



## Relation of Body mass index to Heart rate variability in female medical students

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### ABSTRACT

Heart rate variability (HRV) is a simple non-invasive, sensitive measure to evaluate autonomic system activity. Sympathovagal imbalance can explain increased incidence of sudden cardiac deaths associated with increased Body Mass Index (BMI). Understanding the mechanism that connects obesity and autonomic nervous system (ANS) functions is important because increasing obesity prevalence documented among men and women of all ages. The aim of the study is to assess the relationship of body mass index to heart rate variability in young females. In this study, 90 healthy female students, aged between 17-22 years were included. After calculating the BMI, subjects were divided into three groups. HRV was recorded for 5 min using INCO-NIVIQUIRE DIGITAL ACQUISITION SYSTEM VER.52.0. Low frequency (LF) component, high frequency (HF) component and LF:HF ratio were recorded and the relation between BMI, HF, LF and LF:HF ratio were analysed using ANOVA test. In this study, LF:HF ratio in overweight females was found to be high and parasympathetic was decrease when compared to normal weight and underweight females. Raised BMI is associated with reduced HRV, which correlates with decreased parasympathetic activity and sympathovagal imbalance, thus increases the chances of cardiac autonomic dysfunction and eventually leading to cardiovascular disease in overweight female.

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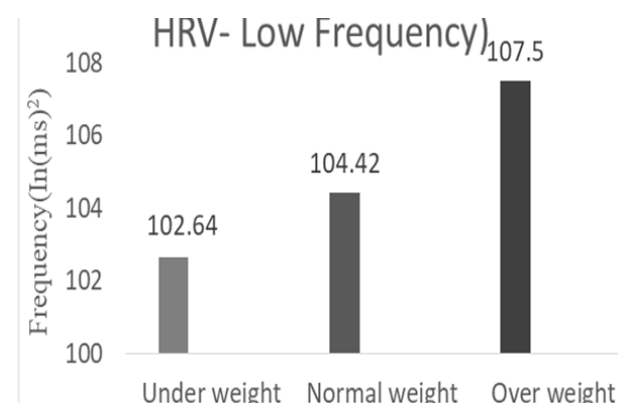
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### INTRODUCTION

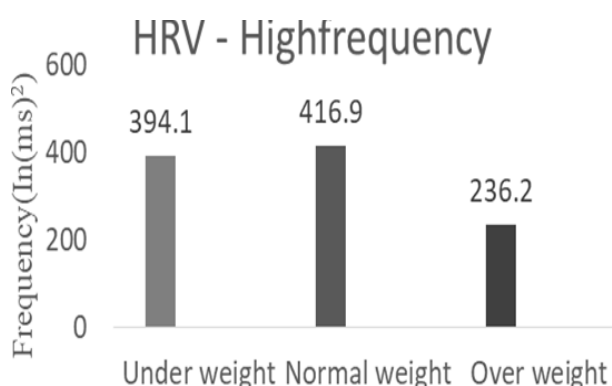
Obesity is one of the causes for majority of cardiovascular diseases. Obesity is an excess fat deposition of fat in the body individual ([Shenoy et al., 2014](#)). Increased BMI also a risk factor for other

some disease such as diabetes, stroke, osteoarthritis, respiratory difficulties, etc. Obesity is associated with a high rate of death in elderly subjects with heart disease, and the rate of coronary artery disease occurrence also more ([Dekker et al., 2000](#)). Heart Rate Variability (HRV) is a non-invasive method to study the changes of the autonomic nervous system in the heart beat -to- beat (R-R interval) variation. Beat-to-beat variability in the heart's rhythm is mainly caused by the modulation of intrinsic cardiac pacemaker of the ANS and hence by assessing the HRV, we can get effective information about the function of heart and autonomic control ([Arbindkumarchoudhary, 2016](#); [Rawal, 2014](#)). Therefore, HRV is used as an index and measurement of ANS activity ([Arbindkumarchoudhary, 2016](#)) when evaluating cardiac function ([Subramaniam, 2011](#)). Decrease in HRV has been seen in many clinical conditions such as auto-

onomic neuropathy, heart transplantation, congestive heart failure, myocardial infarction (MI), and other cardiac and non-cardiac diseases (Stys and Stys, 1998).

