Original Research Article

Comparison of the heart rate variability of regularly exercising and nonexercising young adults

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Abstract

Background: In an industrialised and modernized society, individuals tend to perform less physical work and non-communicable diseases therefore become more prevalent. A major problem of the sedentary lifestyle adopted due to modernization is a sympathovagal imbalance. Exercise can affect this imbalance. Sympathovagal imbalance can be easily assessed by determining the heart rate variability (HRV). **Aim:** To compare the short term heart rate variability (HRV) of regularly exercising and nonexercising young adults. **Material and methods:** This cross-sectional study was conducted in the Department of Physiology of Coimbatore Medical College, Coimbatore. Participants included 30 regularly exercising (Group I) and 30 nonexercising young adults (Group II) aged 18-20 years. After taking informed consent, a 5 minute lead II electrocardiogram (ECG) was acquired and digitized at the rate of 1000 samples per second and HRV analysis was done. Statistical analysis was done using the unpaired Student's t-test. **Results:** There was a significant difference between the LF/HF ratio and HFnu values of exercising and non exercising young adults (p value <0.0001), the LF/HF ratios being higher and the HFnu values being lower in the nonexercising group There was however no significant difference between their LFnu values (p value = 0.0836). The body mass index (BMI) was 22.52 ± 1 and 25.33 ± 2.2 in exercising and nonexercising young adults respectively. **Conclusion:** In this study, we found a significant difference between the LF/HF ratio and HFnu values of exercising and non exercising young adults. The sympathovagal imbalance among nonexercising young adults could possibly be corrected by life style modification.

Keywords: autonomic function, exercise, heart rate variability, sympathovagal imbalance

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Introduction

In the modern era, due to the adoption of a sedentary life style, there is an increased risk of individuals developing many non-communicable diseases. But regular physical activity and exercise reduces cardiovascular and cancer mortality and mortality due to stroke, breast cancer, and colon cancer.[1-4]

Studies have shown that endurance athletes have higher parasympathetic tone and a resultant lower resting heart rate than individuals who do not exercise; and although the exercise itself increases heart rate, these athletes have a lower resting heart rate.[1,3,4] It has also been proven that the resting heart rate is inversely related to life span and that it reflects the status of the cardiovascular system and is an indicator of the cardiac autonomic nervous system activity (the sympathetic and parasympathetic systems) and metabolic rate.[1] Linear analysis of heart rate variability (HRV) provides a non-invasive index of cardiac autonomic modulation in the presence of rhythmic variability.[1]

Heart rate variability (HRV) is thus a specific tool for measuring cardiac autonomic nerve function and is considered as a marker of imbalanced sympathetic/vagal activities or sympathovagal imbalance. HRV also independently predicts cardiovascular disease mortality in patients with coronary artery disease, patients with chronic heart failure and in apparently healthy populations.[1,5,6]

As sympathovagal imbalance is one of the main problems of the sedentary lifestyle adopted due to modernization and as exercise could have an effect this imbalance, we were therefore interested in comparing the short term heart rate variability (HRV) in regularly exercising and nonexercising young adults using frequency domain indices.

Materials and Methods

This cross-sectional study was conducted in the Department of Physiology of Coimbatore Medical College, Coimbatore. The sampling method employed was a non-probability purposive method. Participants included 30 regularly exercising young adults (Group I) and 30 nonexercising young adults (Group II) of both genders who were selected on the basis of the following inclusion and exclusion criteria:

Inclusion criteria: Healthy young adults in the age group of 18-20 years who did moderate exercise like jogging, walking etc, for one hour regularly were considered as exercising young adults and included in Group I, while those belonging to the same age group who never exercised were considered as nonexercising young adults and included in Group II.

Exclusion criteria: Smokers, alcoholics, and those with diabetes mellitus, systemic hypertension, obesity, cardiovascular diseases, sleep disturbances and subjects taking drugs that affected the autonomic nervous system were excluded from study.

As per protocol, the subjects were asked not to eat heavy meals or ingest coffee or alcohol for an hour before arriving at the department for testing.[4] After obtaining informed consent, normal the subjects' weight and height were recorded. Weight was measured using a digital scale to the nearest 100 grams, with subjects wearing light clothing and without shoes, after emptying of bladder. Height was measured without shoes, with a stadiometer to the nearest 0.5 centimetre and the body mass index (BMI) was calculated by dividing the weight in kilograms by the square of height in meters.[4]

The subjects were asked to rest in the supine position with their eyes closed in a quiet and relaxed atmosphere for 15 minutes, following which a 5 minute lead II electrocardiogram was recorded and digitized at rate of 1000 samples per second.[1,3,4]

Heart rate variability (HRV) analysis: The R-R intervals, that is, the time between the R peaks of consecutive QRS complexes were calculated and checked for artifacts. As per standard protocol, occasional ectopic beats were identified and replaced with R-R interval values interpolated from adjacent values and the following frequency domain indices were calculated from the HRV recordings: Normalized low frequency power (LFnu), Normalized high frequency power (HFnu) and LF/HF ratio.[1-4]

Statistical analysis: Statistical analysis was done with the help of SPSS software using the unpaired Student's t- test.

