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Original Research Article

To Study the Comparison of Heart Rate Variability between Obese and Healthy Young Adults

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Abstract

Background: Obesity leads to metabolic and cardiac diseases. There have been studies which have reported association between obesity and sudden cardiac deaths.

Aim: To study the comparison of heart rate variability between obese and young adult males.

Material and Methods: A case control study was conducted in N=50 obese young adult males of 18–30 years and N=50 age-matched healthy adult males. The power spectral analysis of HRV was done to detect early the autonomic imbalance in obese adults. HRV was performed using HRV software Lab Chart. The absolute values of low frequency (LF) and high frequency (HF) (in ms^2), LF and HF units (in nu) and LF/HF ratio were calculated as mean ± standard deviation and statistically analyzed using student unpaired t test.

Results: HF in normalized units was significantly decrease in obese young adults group as to compared to age-matched control group and was statistically significant ($p<0.001$). LF (nu) and LF/HF ratio were increase in obese group as compared to control group and was found statistically significant. A negative correlation between HF and body mass index in obese individuals was reported and positive correlation between LF and LF/HF ratio was found statistically significant.

Conclusion: Obese young adults reported decrease in parasympathetic activity and increase in sympathetic activity hence autonomic imbalance was reported.

Keywords: Autonomic imbalance, Heart rate variability, Obesity.

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Introduction

Obesity has affected all age group subjects where excess fat accumulates in the body as per WHO data.[1] It is the leading cause of hypertension, obstructive sleep apnea, diabetes, cardiovascular diseases etc.[2] Autonomic disturbances in obese may cause sudden cardiac death.[3,4] Heart rate variability (HRV) is a noninvasive technique, using power spectral analysis method of heart rate the sympathetic and parasympathetic activity of heart is monitored.[5,6]Hence, this study focuses on the resting heart rate activity in healthy obese young adults.

Material And Methods-Informed consent was taken. A cross-sectional observational study was conducted. The research took place between Jan 2026 and June 2026 in the Dept of Physiology, NSMCH, Patna

Inclusion Criteria – The study included N= 50 obese (body mass index [BMI] >25 kg/m2) obese young adult males of 18–30 years and N=50, healthy adult males normal weight subjects aged between 18-30 years were enrolled as control group. (BMI: 18.5–22.9 kg/m2) [7] With the help of AI - therapy statistics BETA sample size was calculated. Effect size was 0.8 and an alpha of 0.05. [8] Power was 80% for one tailed hypothesis. [9] A total of 100 subjects were required, 50 per group.

Exclusion Criteria- Chronic illness, diabetics, smokers and alcoholics, hypertensives, heart diseases hypothyroidism, on lipostatic drugs, familial hyperlipidemia were excluded. The statistical significance was evaluated by the student's t-test. Body mass index as weight kg/height m2 was calculated.[10]

History was taken and physical examination was done. Coffee, nicotine, or alcohol was avoided at least 24 h before the procedure and food was avoided 2 hour before testing. Procedure was done between 10 AM and 12 PM at 24–25°C temperature. Procedure was explained and written consent was taken.

During the entire recording period subjects were asked to relax, breathe slowly, eyes were closed and to avoid any kind of movements.

Cough and sneeze was avoided. Standard limb leads and chest leads were applied on the body of subjects. HRV recording in supine position for 5 min was done by HRV software Lab Chart after 15 min rest.

Heart Rate Variability: In the frequency domain analysis, the power spectrum for HRV was calculated with the fast Fourier transformation. The power spectrum has two bands: power in high frequency (HF) range (0.15–0.40 Hz) and power in low frequency (LF) range (0.04–0.15 Hz)

Statistical Analysis: GRAPHPAD QUICKCALCS online student unpaired t-test was used for data analysis of HRV parameters between obese and control group. The statistical significance was at p value < 0.05. Absolute values of LF and HF in ms2, normalized units of LF and HF in nu and LF/HF ratio were recorded.

The comparison of HRV parameters between the two group's obese and healthy young adults was evaluated using unpaired student's t test. Correlation between BMI and HRV parameters was analysed. P < 0.05 was considered statistically significant.

Result

LF and HF (in ms2), LF and HF (in nu), LF/HF ratio and heart rate of both the groups were recorded as mean ± SD. Low frequency power-Mean value of LF (ms2) was increase in obese (166.2 ± 3.2) as compared to control group (67.34 ± 3.11) and was statistically significant [Table 2] In normalized units of LF, similar data was reported.

