



Contents lists available at BioMedSciDirect Publications

International Journal of Biological & Medical Research

Journal homepage: www.biomedscidirect.com



Original Article

Effect Of Obesity On Resting Heart Rate Among Medical Students

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ARTICLE INFO

Keywords:

Body Mass Index

Obesity

Resting Heart Rate

ABSTRACT

Background: Obesity is accompanied with varied combinations of abnormalities in the autonomic nervous system. An elevated heart rate is a warning sign about an increased risk of cardiovascular dysfunction. **Objective:** The present study was conducted to compare resting heart rate (RHR) in normal weight persons against obese medical students. **Methods:** This study included 60 young adult subjects in the age group of 18 to 20 yrs. According to BMI, subjects were classified into obese group (n=30) with Body Mass Index (BMI) of ≥ 25 Kg /m² and Normal Weight group (n=30) with BMI of < 25 Kg /m². Obesity indices like BMI, Waist Circumference (WC), Waist hip ratio (WHR) and Hip Circumference (HC) were measured and calculated. Electrocardiogram (ECG) was recorded in each subject and heart rate was counted manually. Student 't' test, Pearson's correlation coefficient were used to analyse the appropriate data. **Results:** RHR was significantly correlated with BMI ($r=0.305$, $p < 0.01$). Subjects with BMI of ≥ 25 Kg /m² had significantly higher ratio of RHR compared to normal weight subjects ($p < 0.05$). **Conclusion:** There is a significant correlation between obesity indices like BMI and RHR, with the obese group exhibiting significantly faster RHR. This could point towards an altered autonomic balance in young obese persons. Hence there is need to prevent obesity early in life to avoid cardiovascular consequences.

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1. Introduction

Obesity is a nutritional health problem which is gradually increasing and affecting all sections of population. Prevalence rates are increasing in developing as well as in developed countries. Obesity is characterised by hemodynamic and metabolic alterations. Obese individuals have higher prevalence of many diseases like coronary artery disease, hypertension and diabetes mellitus [1,2]. Obesity can cause alterations in the autonomic modulations of heart rate and in the dynamics of cardiovascular system [3]. Therefore detecting cardiac irregularities at an early stage are very important. However, this requires a good physiological understanding of the cardiovascular system. Body mass index (BMI) is the marker for body fat content. It has been used to identify and classify individuals who are most likely to be

overweight or obese. Generally high values indicate excessive body fat and consistently relate to increased health risks and mortality. WHO has set standards for overweight and obesity by defining it as BMI ≥ 25 kg/m² and ≥ 30 kg/m² respectively. But the BMI cut off point for overweight (≥ 23 kg/m²) and obese (≥ 25 kg/m²) for Asians are lower than the WHO criteria [3,4,5,6].

Homeostasis of the cardiovascular system is carried out by efficient control and feedback mechanisms that seek to maintain the mean arterial blood pressure. This is achieved by constant regulation of heart rate and the vascular tonus, which are primarily modulated by Autonomic nervous system [7,8].

Resting Heart rate (RHR) is an easy to measure but important indicator of cardiovascular health. RHR is influenced by several constitutional and environmental factors. The most important determinants are parasympathetic and sympathetic influences. Thus quantifying RHR can give state of balance between parasympathetic and sympathetic activity [9,10]. Obesity is known to cause autonomic dysfunction and RHR is dependent on

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autonomic system [11]. Hence obesity can lead to changes in RHR and arterial blood pressure, and can also alter the responses to changes in posture [12,13]. From studying RHR, indirect information on the integrity and disorders of the heart's autonomic modulation can be obtained [14]. Studying the fluctuations of heart beats intervals over time (Heart rate variability, HRV) have been used extensively as markers of cardiovascular health [15]. Reduction of HRV has been reported in several cardiovascular and non-cardiovascular diseases [16]. Similarly RHR can be used as a tool in predicting the life threatening cardiovascular consequences in advancing age. It has a prognostic value. Various studies have found the direct relationship of increase in RHR with increased incidence of cardiovascular problems [4,11]. Obese people tend to have increased RHR as autonomic responsiveness has been shown to diminish due to obesity [17,18,19].

