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RESEARCH ARTICLE

Correlation of autonomic function tests with age, sex, anthropometry, and body composition in sedentary office workers

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ABSTRACT

Background: Sedentary lifestyle leads to autonomic dysfunction with sympathetic hyperactivity, which leads to increased morbidity. **Aims and Objectives:** This study was aimed to investigate the relationship of autonomic function tests with age, sex, and anthropometric measurements in sedentary workers. **Materials and Methods:** This study was conducted on 50 healthy sedentary office workers aged between 20 and 50 years. Their anthropometric and parameters of body composition were calculated. Autonomic functions were assessed by the recording of frequency domain parameters of heart rate variability (HRV). **Results:** Among the HRV parameters, the mean low frequency (LF), high frequency (HF) LF/HF ratio, and total power were 453 ± 428 ms^2, 406 ± 612 ms^2, 2.15 ± 2.64, and 1432 ± 1238 ms^2, respectively. There was no significant difference in HRV parameters of male and female subjects ($P > 0.05$). HF, LF, and LF/HF ratio decreased significantly with age ($r = -0.422$; $P = 0.032$). No significant correlation was found between HRV parameters and anthropometric parameters ($P > 0.05$). Among the parameters of body composition, specifically in case of fat-free mass, the LF/HF ratio was significantly increased ($r = 0.582$, $P = 0.001$). **Conclusion:** Aging process causes a decrease in HRV. As the weight increases, LF/HF ratio increases indicating increased sympathetic activity.

KEY WORDS: Autonomic Functions; Heart Rate Variability; Sedentary; Sympathetic Activity

INTRODUCTION

Sedentary lifestyle leads to change in body composition[1] and is also a risk factor for cardiovascular diseases.[2] The risk for cardiovascular diseases can be assessed by a simple, non-invasive test for autonomic dysfunction which is known as heart rate variability (HRV)[3,4] which is beat to beat variation in terms of consecutive R-R intervals in an electrocardiogram.[5]

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Most frequently used the technique for the analysis of HRV is a linear technique, specifically spectral analysis.[6]

The HRV in sedentary people has not been studied much. Hence, this research was aimed to identify the sedentary people who are at risk for cardiovascular diseases.

MATERIALS AND METHODS

Study Subjects

This study was conducted on 50 apparently healthy office workers of Dr. Ram Manohar Lohia Institute of Medical Sciences, Lucknow, in the Department of Physiology over a period of 1 year. The subjects were of either sex, aged between 20 and 60 years. Their participation was voluntary and written consent was taken from all the participants. The study was in accordance with the Helsinki Declaration and approved by the Institutional Ethical Committee.

Inclusion Criteria

The subjects who were participating in either one or no occasion of low intensity (<50% of heart rate) or sports activity for <20 min in a week were included in the study.[7]

Exclusion Criteria

The following criteria were excluded from the study:

- History of alcohol intake
- History of smoking
- History of tobacco chewing
- History of drug usage
- Participation in any exercise training for the past 6 months
- History of cardiopulmonary or metabolic diseases.

The subjects were instructed to avoid additional physical activity 48 h to assessment and taking caffeinated products 24 h before testing. They were assessed at a fixed time of the day (4.00 PM) to rule out the diurnal variation.

Anthropometric Measurement

1. Weight
2. Height
   Both weight and height were measured using stadiometer (INCO Instruments and Medical Devices, India)
3. Body-mass index (BMI): Calculated by using Quetlet's index[8]
   BMI (kg/m^2) = Weight (kg)/Height^2 (Meter)
4. Waist-Hip Ratio:
   Waist-hip ratio = waist circumference/hip circumference
5. Waist circumference was measured at a level midway between the lowest rib and iliac crest, and hip circumference was measured at the widest portions of the buttocks using the measuring tape.[9]
6. Skinfold thickness: It was measured at four sites (biceps, triceps, subscapular, and suprailiac) on the right-hand side of the body with a skin caliper. The guidelines of the the International Society for the advancement of kinanthropometry were used for anatomical landmarks.[10]
7. Mid-arm circumference: It was measured in the non-dominant arm at the midpoint between acromion and olecranon process[11]
8. Mid-calf circumference: It was measured as the maximum horizontal distance around the left calf in standing position.[12]
9. Mid-thigh circumference: It was measured at the mid-point between the lower costal margin and the iliac crest in standing position.[13]
10. Body density: It was calculated by using the Durnin-Womersley equation[14]
11. Percentage body fat: It was measured using Siri Equation[15]
    % body fat = (495/body density) − 450
12. Fat mass:
    Fat mass (kg) = (% body fat/100) × weight (kg)
13. Fat mass Index:
    Fat mass index (kg/m^2) = fat mass/height (m)^2
14. Fat-free mass:
    Fat-free mass (kg) = weight (kg) – fat mass (kg)
15. Fat-free mass index:
    Fat-free mass index (kg/m^2) = fat-free mass/height (m)^2