High frequency power, HF (ms2) was decrease in obese (123.02 ± 2.61) as compared to control group (186.2 ± 2.20) and was statistically significant. HF in nu were decrease in obese (27.38 ± 5.4) as compared to controls group (35.2 ± 5.3) and was statistically significant with P = 0.0001 [Table 2].

Low frequency/high frequency ratio: LF/HF ratio was increase in obese (7.91 ± 11. 3) as compared to control group (2.23 ± 3.21) was found statistically significant [Table 2].

Heart rate: Heart rate of obese (72.90 ± 4.87) and controls (74.40 ± 2.2) was statistically non-significant [Table 2]. A negative correlation between HRV parameters and BMI in obese individuals was statistically, significant.[Table3]

Table 1: Demographic Data

Parameters	Group 1 (n=50) Obese	Group 2 (n=50) Control
Age (Years)	24.2± 3.1	21.7± 1.3
Weight(Kg)	74.13± 5.60	55.17± 4.85
Height (cm)	163.71± 5.22	166.86± 4.88
BMI	27.90± 2.62	20.02± 1.12

p < 0.05 – Statistically Significant.

Table 2: Comparison of heart rate variability parameters and body mass index in between obese individuals and healthy adult males

HRV Parameter	Group 1 Mean ± SD, Obese (n=50)	Group 2 Mean ± SD, Control (n=50)	P value
HF (ms2)	123.02 ± 2.61	186.2 ± 2.20	<0.001*
LF(ms2)	166.2 ± 3.2	67.34 ± 3.11	<0.001*
HF(nu)	27.38 ± 5.4	35.2 ± 5.3	<0.001*
LF(nu)	77.06 ± 4.5	67.30± 3.2	<0.001*
LF/HF Ratio	7.91 ± 11.3	2.23 ± 3.21	<0.001*
Heart Rate(beats/min)	72.90 ± 4.87	74.40 ± 2.2	<0.10

***p < 0.05 – Statistically significant.**

Table 3: Relationship between body mass index and heart rate variability parameters in obese individuals

HRV Parameters	Correlation coefficient	P value
HF(nu)	-0.7	<0.05
LF(nu)	0.8	<0.05
LF/HF Ratio	0.8	<0.05

Discussion

The spectral analysis of HRV records the changes in the sympathovagal activity.[11] The vagus nerve activity during respiration is represented by the HF component. The LF component represents both the sympathetic and parasympathetic activity and the RR interval variation. [12] Sympathovagal balance is represented by the LF to HF power ratio. Increased LF and LF/HF power represents increased sympathetic tone.

Obese subjects between age group of 18-30 years had increase in LF power (both in ms2 and nu), and was statistically significant. Lower HF power was recorded in obese subjects as compared to controls (P = 0.001). The LF/HF ratio was more in obese subjects was significant. It may be due to increase sympathetic activity and decrease parasympathetic activity.

Hence obesity represents increase sympathetic activation and impairment of baroreflex.[13] Wu et al. reported that increased BMI shifts the autonomic balance toward sympathetic activity.[14] The increase LF/HF ratio reports the autonomic imbalance.[15] Karason et al. reported that obese subjects have increased sympathetic activity and decrease vagal response[16].

In our study, though there was negative correlation between Hf and BMI in obese subjects, it was statistically significant. Positive correlation between LF and LF/HF ratio shifts towards sympathetic dominance and was statistically significant. Guízar et al reported that both central and general obesity was related to autonomic disturbance of the heart.[17] Fat cells secrete adipokines like leptin, that increases the sympathetic activity.[18,19]

Vanderlie et al reported autonomic dysfunctions i.e decrease in parasympathetic activity in obese children.[20] Barbara Zahorska et al. study supported the autonomic imbalance in obesity. They reported that HRV parameters improved after weight loss for 3 months.[21]

Hence, HRV test may be used as a screening tool to detect early the cardiac autonomic dysfunction in asymptomatic obese subjects in order to decrease the mortality risk in obese subjects due to autonomic imbalance. Weight loss, regular physical activity, lifestyle changes have reported increase HRV. Hence, regular HRV test in obese subjects can be used as a biomarker for early detection of cardiovascular disorders and decrease in mortality.

Conclusion

Obesity in adults alters the autonomic nervous system. Parasympathetic activity is decreased and sympathetic activity was increased in obese. Hence early intervention is required in order to maintain the normal weight to avoid cardiovascular risk in future.

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