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RESEARCH ARTICLE

Effect of regular exercise training on heart rate variability parameters: A cross-sectional study

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ABSTRACT

Backgrounds: Sedentary lifestyle has given rise to a huge problem of lifestyle diseases which are affecting our day-to-day living and work. Exercises alter cardiac autonomic functions of the body. Heart rate variability (HRV) also has prognostic significance for cardiovascular diseases. **Aim and Objective:** The aim of this study is to compare pulse, blood pressure (BP), and HRV parameters among regular exercise group and sedentary groups. **Materials and Methods:** The study was conducted on 50 healthy medical students of age 19–23 years with permission from the Institutional Human Ethics committee. Subjects were divided into two groups. Group I consists of 25 apparently healthy subjects who have regularly run/walk/swimming for at least the past 6 months. Regular practice was defined as run/walk/swimming in 150 min in a week and Group II consists of 25 apparently healthy individuals of sedentary lifestyle who carried out only their daily chores and did not do any form of extra physical exercise to improve their physical fitness. This non-exercise regimen was continued for 6 months. Pulse, BP, and HRV parameters among both groups compared. **Results:** Resting heart rate, systolic BP, and diastolic BP were significantly lower in exercise groups than non-exercise groups. There were insignificantly higher low-frequency (LF) (normalized unit [nu]) and LF/high-frequency (HF) ratio in non-exercise group compared to exercise groups. There was insignificantly higher HF (nu) in exercise group compared to non-exercise groups. **Conclusion:** HRV also has prognostic significance for cardiovascular diseases. Our finding suggestive of parasympathetic dominance in regular exercise group compared to sedentary group. Regular exercise regime has many advantages and helps also to prevent from lifestyle diseases.

KEY WORDS: Heart Rate Variability; Exercise; Sedentary Lifestyle

INTRODUCTION

A sedentary lifestyle means little or no physical activity and person often sitting or lying down more while reading, socializing, watching television, playing video games, or using a mobile phone/computer for much of the day. A sedentary lifestyle can potentially contribute to ill health and many preventable causes of death. Lifestyle diseases which are affecting our day-to-day living and work occur due sedentary lifestyle. Medical research to pinpoint exact reasons for these diseases is being conducted so as to prevent and cure them. There was direct and indirect effect of sedentary lifestyle in our health. One of the most direct prominent effects of a sedentary lifestyle is an increased body mass index, leading to obesity. One of the leading causes of preventable death worldwide is lack of physical

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activity.[1] Obesity and sedentary lifestyle lead to at least 300,000 premature deaths and $90 billion in direct health-care costs a per year in the US alone. Those who sit still more than 5 h/day have maximum risk. There is 40% higher risk among people that sit still more than 4 h/day than those that sit fewer than 4 h/day. Those who exercise at least 4 h/week are as healthy as those that sit fewer than 4 h/day.[2] The study of exercise physiology is see the acute responses and chronic adaptations to a wide range of physical exercise conditions. Exercise may lead to improvement of a person's general health, physical fitness, and also augments an existing treatment to remedy or to ameliorate the effects of a disease or illness on the body. Every process and organ within the body is affected by exercise. Various physical activities such as sports and exercises such as walking, jogging, swimming, or yoga can help in achieving efficient cardiorespiratory functions and are thus helpful in prevention of lifestyle diseases. Specifically, it has been found that exercises alter cardiac autonomic functions of the body.

Autonomic nervous system plays an important role in the regulation of cardiovascular activities.[3] Heart rate variability (HRV) can measure autonomic functions of the heart. HRV is beat-to-beat variability of heart rate (variability in intervals between R waves – "RR intervals"). HRV can be give idea about fluctuations in autonomic inputs to the heart rather than the mean level of autonomic inputs. Main contributor to the high-frequency (HF) component is due to efferent vagal (parasympathetic) activity. Low-frequency (LF) component was considered as a marker of sympathetic modulation. Decrease in HRV indicates autonomic dysfunction. HRV also has prognostic significance for cardiovascular diseases.[4] Several studies have been conducted previously to know the modulations in autonomic functions due to exercise. It is documented that athletes have resting bradycardia. However, sympathovagal balance is by moderation of sympathetic system or by enhancement of vagal tone is not very clear. Furthermore, long duration of training by athletes has not been studied extensively to know long-term effects of athletic training on individuals. Hence, the present study was to assess and compare the HRV in trained athletes and sedentary individuals.

MATERIALS AND METHODS

Fifty healthy medical students between 19 and 23 years of age with written consent were screened for height and weight. Those have a history of taking abusive substances such as smoking and alcohol, endocrine disorders, long-term steroid therapy, and congenital heart diseases, were excluded from the study. BMI was calculated using the formula weight in kg/height in m^2 (Quetelet index). Two groups created among subjects. Group I consists of 25 apparently healthy subjects who have regularly run/walk/swimming for at least the past 6 months. Regular practice was defined as run/walk/swimming in 150 min in a week and Group II consists of 25 apparently healthy individuals of sedentary lifestyle who carried out only their daily chores and did not do any form of extra physical exercise to improve their physical fitness. This non-exercise regimen was continued for 6 months. Duration and type of the exercise practice sessions were noted for Group I subjects. To avoid circadian rhythm influences to HRV and other measurements, all tests were carried out between 10 AM and 1 PM. The Institutional Human Ethical Committee of GMERS Medical College, Gotri, Vadodara, approved our study. All detailed about study were explained to students. Their informed consent was obtained.