Therefore the aim of present study was to evaluate the effect of obesity on Resting Heart Rate in young normal weight and obese individuals and to find out correlation of Resting Heart Rate with indices of general obesity like BMI.

2. Materials And Methods

In this study, 100 medical students in the age group 18 to 20 yrs studying in 1st MBBS at GMC, Akola were included. Those subjects with the personal history of Essential Hypertension (n=2), Bronchial Asthma (n=3) and with history of tobacco and alcohol intake (n=8) were excluded from the study. Thus only 87 students were selected for the study. The individuals were given explanation about the relevance of the study and the non-invasive experimental procedures. The participants gave informed written consent to participate in the experiment which was approved by the institutions human research ethics committee. The study was carried out in a laboratory where daily ambient temperature ranged from 24 to 28°C during the same period of the day (between 2 pm to 5 pm). All the participants were tested over a week period. On the days before the tests, each volunteer received important instructions for ensuring the success of these tests, such as avoiding consumption of stimulating drinks (tea, coffee or alcoholic drinks) not performing heavy strenuous physical activities, having light meals and having night time sleep of at least 8 hrs.

The subjects were examined for anthropometric parameters i.e. height, weight, waist and hip circumference. Resting heart rate was counted after complete rest of 10 min by using the radial pulse. Three successive reading were taken for 60 sec each with an interval of one minute while the subject in supine position. Similarly Heart rate measured while the subject in standing position for 3 min. Clinical examination of all subjects was conducted along with electrocardiogram. BPL Cardiart ECG machine was used to record electrocardiogram. BMI, WHR, WSR were then calculated. Obesity is described in terms of Body Mass Index (BMI). BMI was calculated by dividing the patient's weight taken in kilograms by the square of height taken in meters (kg /m²). On the basis of BMI, the volunteers were categorised into Obese group (if BMI ≥25 Kg /m²) and Normal

Weight group (if BMI < 25 Kg /m²). The Obese group was considered to form the study group (n = 30). Out of remaining 57 normal weights group only 30 subjects were randomly selected. Thus the study consists of 2 groups namely Normal Weight group (n=30) and Obese group (n=30).

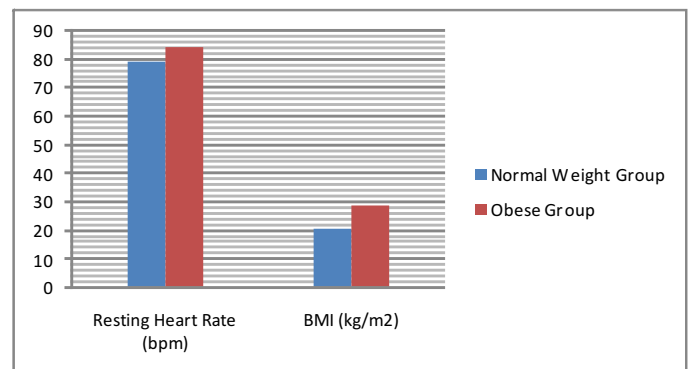
The data obtained were presented as Mean ± SD for each type of parameter. Data showing RHR of normal weight group and obese groups was compared using unpaired t-test. Correlation coefficients were estimated to quantify the linear relationship between the indices of obesity and HRV using Pearson's correlation coefficient (r). The p-value of less than 0.05 was considered statistically significant.

3. Results

Table. The physical characteristics of the 2 groups

Parameters	Normal Weight Group (Mean ± SD) n=30	Obese Group (Mean ± SD) n=30	p-value
Age (Yrs.)	18.1±0.8	18.4±0.61	0.155
Weight (kg)	57.8±8.04	80.4±12.35	<0.001
Height (m)	1.68±0.11	1.67±0.07	0.775
Resting Heart Rate (bpm)	79.3±8.36	84.3±9.48	0.033
BMI (Kg/m ²)	20.4±1.37	28.6±3.06	<0.001
WC (cm)	76.0±6.60	92.2±10.14	<0.001
HC (cm)	92±4.20	105.7±8.61	<0.001

Figure



The subjects in both groups were age matched (p=0.155). RHR between normal weight group and obese group were compared. The RHR in obese group (84.3 ± 9.48) was significantly higher than normal weight group (79.3 ± 8.36). RHR varied significantly between normal weight group and obese group (p < 0.038) meaning thereby obesity reflects on vital parameters like heart rate. The mean change in RHR was 5 bpm. Hence there was a highly significant positive correlation between RHR and BMI.