Autonomic Function Tests

Autonomic function tests were assessed by a recording of HRV. The 5 min standard lead II ECG recording was done after 15 min rest in a quiet room with the help of three channel physiograph (AD instruments). Data were stored and analyzed by software LABCHART PRO V8.1.8 WITH HRV MODULE V.2.0.3. The following frequency domain parameters were analyzed:

- Total power
- Low frequency (LF)
- High frequency (HF)
- LF/HF Ratio.

Statistical Analysis

Statistical analysis was performed using Stata version 12. Data were expressed as mean ± standard deviation. K W equality of proportions rank tests was used to analyze the correlation of HRV with gender. Spearman's correlation was used to analyze the correlation between HRV and other parameters. $P < 0.05$ was considered statistically significant.

RESULTS

A total of 50 subjects participated in the study out of which 16 were females and 24 were males [Figure 1].

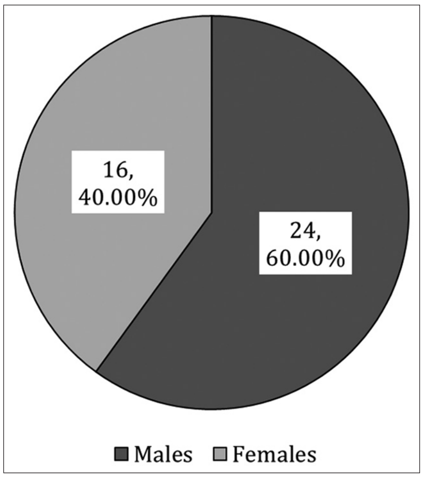

Figure 1: Gender distribution

The mean age of the subjects was 37.0 ± 10.8 years (male: 37.4 ± 11.9 years vs. female 35.5 ± 4.9 years, $P = 0.705$), mean weight was 64.7 ± 13.1 kg (male: 66.7 ± 13.9 kg vs. female: 56.8 ± 4.4 kg, $P = 0.100$), mean BMI was 23.7 ± 4.4 kg/m^2 (male: 23.6 ± 4.9 kg/m^2 vs. female:24.0 ± 1.6 kg/m^2, $P = 0.856$), and mean waist-hip ratio was 0.94 ± 0.18 (male: 0.96 ± 0.19 vs. female 0.85 ± 0.04, $P = 0.204$) [Table 1].

Mean mid-arm circumference of the subjects were 26.6 ± 4.2 cm (male: 26.6 ± 4.5 cm vs. female: 26.5 ± 2.3 cm, $P = 0.949$), mean mid-calf circumference was 33.2 ± 4.5 cm (male: 32.8 ± 4.8 cm vs. female: 34.8 ± 2.5 cm, $P = 0.331$), and mean mid-thigh circumference was 47.7 ± 6.9 cm (male: 47.2 ± 7.5 cm vs. female: 50.0 ± 3.3 cm, $P = 0.377$) Table 2.

The mean body density of the study group was 1.06 ± 0.01 g/ml (male: 1.06 ± 0.01 g/ml vs. female: 1.04 ± 0.01 g/ml, $P = 0.036$), mean percentage body fat was 16.5 ± 6.7% (male: 15.4 ± 6.3% vs. female: 21.2 ± 6.8%, $P = 0.058$), mean fat mass was 11.1 ± 6.3 kg (male: 10.8 ± 6.7 kg vs. female: 12.3 ± 4.5 kg, $P = 0.618$), mean fat free mass was 54.1 ± 11.0 kg (male: 56.4 ± 11.2 kg vs. female: 45.1 ± 3.1 kg, $P = 0.022$), mean fat mass index was 4.1 ± 2.3 kg/m^2 (male: 3.8 ± 2.4 kg/m^2 vs. female: 5.1 ± 1.7 kg/m^2, $P = 0.213$), and mean fat-free mass index was 19.8 ± 3.6 kg/m^2 (male: 19.9 ± 3.9 kg/m^2 vs. female: 19.1 ± 1.8 kg/m^2, $P = 0.606$) Table 3.

