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Original Research Article

A CROSS-SECTIONAL STUDY ON EFFECT OF HIGH BODY MASS INDEX ON HEART RATE IN ADULTS IN SRI GANGANAGAR

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Abstract

Background: Both overweight and obesity in adults are linked to lower heart rate variability (HRV). Heart rate variability (HRV) is a non-invasive indicator of autonomic cardiac regulation that has been associated to a number of clinical diseases. The present study objective was to find out the correlation between heart rate and body mass index in the study participants. **Materials and Methods:** The study was conducted in Dr SS Tantia Medical College, hospital and research center. 50 adult obese participants with BMI >30 Kg/m2 and 50 Normal weighted participants with BMI in the range of BMI 18.5–24.99 Kg/m2 as controls were included in the study. A simple method was used to evaluate the parameters. Data were recorded and entered into MS Excel and analyzed using MS Excel and SPSS (Statistical Package for Social Sciences). **Result:** RR Interval (SD), RR interval difference (RMS), RR interval difference when compared to the normal weight group were significantly lower in the obese group (p value <0.05). **Conclusion:** It is important to study the effect of High BMI on HRV for effective control of cardiovascular disorders.

INTRODUCTION

Minor variations occurring in the time between heartbeats are known as heart rate variability. These variations can nevertheless signal existing or potential health difficulties, including as cardiac disorders and mental health illnesses like anxiety and depression, even though they cannot be seen without the use of specialist equipment. Heart rate fluctuation is a common phenomenon and is not by itself an arrhythmia.[1]

"Sinus rhythm" refers to regular heartbeat." Sinus arrhythmia" is the term used for when the heart is beating rhythmically yet there is more than 0.12 seconds of fluctuation between heartbeats. Sometimes heart rate variability satisfies the requirements for sinus arrhythmia.[2]

Breathing is often the cause of sinus arrhythmia (also known as respiratory sinus arrhythmia), which is a typical reaction of your heart and circulatory system. Sinus arrhythmia, on the other hand, may indicate a different cardiac condition that requires evaluation by a healthcare professional when it isn't brought on by breathing.[3]

One of the main illnesses that make people with high body mass index (BMI) more likely to die from all causes, particularly cardiovascular diseases, is obesity.[4]

The cause of these connections is yet unknown, despite the generally consistent observations that obesity is associated with a higher frequency of CVD. Several variables, including insulin resistance, hypertension, and decreased high-density lipoprotein, have been proposed as possible explanations for this association. Yet, it has also been proposed that the higher prevalence of CVD in obesity may be caused by a decline in autonomic function.[5]

MATERIALS AND METHODS

The study participants were included from the medical staffs, students, and attendants to the patients at Dr SS Tantia Medical College, Sri Ganganagar, fifty normotensive obese people and 50 age-matched normally weighted controls were chosen for the study. Adult males were the only participants. According to World Health Organization guidelines, a BMI of above 30 was considered obese, while a BMI of less than 25—i.e. between 18.5 and 24 kg/m2—was considered normal. [6]

Weight, height and waist hip ratio were recorded using standard measurement techniques used in a similar study.[7]

After a 20 minute of rest in supine position, the ECG was recorded for 5 minutes when the subject was normally breathing. Prior to the ECG recording, blood pressure was also taken. HRV parameters were recorded under three domains. The was time-domain measures included the standard deviation of all RR intervals and the root mean square of differences of subsequent RR intervals, the number of RR intervals that differ by more than 50 ms. Frequency domain included high and low frequency power.[8]

Statistical Analysis

The Mann-Whitney U test was used to compare data between groups. Using Spearman's correlation analysis, obesity indices such as waist circumference, hip circumference, waist-hip ratio (WHR), and BMI were measured, computed, and compared with HRV indicators.

RESULTS

Age and height were comparable across the two groups of study and controls. However, compared to normal weighted subjects, those with high BMI (>30) had significantly more body weight (t=11.8593, 0.0001), BMI (t=11.8593, 0.0001), waist-hip ratio (t= 6.1898, p=0.0001), systolic blood pressure (t=2.7849, 0.0064), and diastolic blood pressure (t=4.0191, 0.0001) than the other group. The difference among the two was checked for significance of difference by applying student's t test. [Table 1].

Table 1: Anthropometric measurements in controls and study group.

Parameter	Control Mean ± SD	BMI >30 Kg/m^2 Mean ± SD	t value	p value
Age in Years Completed	29.97 ± 6.99	31.4 ± 7.21	1.0069	0.3165
BMI in Kg\m2	22.21 ± 4.33	31.25 ± 3.21	11.8593	0.0001
Weight in Kg	62.2 ± 11.2	83.0 ± 13.6	8.3481	0.0001
Height in meters	1.71 ± 0.13	1.69 ± 0.11	0.8305	0.4083
Waist Hip Ratio	.79 ± .09	0.99 ± .21	6.1898	0.0001
Systolic BP	117.5 ± 11.5	123.40 ± 9.6	2.7849	0.0064
Diastolic BP	78.2 ± 10.5	86.6 ± 10.4	4.0191	0.0001

Table 2: Measurements of HRV among obese and control groups.