4. Discussion

The present study was designed to assess the effect of obesity on Resting Heart rate in healthy young medical students between age group 18 to 21 yrs, which in turn gives the information about the effect of obesity on cardiac autonomic activity.

In the present study the mean values of RHR (79.3 ± 8.36) was comparable to other studies in young individuals done by Al Qureshi et al [20], Salameh et al [21]. The RHR (74.5 ± 1.65) of 17 yrs old black males in USA as reported by Gillium RF et al [22] were also close to the results found in our study. A RHR of 74.1 was also observed in a large population study of 19 yr old male University students in Belfast by Black A et al [23]. The differences in the RHR among different population could be due to the differences in genetic characteristics, anthropometrics, and geographical distribution etc.

It was observed that there was high RHR in obese group as compared to normal weight group. It was also found that there was a positive and significant correlation of RHR with obesity parameters like BMI. This study has added to the evidence that obesity has significant effect on RHR among medical students. Studies done by Dimkpa et al [24] and Grassi et al [25] also observed a significant increase in RHR with increase in body weight, which were similar with our study.

The heart rate at rest is influenced by different factors such as genetic characteristics, anthropometrics, age, gender, body posture, hormonal and emotional factors, and level of physical fitness. Several mechanisms are involved in causing cardiovascular complications in obese individuals due to increase in heart rate, one such is high heart rate can directly increase the myocardial oxygen consumption and induces breaking up of elastic fibres within the arterial wall. Obesity and cardiac autonomic nervous system are related to each other. An elevated heart rate is a warning sign about an increased risk of cardiovascular dysfunction. In the NHANES study, a heart rate of more than 80 bpm implied a greater risk of cardiovascular complication [26]. An increase in body weight is associated with an increase in RHR which in turn cause increase in sympathetic and simultaneously decrease in parasympathetic activity. Conversely decrease in heart rate occurs during weight reduction [27]. This effect of increase in parasympathetic activation due to weight reduction is beneficial for the health of individuals with obesity.

Limitation of the present study is that the duration of the obesity was not considered which could have helped in establishing the relation of the duration of the obesity on cardiac autonomic activity. In the present study RHR was measured manually instead of automated machine. Nevertheless, the manual method also gives us the exact reading if done properly.

5. CONCLUSION

The present study showed that there is a significant direct correlation between obesity indices and RHR, with the obese group exhibiting a significantly faster RHR compared to normal weight group. This faster RHR in obese individuals could contribute to various cardiovascular problems in later life.

Thus it can be concluded from the results of the present study that there was altered cardiac autonomic activity in obese individuals. Obese group showed a significant reduction of parasympathetic activity and a significant increase in sympathetic activity. This shows imbalance in the autonomic neural activities of the heart. Hence there is need to prevent obesity early in life to avoid life threatening cardiovascular consequences in advancing age. Thus early interventional programmes like weight reduction, life style changes and physical exercises can be advised to reduce the chances of subsequent cardiac problems.

6. ACKNOWLEDGEMENT

The authors acknowledge their gratitude to Dr. Sampada Rajurkar (Asst. Prof. Dept. of Community Medicine, GMC, Akola) for all the help rendered in the statistical analysis, Laboratory Assistant for technical assistance in the completion of this study and the medical students of GMC, Akola for showing their willingness to take part in the study as subjects. The study was done using manual method. The only instrument used for this study purpose (ECG machine) was from the clinical physiology laboratory of department of Physiology, Govt. Medical College, Akola. Hence there was no extra funding received for this study from any source.

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