Resting pulse rate and resting blood pressure (BP) were recorded. HRV at rest was recorded using Recorders and Medicare Systems (RMS) Polyrite D (multichannel digitalized polygraph machine, model version 2.4, Recorders and Medicare Systems Private Limited, Chandigarh, India). After a complete rest in supine position for 15 min, baseline acquisition was recorded in electrocardiography (ECG) mode on Polyrite D machine. Continuous ECG (lead II) was recorded at 30 mm/s for 5 min in supine position with quiet breathing. Stabilized signals were stored after automatically filtering ectopic beats, artifacts, and noise. Recording was analyzed with inbuilt software and HRV parameters were assessed in frequency domain as spectral density analysis by fast Fourier transformation.

Frequency Domain Methods

The components of spectrum that is mainly described are (1) very LF (VLF), (2) LF, and (3) HF components. VLF, LF, and HF components are usually measured in absolute values of power (ms2), but normalized units (nu) can be used to measure LF and HF. Measurement and interpretation of HRV were conducted as per guidelines given by the "Task Force of The European Society of Cardiology and The North American Society of Pacing and Electrophysiology."[5] Data analysis was done using RMS Polyrite-D machine and statistical analysis was done by unpaired *t*-test.

RESULTS

Findings of the present study are described in Tables 1 and 2.

Table 1: Mean distribution of age, sex, and BMI in the two study groups

Variables	Exercise group	Non-exercise group	*P*-value
Age (years)	21.15±2.3	21.1±2.09	0.9430
Height (cm)	168.05±5.02	170.2±2.46	0.0936
Weight (kg)	60.45±5.70	62.55±7.53	0.3263

BMI: Body mass index

Table 2: Comparison of resting pulse, SBP, DBP, LF (nu), HF (nu), and LF/HF in the two study groups

Variables	Exercise group	Non-exercise group	*P*-value*
Resting pulse in minute	77.1±5.37	86.4±4.62	<0.0001
SBP (in mmHg)	113.6±7.80	124±6.47	<0.0001
DBP (in mmHg)	77.2±5.48	81.2±5.11	0.0220
HF (nu)	44.68±44.61	40.81±13.87	0.4885
LF (nu)	55.32±55.32	59.19±13.87	0.4884
LF/HF ratio	1.45±0.92	1.49±0.99	0.089

*$P \leq 0.05$ considered statistically significant. SBP: Systolic blood pressure, DBP: Diastolic blood pressure, LF: Low frequency, HF: High frequency, nu: Normalized unit

DISCUSSION

Fifty healthy subjects between 19 and 23 years of age were divided into two groups. Group I consists of 25 apparently healthy subjects who have regularly run/walk/swimming for at least the past 6 months. Regular practice was defined as run/walk/swimming in 150 min in a week and Group II consists of 25 apparently healthy individuals of sedentary lifestyle who carried out only their daily chores and did not do any form of extra physical exercise to improve their physical fitness. This non-exercise regimen was continued for 6 months. There were no significant differences in the age, height, and weight between two groups [Table 1]. In our finding, resting heart rate, systolic BP (SBP), and diastolic BP (DBP) were significantly lower in exercise groups than non-exercise groups [Table 2]. There were insignificantly higher LF (nu) and LF/HF ratio in non-exercise group compared to exercise groups. There was insignificantly higher HF (nu) in exercise group compared to non-exercise groups [Table 2].

Hegde *et al*.[6] studied in trained athletes in comparison to sedentary individuals show that increase in HRV. Significant increase in HF parameter of HRV in trained athletes. No significant difference in LF/HF ratio observed between two groups. Decrease in resting heart rate is noted in trained athletes. Mean value of diastolic BP is significantly lower in trained athletes in comparison to sedentary individuals. These indicate parasympathetic (vagal) dominance in trained athletes which is beneficial to cardiovascular system. Similar finding observed in another studied that after aerobic training, increased HF nu, decreased LF nu power, and decreased LF/HF ratio showed an alteration in autonomic regulation of heart rate toward increased vagal dominance.[7] Panda and Krishna conducted study to know the effect of exercise on cardiac autonomic activity. In their study, resting HRV was compared in exercising group and non-exercising group. The exercising subjects were found to have a lesser heart rate compared to non-exercising group.[8] Few studies have shown a significant decrease in resting heart rate after 24 sessions of moderate intensity training program[9] and a small reduction in resting heart rate after 20 weeks of endurance training[10] compared to the controls. Studies conducted by Sawane and Gupta showed similar results and suggested that athletic exercise training program was thought to be a conditioning phenomenon which improved the vagal index.[11] Studies conducted by Nagarajan[12] showed that after the 4 weeks of respiratory training, resting mean arterial pressure decreased significantly from 82.33 ± 3.40 to 79.17 ± 3.64 mmHg ($P < 0.05$). In spite of the limitation of less sample size, our study emphasizes parasympathetic dominance in regular exercise group compared to sedentary group. Regular exercise training reduces resting diastolic BP perhaps due to changes in sympathetic/parasympathetic activation, with alterations in cardiovascular autonomic reflexes. Physiological bradycardia in trained athletes is said to be mainly due to long endurance training which increases the "vagal tone."[13]

CONCLUSION

In our finding, resting heart rate, SBP, and DBP were significantly lower in exercise groups than non-exercise groups. There were insignificantly higher LF (nu) and LF/HF ratio in non-exercise group compared to exercise groups. There was insignificantly higher HF (nu) in exercise group compared to non-exercise groups. Thus, above findings are suggestive of parasympathetic dominance in regular exercise group compared to sedentary group. Regular exercise regime has many advantages and helps also to prevent from lifestyle diseases.

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