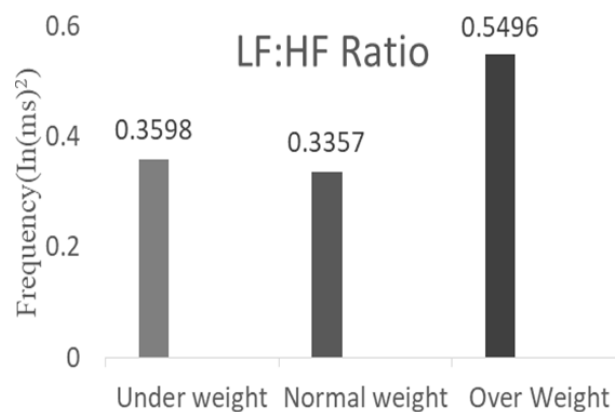


**Figure 1: Low Frequency indicates sympathetic activity and P Value show significance ( $P < 0.05$ ) in overweight subject when compare to normal and underweight. (P Value: 0.92)**



**Figure 2: High Frequency (HF) indicates the parasympathetic activity. In this study shows increased weight significantly decreases the parasympathetic activity (P-Value: 0.0117)**

Many other factors like age, gender exercise, physical and mental stress, blood pressure, thermoregulation, renin-angiotensin system activity, breathing, circadian rhythm, endogenous sex hormones and other unknown factors may also influence heart autonomic control (Vallejo *et al.*, 2005). Obese persons were subjected from an increased risk of mortality due to cardiovascular disorders related to either continuously lowered parasympathetic or altered sympathetic activation (Laederach-Hofmann *et al.*, 2000). Body mass index (BMI) is a value obtained from the weight and height of a person. Adults, BMI between 25 to 30 Kg/ m<sup>2</sup> is consider as overweight and BMI greater than 30 Kg/ m<sup>2</sup> is as obesity. Low HRV is an index for risk related to a large number of diseases and adverse events in healthy individuals shows the role of ANS



**Figure 3: LF:HF ratio indicates sympathovagal balance. Because of increased sympathetic activity and decreased parasympathetic activity in the overweight subject have higher LF:HF ratio signifies increased sympathovagal imbalance. (P-Value: 0.0021)**

in health maintaining (Lutfi *et al.*, 2011). LF and HF can be also measured in normalized units (nu) to emphasize the controlled and balanced behaviour of the two branches of the autonomic nervous system (Brar *et al.*, 2015). Studies were reported that BMI and HRV has a very strong correlation in high blood pressure and obese young individuals (Sreenivas *et al.*, 2018). The present study was carried out to assess the relationship between body mass index and changes of the autonomic system in heart rate variability among young female medical students.

## MATERIALS AND METHODS

### Experimental setup and study sample

The study was carried out in the research room of the physiology department of saveetha medical college. The room had an adequate ventilation and normal environmental temperature of about 30°C- 36°C with no external noise disturbance. Participant asked to keep their electronic gadget away from them. Ethical committee approval is obtained for this study from Institutional ethical committee, Saveetha Medical College (SMC/IEC/2018/11/274). For this study, 90 voluntary students from saveetha medical college were involved. The information with respect to the study was explained and a written consent was taken from the participants and kept confidentially followed by anthropometric measurement were also taken.

All General information data like age, about medical history and cardiovascular disease and hypertension were collected. Female between 18-22 years, normotensive and euglycemic were included

**Table 1: Comparison of anthropometric data**

Parameter	Under weight	Normal weight	Over weight
Height	155.4 + 5.70	157.2 +6.96	158 + 4.06
Weight	43.3 + 3.36	52.61 +4.83	68.666 + 6.36
BMI	17.6+0.69	21.31+ 2.98	27.403 +1.96

in the study and Subjects with Diabetes mellitus, Hypertension, heart disease and Medications which affects the Autonomic Nervous System activity were excluded. Body Mass index (BMI) was calculated from anthropometric parameters, namely, height, weight without wearing shoes. Subjects were categorized into three groups based on their BMI: Group I (BMI <18.5), Group II (BMI 18.6-25) and Group III (BMI 25-30).