Results

The LF/HF ratio was compared between exercising young adults (Group I) and nonexercising young adults (Group II) and the difference was found to be significant by the unpaired Student's t- test (p value is <0.0001) as shown in Table 1.

There was also a significant difference between the HFnu values of exercising and non exercising young adults (p value <0.0001), although there was no significant difference between the LFnu values of exercising and nonexercising young adults (p value = 0.0836).

Table 1: Comparison of the heart rate variability of exercising young adults and non exercising young adults

Parameter	Group I	Group II	p value
LF/HF	3.65 ±0.86	6.55 ±0.4	< 0.0001*
LFnu	77.57 ±3.8	86.49 ±1.0	0.0836
HFnu	22.18 ±3.9	13.47 ±1.3	< 0.0001*

Group I: Regularly exercising young adults and Group II: Nonexercising young adults; Frequency domain indices of heart rate variability used being LF/HF: low frequency to high frequency ratio, LFnu: Normalized low frequency power, HFnu: Normalized high frequency power; values expressed as mean±SD in normalized units; statistical analysis done using the unpaired Student's t-test; *p value of < 0.05 being considered as significant.

The mean BMI of the regularly exercising young adults was found to be 22.52 ± 1.1 kg/m^2 while it was 25.33 ± 2.2 kg/m^2 in the non- exercising young adults.

Discussion

The results of our study revealed that there was a significant difference between the LF/HF ratio and HFnu values of exercising and non exercising young adults, the LF/HF ratios being higher and the HFnu values being lower in the nonexercising group. There was however no significant difference between their LFnu values.

Heart rate variability (HRV) is used as a tool to measure sympathovagal balance and it basically is the beat to beat variation caused due to variation in cardiac cycle length - a physiological phenomenon that mainly occurs due to variation in cardiac activities during the respiratory cycle (respiratory sinus arrhythmia) at rest, although other factors also contribute.[6]

Pichon *et al.* studied the effects of exercise intensity and duration on heart rate variability in 14 healthy trained subjects and found that the HFnu component of HRV, which is believed to reflect parasympathetic influences modulating the sino-atrial node, increased significantly with the exercise load. They also found that the LF/HF ratio, which is the classic indicator of sympathetic modulation, and the LF component decreased significantly with the exercise However, unlike our study, they measured the HRV indices of trained subjects while they were actually performing strenuous exercise and they felt that HRV indices for assessing autonomic control of heart rate may not be very accurate during strenuous exercise load.[7]

It was also seen that ventilation had a major influence on the HRV indices measured during exercise and it was postulated that the increased respiratory drive could explain the change in the sympathetic/parasympathetic balance associated with exercise and that non-autonomic mechanisms may be physiologically useful by regulating the heart rate in the absence of effective autonomic modulation during strenuous exercise.[7]

Stable homeostasis in yoga practice is achieved physiologically by improving the sympathovagal balance.[6] High levels of Respiratory Sinus Arryhmia (RSA) are often found in regularly exercising individuals; low RSA is a risk factor in cardiovascular disease, and exercise-induced increases in RSA could partly account for the beneficial effect of exercise in reducing cardiac disease risk.[2] De Geus *et al.* studied 157 adolescent and 208 middle-aged twin pairs in an effort to assess the genetic correlation of exercise with heart rate and respiratory sinus arrhythmia and concluded that the association between exercise and cardiovascular risk factors is mainly derived from a common genetic factor.[2]

In our study, an increased LF/HF ratio, a decreased HFnu, a higher BMI (statistically significant) and an increased LFnu (though not statistically significant) were observed in nonexercising young adults. It could indicate increased sympathetic activity and this sympathovagal imbalance should be corrected by life style modification to prevent non-communicable diseases from developing.

The limitations of this study include the sampling method employed and the fact that the findings may not be representative of all young adults in general, for which further detailed studies would be required. Also, although we studied only frequency domain indices, timed domain indices of heart rate variability could also be used.

Conclusion

In this study, we found a significant difference between the LF/HF ratio and HFnu values of exercising and non exercising young adults, the LF/HF ratios being higher and the HFnu values being lower in the nonexercising group. The sympathovagal imbalance among nonexercising young adults could possibly be corrected by life style modification.

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Conflicts of interest: Nil

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