Among the frequency domain parameters of HRV, the mean total power, LH, HF, and LF/HF ratio was 1432 ± 1238 m^2 (male: 1352 ± 1060 m^2 vs. female: 1754 ± 1889 m^2, $P = 0.487$), 453 ± 428 m^2 (male: 441 ± 428 m^2 vs. female: 501 ± 466 m^2, $P = 0.767$), 406 ± 612 m^2 (male: 312 ± 290 m^2 vs. female: 784 ± 1254 m^2, $P = 0.091$), and 2.15 ± 2.64 (male: 2.33 ± 2.91 vs. female: 1.42 ± 0.95, $P = 0.458$), respectively Table 4.

Table 1: Demographic characteristics of participants

Variable	Mean±SD	Mean±SD (Male)	Mean±SD (Female)	*P*-value
Age (years)	37.0±10.8	37.4±11.9	35.5±4.9	0.705
Weight (kg)	64.7±13.1	66.7±13.9	56.8±4.4	0.100
BMI (kg/m^2)	23.7±4.4	23.6±4.9	24.0±1.6	0.856
Waist-hip ratio	0.94±0.18	0.96±0.19	0.85±0.04	0.204

SD: Standard deviation, BMI: Body mass index

Table 2: Anthropometric characteristics of the subjects

Variable	Mean±SD	Mean±SD (Male)	Mean±SD (Female)	*P*-value
Mid-arm circumference (cm)	26.6±4.2	26.6±4.5	26.5±2.3	0.949
Mid-calf circumference (cm)	33.2±4.5	32.8±4.8	34.8±2.5	0.331
Mid-thigh circumference (cm)	47.7±6.9	47.2±7.5	50.0±3.3	0.377

SD: Standard deviation

Table 3: Body composition of the subjects

Variable	Mean±SD	Mean±SD (Male)	Mean±SD (Female)	*P*-value
Body density (g/ml)	1.06±0.01	1.06±0.01	1.04±0.01	0.036
Percentage body fat (%)	16.5±6.7	15.4±6.3	21.2±6.8	0.058
Fat mass (kg)	11.1±6.3	10.8±6.7	12.3±4.5	0.618
Fat-free mass (kg)	54.1±11.0	56.4±11.2	45.1±3.1	0.022
Fat mass index (kg/m^2)	4.1±2.3	3.8±2.4	5.1±1.7	0.213
Fat-free mass index (kg/m^2)	19.8±3.6	19.9±3.9	19.1±1.8	0.606

SD: Standard deviation

Table 4: Frequency domain parameters of HRV of participants

Parameter	Mean±SD	Mean±SD (Male)	Mean±SD (Female)	*P*-value
Total power (ms^2)	1432±1238	1352±1060	1754±1889	0.487
LF (ms^2)	453±428	441±428	501±466	0.767
HF (ms^2)	406±612	312±290	784±1254	0.091
LF/HF ratio	2.15±2.64	2.33±2.91	1.42±0.95	0.458

HRV: Heart rate variability, SD: Standard deviation, LF: Low frequency, HF: High frequency

All the parameters of HRV decreased with age, and there was a significant correlation of age of subjects with LF, HF, and LF/HF ratio ($P < 0.05$). Total power, LF, and LF/HF ratio increased with increase in BMI while HF component decreased with an increase in BMI. There was no a significant correlation of HRV with BMI. ($P > 0.05$). All the parameters of HRV increased with increase in waist-hip ratio, and the correlation was not significant ($P > 0.05$). Total power, LF, and HF decreased while LF/HF ratio increased with increase in mid-arm circumference, but the correlation was nonsignificant. ($P > 0.05$). As the mid-calf circumference increased, total power, HF, and LF/HF ratio increased while LF decreased also the correlation was nonsignificant ($P > 0.05$). With mid-thigh circumference, total power, LF and HF decreased while LF/HF ratio increased ($P > 0.05$) Table 5.

Total power and LF increased with increase in body density, fat-free mass, and fat-free mass index while decreased with increase in percentage body fat, fat mass, and fat mass index. HF increased with increase in body density but decreased with increase in percentage body fat, fat mass, fat index, fat-free mass, and fat-free mass index. The LF/HF ratio increased with all the parameters of body density except body density with which it decreased. The correlation of only fat-free mass with LF/HF ratio was found significant ($P < 0.05$) while all others were nonsignificant ($P > 0.05$) Table 6.