Heart rate variability is measured by recording the Electrocardiogram to obtain the QRS complex in digitalized physiograph for 5min using INCO-NIVIQUIRE DIGITAL ACQUISITION SYSTEM VER.52.0. In Frequency domain the high-frequency (HF) component (0.15–0.40 Hz) and low-frequency (LF) component (0.04–0.1 Hz) and LF:HF ratio were taken for this study. The method used for Comparison of autonomic changes among underweight, normal weight & over weight using Heart rate variability in young females analysing statistic was ANOVA and the significance level was set at  $p < 0.05$ .

## RESULTS AND DISCUSSION

All the data obtained from underweight, normal and overweight groups were expressed as mean  $\pm$  Standard Deviation. Statically analysis was performed to evaluate any possible relation is present between BMI and heart rate variability. The anthropometric parameters have been shown in table 1. LF/HF ratio was significantly high in those with BMI >25 kg/m<sup>2</sup> ( $P = 0.54$ ) as compared to those with BMI 20-25 kg/m<sup>2</sup> ( $p = 0.33$ ) and BMI <20 kg/m<sup>2</sup> ( $p = 0.35$ ).

Low frequency and High frequency indicate sympathetic and parasympathetic activity respectively. This study shows significant changes in HF and HF: LF ratio of HRV indicates the alternation of autonomic nervous system in obese women when compared to normal and underweight women.

The relation of BMI to HRV is correlated using Pearson's correlation. On correlation of BMI with frequency domain parameters such as ratio of LF/HF, LF and HF ratio revealed a negative relation between LF with BMI in overweight (Table 1).

The study supports finding of alterations in sym-

pathovagal balance, related to higher BMI. Main goal of the study was to detect changes of autonomic cardiovascular regulation in overweight. The risk of cardiovascular disease, respiratory disease (Poulain, 2006) and death is more in higher BMI when compare to lower BMI (Figure 1). The current study demonstrates overweight exhibit a significantly decrease in high-frequency of heart rate variability than normal and underweight individuals which may alter the autonomic function (Figure 2). In this study, LF and LF: HF ratio was significantly increased in overweight females (BMI 25–29.9 kg/m<sup>2</sup>) compared to normal-weight females (BMI 18.5–24.9 kg/m<sup>2</sup>) which indicate increased sympathetic activity and sympathovagal imbalance, respectively (Figure 3). Previous studies showed that 10% increase or decrease in weight reduces and increase parasympathetic activity respectively in both obese and non-obese subjects lead to cardiac alternation (Sheema and Malipatil, 2015; Gentile et al., 2007). Increased fat content in the body may cause activation of sympathetic nervous system directly, thus increase in norepinephrine turnover, and through leptin decrease in cholinergic activity at the cardiac level (Sheema and Malipatil, 2015).

Some studies have indicated weight gain produces sympathetic neural activation in non-obese subject (Gentile et al., 2007). The high body fat with low sympathetic activity in young healthy adult signifies that body fat percentage also influence cardiac sympathovagal balance in healthy adults (Krishna and Navekar, 2013; Wu et al., 2008). Studies have shown that susceptible individuals who have obesity and parental hypertension show a strong sympathetic overactivity due to decrease parasympathetic control, which may cause cardiovascular risks in future (Sreenivas et al., 2018). Study has also revealed that in overweight subjects there was no difference in LF, but they had reduced HF, increased LF/HF compared to normal weight subjects (Krishna and Navekar, 2013) Imbalance of the autonomic nervous system for a prolonged duration of time is an Extensive and influential risk factor for adverse cardiovascular events, including mortality (Curtis and Keefe, 2002). In obesity for a prolonged period causes reduction of autonomic activity and hence reduction in sympathetic activ-

ity (Chethan *et al.*, 2012). Patients have higher risk of cardiovascular mortality, which correlates with the decrease in HRV. There appears to be in association of increased HRV with successful treatment may help to decrease the risk of cardiovascular mortality (Stys and Stys, 1998).

## CONCLUSIONS

Present study findings made an evidence to proof that the autonomic nervous system is altered with increase body weight and decrease in parasympathetic activity may act against the obesity, thus increasing the chances of cardiac autonomic dysfunction and ultimately leading to cardiovascular disease in females.

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## Conflict of Interest

No Conflict of interest.

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