±5.30	128.0±5.81	86.98±5.00
t-test		t=1.85	t=1.58	t=1.70	t=3.10	t=3.61	t=4.03	t=6.27	t=1.32
p-value		p>0.05	p>0.05	p>0.05	p<0.05	p<0.05	p<0.05	p<0.05	p>0.05
Remarks		NS	NS	NS	S	S	S	S	NS

NS: Not Significant, **S:** Significant

Table 2: Effect of physical training on systolic blood pressure to graded exercise load [Male]

Characteristics	n	Resting Supine SBP	1st min	2nd min	3rd min	4th min	5th min	6th min	Recovery Supine SBP
Pre training	50	112.72±5.54	122.18±4.83	127.26±4.67	132.46±4.55	137.12±4.17	140.24±4.3	147.82±4.34	125.46±3.92
Post training	50	112.38±5.55	121.94±4.79	127.06±4.51	132.14±4.70	136.18±4.45	139.12±4.63	145.98±4.57	125.82±3.87
t-test		t=1.67	t=1.45	t=1.65	t=1.63	t=3.25	t=3.79	t=6.73	t=1.36
p-value		p>0.05	p>0.05	p>0.05	p>0.05	p<0.05	p<0.05	p<0.05	p>0.05
Remarks		NS	NS	NS	NS	S	S	S	NS

NS: Not Significant, **S:** Significant

Table 3: Effect of physical training on heart rate to graded exercise load [Females]

Characteristics	n	Resting HR	1st min	2nd min	3rd min	4th min	5th min	6th min	Recovery HR
Pre training	50	75.62±3.77	99.38±4.16	109.18±4.31	118.8±4.77	125.78±4.77	133.9±4.46	140.08±4.46	102.1±5.83
Post training	50	75.38±4.03	99.12±4.03	108.78±4.17	118.26±4.61	125.32±4.74	133.20±4.43	139.28±4.31	101.98±5.68
t-test		t=1.66	t=1.82	t=2.087	t=2.811	t=3.08	t=3.911	t=4.54	t=1.13
p-value		p>0.05	p>0.05	P<0.05	p<0.05	p<0.05	p<0.05	p<0.05	p>0.05
Remarks		NS	NS	S	S	S	S	S	NS

NS: Not Significant, **S:** Significant

Table 4: Effect of physical training on systolic blood pressure to graded exercise load [Females]

Characteristics	N	Resting Supine SBP	1st min	2nd min	3rd min	4th min	5th min	6th min	Recovery Supine SBP
Pre training	50	110.2±5.52	124.02±3.13	128.72±4.16	134.1±3.05	138.24±4.73	142.1±2.96	148.48±2.66	127.8±2.99
Post training	50	109.90±5.35	123.42±2.86	128.14±3.11	133.76±2.84	136.68±3.08	141.08±3.35	145.16±4.04	127.42±3.02
t-test		t=1.118	t=1.35	t=1.53	t=1.72	t=2.703	t=4.553	t=6.704	t=1.69
p-value		p>0.05	p>0.05	p>0.05	p>0.05	p<0.05	p<0.05	p<0.05	p>0.05
Remarks		NS	NS	NS	NS	S	S	S	NS

NS: Not Significant, **S:** Significant

DISCUSSION

There are many studies in which duration of physical training is long and the training programmes are different. We were interested in finding out training effects of short duration of physical training, because previously it has been shown that even 3 weeks of training results in a decrease in catecholamine response to heart rate after an acute bout of exercise.[7] not only in healthy state but also in certain diseases it has been found that short duration of physical training affects the cardiorespiratory parameters in a favorable way. In case of hypertension a short duration of physical training results in decrease in blood pressure, and in case of depressive patients 3 weeks of sub maximal exercise training showed improvement in aerobic capacity of the patients. The effect of physical training on physical performance measurements in Males for Heart rate response to graded exercise on bicycle ergometer showed a significant decrease at 3rd minute, 4th minute, 5th minute and 6th minute after physical training [p<0.05] as shown in Table No. 1 Similarly the effect of physical training on physical performance measurements in Females showed the Heart rate response to graded exercise on bicycle ergometer a significant decrease at 2nd minute, 3rd minute 4th minute, 5th minute and 6th minute after physical training [p<0.05] as shown in Table No. 3. The current study demonstrated that for young, regular aerobic exercise

training reduced HR during supine rest and upright exercise with minimal changes in the LF and HF components of HRV. Factors other than an increased cardiac vagal modulation (i.e., nonautonomic) may contribute to the mechanism of training-induced bradycardia and cardioprotection.

CONCLUSION

Thus the results of our present study show that even a short duration of moderate intensity of physical training results in improvement in the cardiovascular status in humans. We conclude from our present study that even a short duration of physical training results in favourable cardiovascular performance and it may be ascribed to autonomic modulation

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