Table 5: Correlation of age and anthropometric parameters with HRV

Variable	Total power	LF	HF	LF/HF ratio
Age				
R	−0.297	−0.422	−0.405	−0.4220
P	0.14	0.03	0.04	0.03
BMI				
R	0.071	0.104	−0.179	0.267
P	0.73	0.61	0.38	0.18
Waist-hip ratio				
R	0.106	0.100	0.026	0.145
P	0.60	0.62	0.90	0.48
Mid-arm circumference				
R	−0.059	−0.195	−0.163	0.269
P	0.757	0.302	0.389	0.151
Mid-calf circumference				
R	0.070	−0.167	0.026	0.189
P	0.713	0.378	0.892	0.317
Mid-thigh circumference				
R	−0.016	−0.208	−0.079	0.278
P	0.933	0.270	0.678	0.137

HRV: Heart rate variability, LF: Low frequency, HF: High frequency, BMI: Body mass index

Table 6: Correlation of body composition with HRV

Variable	Total power	LF	HF	LF/HF ratio
Body density				
r	0.185	0.148	0.065	−0.139
p	0.328	0.435	0.733	0.464
Percentage body fat				
r	−0.230	−0.164	−0.137	0.157
p	0.221	0.387	0.470	0.407
Fat mass				
r	−0.250	−0.188	−0.204	0.348
p	0.221	0.320	0.280	0.060
Fat-free mass				
r	0.023	0.043	−0.189	0.582
p	0.904	0.821	0.317	0.001
Fat mass index				
r	−0.216	−0.179	−0.153	0.301
p	0.252	0.344	0.420	0.106
Fat-free mass index				
r	0.164	0.082	−0.006	0.038
p	0.387	0.667	0.975	0.842

HRV: Heart rate variability, LF: Low frequency, HF: High frequency

DISCUSSION

Our study showed a significant decrease in parasympathetic activity as estimated by frequency parameters of HRV. LF, HF, and total power were higher in females than male while LF/HF ratio was higher in males than females. However, these results were not significant ($P > 0.05$) and non-conclusive. Further study is needed to assess the correlation. In our study, parasympathetic activity significantly decreased with age ($P < 0.05$).

Our study showed a positive but nonsignificant correlation of LF, LF/HF ratio and total power with BMI, waist-hip ratio, and mid-arm circumference ($P > 0.05$). HF component showed a nonsignificant inverse correlation with mid-arm circumference while the positive correlation with waist-hip ratio. Overall autonomic activity and parasympathetic activity decreased with increase in body density, percentage body fat, fat mass, and fat mass index while increased with an increase in fat-free mass and fat-free mass index.

The results were similar to other studies.[16,17] The parameters of HRV showed sympathetic dominance in all the subjects. The mean LF/HF ratio was more than 1 indicating higher sympathovagal balance also shown by Matic *et al*.[18] They studied time domain parameters while we investigated frequency domain parameters in our study. Earlier studies reported a lower level of parasympathetic activity in females.[19] Kuo *et al*. demonstrated higher HF in females.[20] Gonadal hormones may play an important role in gender difference of autonomic function tests. Moreover, the estrogen hormone exerts a protective effect over physiological cardiovascular functioning during the active menstrual cycles in female.[21] It has been observed that arteries become tortuous and sympathetic influence enhances with the advancement of age. Our findings were in concurrence with that of Zhang[22] who also pointed out that total power decreased and LH and HF increased with age. A study done by Monteze *et al*.[23] showed a positive correlation of all the parameters of the frequency domain of HRV with anthropometric parameters and body composition variables. Our study included more detailed parameters of anthropometry and body composition such as mid-arm circumference, mid-calf circumference, mid-thigh circumference, fat-free mass, fat mass index, and fat-free index apart from waist-hip ratio, waist-height ratio, and BMI in anthropometry and body fat, percentage body fat, and visceral fat area in body composition done by them.

Sedentary behavior is an important risk factor for cardiovascular diseases. The present study was aimed to investigate whether there is any correlation of HRV with age, sex, anthropometry, and body composition in sedentary office workers.

CONCLUSION

Sympathovagal balance is higher in males than females. As age increases, parasympathetic activity decreases. The parasympathetic activity also increases with an increase in body fat and body density and with an increase in anthropometric measurements.

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