Parameter	Control Median (Q1-Q3)	BMI >30 Median (Q1-Q3)	p value
High Frequency (ms2)	594.5 (288.63–1010.88)	199 (93.6–610)	<0.05
Low Frequency (ms2)	502 (178–1012)	264 (126.75–444)	>0.05
Ratio of Low\High Frequencies	0.89 (0.4–.98)	0.99 (0.73–1.93)	>0.05
RR interval difference >50ms	92.5 (35.25–120.75)	17.25 (2.25–40.75)	<0.05
RR Interval (Standard Deviation)	51.25 (31.36–60.01)	35.55 (26.77–49.25)	<0.001
RR interval difference (root mean square)	39.65 (29.4–60.25)	30.25 (17.25–41.02)	<0.05

The comparison of the estimated time domain and frequency domain characteristics of the heart rate variability among two groups was done. The time domain included RR Interval (Standard Deviation), RR interval difference (root mean square), RR interval difference >50ms. When compared to the normal weight group, all of these time domain characteristics were substantially lower in the obese group (p value <0.05). The LF/HF ratio, HF power and LF power were the variables examined among the frequency domain metrics. In comparison to the controls, the study group's HF and LH/HF ratio were both considerably greater (p <0.05). [Table 2]

Table 3. Correlation between heart rate variability (HRV) and anthropometric parameter of the study group i.e. BMI >30. (N=50).

Parameter		BMI	Age	Pulse Rate	Waist Hip Ratio	Systolic BP	Diastolic BP
High Frequency (ms2)	Rho	0.021	-0.610	-0.536	-0.522	-0.395	-0.410
	p value	0.787	0.000	0.001	0.034	0.000	0.022
Low Frequency (ms2)	Rho	0.000	-0.388	-0.935	-0.145	-0.0992	-0.062
	p value	1.000	0.021	0.000	0.625	0.666	0.887
Ratio of Low\High Frequencies	Rho	-0.015	0.314	-0.0008	0.522	0.752	0.600
	p value	0.888	0.035	0.899	0.0064	0.005	0.009
RR interval difference >50ms	Rho	0.256	-0.510	-0.801	-0.111	-0.352	-0.256
	p value	0.555	0.010	0.000	0.788	0.324	0.6
RR Interval (Standard Deviation)	Rho	-0.009	-0.399	-0.725	-0.362	-0.420	-0.366
	p value	0.099	0.045	0.000	0.235	0.158	0.444
RR interval difference (root mean square)	Rho	0.252	-0.333	-0.485	-0.033	-0.658	-0.475
	p value	0.658	0.0078	0.000	0.486	0.258	0.654

Spearman's rank correlation was used to assess relationship between the HRV and subject parameters. It was seen that correlation of High frequency (HF) with age, WHR, BMI, Pulse rate,

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systolic and diastolic BP was significant ($p<0.05$) while among the Low frequency (LF) parameter it was statistically correlated to age and pulse rate ($p<0.05$). L/H ratio was associated with age, WHR and blood pressure which was also statistically significant ($p<0.05$). Among the parameters related to RR interval the standard deviation and root mean square both were associated with age and pulse rate ($p<0.05$).

DISCUSSION

Prior research suggested that physical inactivity and BMI both individually lead to increased sympathetic activity and decreased HRV power. Nevertheless, only when the BMI was more than 30 kg/m^2 was this link discovered.[9] Similar findings to the results of the present study were reported in a number of studies body fat percentage, high body mass, and waist circumference were negatively related to vagal modulation.[10-12]

In a study conducted by Antonio I et al,[13] the key time-domain variables (Mean RR, STDRR, and RMSSD) and frequency-domain variables (LF, HF, and LF/HF), as dependent factors, and age, FM, and VAT/FM, as independent variables, were initially analysed using a linear regression model. As none of the HRV data fit a normal distribution (Shapiro-Wilk test, p 0.05), they were all log-transformed. In a similar study lower low frequency (LF) and smaller root mean square differences of consecutive NN intervals (RMS standard deviation) were strongly linked with higher levels of fat mass, % fat content, and waist/hip ratio (r = 0.34, r = 0.43; P .01, r = 0.33, P .05). Standard deviation of NN interval (SDNN) and low frequency/high frequency ratio changes during quiet, noise, and standing did not differ between the normal and obese groups (p value >.05).[14]

Because of the stringent exclusion criteria used, our study's sample size was relatively small, but the results are comparable to those of the majority of other studies in the field, confirming the existence of an interaction between HRV and overall body fat.

Early identification and management through weight loss, lifestyle modification, and regular exercise can lower the risk because they have been demonstrated to boost HRV. Changes can be found with HRV analysis even before they manifest clinically. As a result, routine HRV measurement in obese individuals can be employed as a biomarker for the early diagnosis and prompt management of cardiovascular illnesses.

CONCLUSION

From the present study, it has been observed that HRV was influenced by high body mass index & other associated variables which could increase the risk of cardiovascular disorders. Hence, its right strategy to diagnose the problem in early stage through screening & timely intervention which would be very effective in decreasing cardiovascular morbidities & mortalities.

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