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Original Research Article

A COMPARATIVE STUDY OF HEART RATE VARIABILITY IN MIDDLE AGED OBESE MALE AND NON OBESE MALE

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ABSTRACT

Objectives: Obesity is on the rise in our country once viewed as a sign of prosperity it is a contributing factor to diseases. The purpose of this study is to see whether obesity has an effect on the heart rate of the subject by comparing and possibly contrasting the heart rate variability in obese and non-obese males.

Materials and methods: Out of 100 participants, 50 healthy male obese (BMI >25kg/m^2) individuals and 50 healthy male non-obese individuals (BMI <25kg/m^2) of age group 35yrs-55yrs were taken from the general population. The ECG was recorded and HRV were derived from it. Results were compared by using independent 't' test and Pearson's correlation test was done for BMI and HRV. $P < 0.05$ was considered as significant.

Results: HRV parameters and heart rate between the two groups LF, HF and HFnu, was found to be significantly reduced and LFnu and LF/HF was found to be significantly higher in obese persons. The correlation of BMI with the parameters such as ratio of LF/HF, normalised units of LF and HF revealed a significantly negative relation with HFnu. A positive relationship was also observed between LFnu and LF/HF ratio. However, it was statistically not significant.

Conclusion: The middle aged obese males had reduced parasympathetic activity associated with elevated sympathovagal modulation. This altered balance of the autonomic nervous system increases the risk of cardio-vascular disorders.

KEY WORDS: BMI, Heart rate variability (HRV), High frequency (HF) and Low frequency (LF).

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INTRODUCTION

The visceral functions in the body like heart rate, blood pressure, secretion of insulin, regulation of heart rate and many others are controlled by the autonomic (self-governing) nervous system [1,2]. Obesity is on the rise in our country. Once viewed as a sign of prosperity, it is a contributing factor to diseases like diabetes, hypertension etc leading to an increasing toll on health expenditure in our country and around the world. A number of studies showed different results with regards to which component of the autonomic nervous system is affected (sympathetic or parasympathetic or both) by obesity. The middle age was selected for the study aged group because many chronic diseases that have been attributed to obesity usually begin in the middle aged group and the possibility of primary preventative measures can be started before the disease may take hold [3]. To determine if a person is obese or not there are various parameters like Body Mass Index, Waist circumference

and Waist hip ratio. According to the WHO and IOTC standards the Indian population has different values compared to Caucasians and westerners because of a higher body fat composition [4]. The purpose of this study is to see whether obesity has an effect on the heart rate of the subject by comparing and possibly contrasting the heart rate variability in obese and non-obese males.

MATERIALS AND METHODS

After obtaining Institutional Ethical clearance the present study was conducted in the department of physiology. 50 healthy male obese individuals age group of 35yrs-55yrs with BMI >25kg/m^2, waist hip circumference above 90 cm and waist-hip ratio above 1.0, chronically obese (>6 months) and willing to participate in the study were taken as cases, and 50 healthy male non-obese individuals of age group 35yrs-55yrs with BMI of <23kg/m^2 and waist hip circumference below 90 cm and waist hip ratio below 1.0 were included as controls from the general population. Females, known cases of diabetes, hypertension, coronary heart disease, endocrine disorders, on any drugs that may alter the autonomic function of their bodies like beta blockers, antidepressants, antiarrhythmic, ACE inhibitors, thyroid medication, subjects who do not have the necessary body mass index, non-consenting subjects, smokers and alcoholics, patients of parkinson's disease and head trauma, epileptics, and psychiatric patients were excluded from the study.

Informed consent was obtained after explaining the detailed procedure. A brief history was taken and a clinical examination of the cardiovascular system and respiratory system was done to exclude medical problems. Anthropometric parameters were recorded. Body mass index was derived by Quetelet's index - weight (kg)/ height (m^2). Female subjects are excludedfrom this study because their autonomic functions vary in relation to the various phases of the menstrual cycle [5]. Based on the Asian guidelines for obesity, subjects with BMI more than 25 kg/m^2 were considered as obese and those with values lesser than 25kg/m^2 were considered as non-obese [6]. After allowing them to take a rest for a minimum of 15 minutes in supine position, electrocardiogram (ECG) in Lead II was obtained for a continuous period of 10 minutes by placing the electrodes in right infraclavicular, left infraclavicular and left iliac regions. The ECG was analyzed in frequency domain for HRV by using RMS Vagus HRV software (RMS, India). The values for low frequency (LF) and high frequency (HF) were obtained in ms [2], the normalized units for LF and HF (LFnu, HFnu) were also noted along with the ratio of LF and HF (LF/HF). HF is mainly reflecting parasympathetic activity whereas LF/HF is an indicator of sympathovagal balance. All the techniques of measurement, duration, instruments were maintained uniformly throughout the study.

Statistical Analysis: All the data obtained in both obese and non-obese groups were expressed as mean ± Standard Deviation. The difference in parameters between the two groups was compared by using independent student 't' test. A relation between BMI and HRV parameters was determined using the Pearson correlation coefficient. $P < 0.05$ was considered as significant. SPSS software version 18 was used for the statistical analysis.

RESULTS

100 healthy middle aged obese and non-obese male individuals were participated in this study. They were divided into two groups based on their BMI as per WHO Asian guidelines. Out of these, 50 healthy male obese individuals age group of 35yrs-55yrs with BMI >25kg/m^2, waist hip circumference above 90 cm and waist-hip ratio above 1.0, were cases and 50 healthy male non-obese individuals of age group of 35yrs-55yrs with BMI of <23kg/m^2 and waist hip circumference below 90 cm and waist hip ratio below 1.0 were controls were taken from the general population.

Table 1: The Comparison of anthropometric data between Obese and non-obese individuals.

Variables	Obese	Non-Obese	p-value
Age (yrs)	48.12 ± 5.50	47.11 ± 5.46	>0.05
Height (Mts)	1.67 ± 0.08	1.68 ± 0.05	>0.05
Weight (Kg)	73.61 ± 12.44	62.77 ± 13.15	<0.05*
BMI (Kg/m2)	32.15 ± 3.10	22.01 ± 1.36	<0.05*

The anthropometric parameters between obese and non-obese individuals have been shown in Table No.1. Age of participants was statistically

no difference between the two groups (obese: 48.12 ± 5.50 vs non-obese: 47.11 ± 5.46 respectively). BMI of participants was statistically different in the two groups (obese: 32.15 ± 3.10 vs non-obese: 22.01 ± 1.36).

Table 2: The Heart Rate (HR) and HRV (frequency domain) parameters in obese and non-obese individuals.

Variables	Obese	Non-Obese	p-value
HR (beats/min)	85.28 ± 7.89	82.55 ± 5.66	>0.05
LF (ms2)	33.85 ± 28.98	54.58 ± 38.14	<0.05*
HF (ms2)	15.16 ± 14.28	31.05 ± 20.25	<0.05*
LFnu	71.19 ± 14.57	60.98 ± 12.14	<0.05*
HFnu	29.98 ± 6.54	40.09 ± 10.17	<0.05*
LF/HF	3.01 ± 0.75	1.66 ± 0.73	<0.05*

The heart rate and HRV parameters in obese and non-obese individuals have been compared in Table No.2. LF, HF and HFnu, was found to be significantly reduced and LFnu and LF/HF were found to be significantly higher in obese individuals as compared to the non-obese individuals.

Table 3: The Correlation of BMI with HRV parameters.

Variables	BMI	
	r-value	p- value
LFnu	0.19	>0.05
HFnu	-0.315	<0.05*
LF/HF	0.198	>0.05

The correlation of BMI with the HRV parameters have been shown in Table No.3. BMI showed significantly negative correlation with HFnu, and non-significant positive correlation with LFnu and LF/HF ratio.

DISCUSSION

In the present study, we demonstrated that HRV was decreased in middle aged obese individuals without comorbidities as compared to the non-obese individuals. Under the resting condition, beating of the healthy heart is irregular, which is overlooked when the average heart rate is calculated. With the ECG recorder, non-invasive measure of heart rate fluctuations, HRV was derived, and the variation in R-R interval represents beat-to-beat control mechanisms of the heart. Sympathetic and parasympathetic activities directed to the sinus node during each cardiac cycle can be modulated by central and peripheral stimulators, which in turn manifest as oscillations in the heart beat duration. The variability of instantaneous HR and consecutive RR intervals are the HRV denotes. Hence cardiac autonomic function can be quantified by short term and long term HRV analysis[7]. So the present study was planned to use short term HRV analysis under resting condition in healthy obese middle aged males and to compare the same with non-obese individuals.

The factors like age, gender and physical activity can also influence the HRV other than obesity [8]. In this study, age and sex matched 100 healthy middle aged obese and non-obese male individuals were participated (Table 1). In the obese group, LF, HF and HFnu, was found to be significantly reduced and LFnu and LF/HF were found to be significantly higher as compared to the non-obese individuals. But resting heart rate was not varying in the both groups. Similar results were also observed by Anahita R Shenoy et al [8] in the age group of 40-55 years, Savas Sarikaya et al. [9] in the 100 young age and sex matched patients, and Rajalakshmi et al. [10] but their study was in younger population in the age group of 18-20 years. Chetan HA et al [11] have reported similar results in 20-24-year-old young Indian males, but their criteria for obesity classification (BMI > 30 kg/m^2) was different. Compared to other ethnicities, it has been observed that Asians are more prone for obesity related disorders at lower levels of BMI. So in the present study effect of overall obesity was studied by considering BMI as an indicator, and the participants with BMI more than 25 kg/m2 as obese as per WHO Asian guidelines [7]. The representation of LF and HF in normalized units emphasizes the controlled and balanced behavior of the two branches of the autonomic nervous system. Normalisation also tends to minimise the effect on the values of LF and HF components of the changes in total power. Hence the result of the present study reflects a reduced parasympathetic activity and altered sympatho-vagal balance in obese even in the resting state. The higher value of LF/HF ratio in obese can be interpreted as increased sympathetic activity. Previous studies have shown an elevated level of insulin and leptin in obese individuals. This increased level of insulin and leptin could be a reason for the increased sympathetic activity [8].

Simran Grewal et. al. [12] have shown obese

subjects had impaired sympathetic and parasympathetic activity. While Archana Damodaran et al. [13] and Chetan H A et al [14] have shown there is autonomic imbalance in subjects with central obesity with sympathetic overdrive and parasympathetic withdrawal. While Ramis Colak et al [15] have shown sympathetic activity reduced in obese subjects. Heart rate variability has been shown to be an effective and inexpensive early marker of autonomic dysfunction and heart disease and an excellent predictor of cardiac morbidity and mortality [16]. By using frequency domain methods different components of the autonomic nervous system can be assessed. On correlation of BMI with ratio of LF/HF, normalised units of LF and HF revealed a significantly negative relation with HFnu. Rajalakshmi et al [10] and Fu CC et al. [17] have also observed a similar relation between BMI and HFnu in their studies.

CONCLUSION

Present study was observed that middle aged obese males had reduced parasympathetic activity associated with elevated sympathovagal modulation. This altered balance of the autonomic nervous system increases the risk of cardiovascular disorders. Adopting healthy lifestyle practices reduce the weight can shift the sympathovagal balance towards vagal predominance which is known to be protective to the heart.

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