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STUDYING THE VARIABILITY IN THE HEART RATE OF OVERWEIGHT AND UNDERWEIGHT YOUNG SUBJECTS

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ABSTRACT

Background: Obesity represents excessive adipose tissue mass and is generally expressed as BMI (Body mass index). The autonomic nervous system plays a vital role in regulating body fat content and energy expenditure. HRV (heart rate variability) is one of the tests that assess the effect of autonomic regulation on the heart.

Aim: The present study aimed to assess the variability in the heart rate of overweight and underweight young subjects taken as BMI>25 kg/m2 and <18 kg/m2 respectively.

Methods: The present study included subjects aged 18-25 years to assess variations of heart rate variability in young subjects as assessed by body weight. In all the subjects from both groups, anthropometric parameters such as 5-minute supine heart rate variability, blood pressure, and resting pulse rate were assessed. Effects of body weight on heart rate variability were evaluated in two groups and were compared.

Results: The study results showed a significant decrease in higher Low Frequency Normalized Unit (LFnu), RMSSD (Square root of Mean Squared difference of successive NN interval), SDNN (Standard deviation of NN interval), High Frequency (HF), and TP (total power) in overweight group subjects compared to underweight group. The study results also showed a significant negative correlation in HFnu, LFnu, and RP (resting pulse) in the two study groups.

Conclusions: The present study concludes an autonomic dysfunction characterized by a decrease of parasympathetic and increased sympathetic activity in overweight group subjects that can result in early heart-related complications.

Keywords: Heart rate, heart rate variability, heart disease, obesity, overweight, underweight

INTRODUCTION

Derangements in nutrition pose bi-faceted effects on the BMI (body mass index) either as malnutrition owing to marginal intake or as obesity owing to excess eating. Obesity can be defined as a state of excess adipose tissue mass. The magnitude of the increase in obesity and overweight incidence is alarmingly increasing globally including in India. Presently, it has become a vital health concern in developing nations such as India. It has been estimated that nearly 20% to 40% of adults and 10%-20% of adolescent and child subjects are in developing nations. In India, nearly 8.6% and 28.9% of females from rural and urban residences and 22% of males from urban residents are obese.[1]

A reliable and convenient indicator of body fat is BMI. Obesity leads to various health concerns including psychological, gastroenterological, orthopedic, metabolic, pulmonary, and cardiovascular problems that are of significant importance in obese subjects. Obese subjects are at higher risk of mortality which can be attributed to cardiovascular disorders related to either altered sympathetic activation or decreased parasympathetic activation. Despite the relatively similar findings for an increase in the prevalence of cardiovascular disease in obese subjects, the reason for this correlation remains unclear.[2]

Existing literature data suggest that various factors are linked to the development of obesity including a reduction in high-density lipoprotein, hypertension, and insulin resistance. Also, it is suggested that a decrease in the autonomic function can be the mechanism for an increase in cardiovascular diseases in obese subjects which also plays a vital role in the regulation of body fat content and energy expenditure. HRV or heart rate variability assesses the effect of autonomic function on the heart alone. Hence, it could be the most beneficial method for assessment of the effect of obesity on cardiovascular disease.[3]

On the contrary, malnutrition is an old age concern in the Indian context. Various students in India are going to either colleges o schools without needed and adequate malnutrition. It has been considered that nearly 50 percent of Indian adults are undernourished based on the BMI assessed in kg/m2 of less than 18.5. these subjects also have deficient height which is an indicator of stunting from marginal nutrition intake in childhood.[4] Considering these factors, the present study aimed to assess the variability in the heart rate of overweight and underweight young subjects taken as BMI>25 kg/m2 and <18 kg/m2 respectively.

MATERIALS AND METHODS

The present prospective clinical study was aimed to assess the variability in the heart rate of overweight and underweight young subjects taken as BMI>25 kg/m2 and <18 kg/m2 respectively. The study was done after the clearance was given by the concerned Institutional Ethical committee. Verbal and written informed consent were taken from all the subjects before study participation.

The study included 60 subjects both genders aged 18 years or more and in the age range of 18-25 years and were students of a medical college. The inclusion criteria for the study were non-alcoholic and non-smoker subjects with no history of any significant illness. The exclusion criteria for the study were subjects with any systemic illness or hypertensive subjects. The instruments used in the study were an RMS Polywrite D instrument, a Flat comfortable cot, a height measuring stand, a weighing machine, a stopwatch, a stethoscope, and a mercury sphygmomanometer.

Before the start of the study, clinical history was recorded for all the subjects, and before starting the test, all the subjects were given 5 minutes of rest. For BMI, height and weight were assessed for all the subjects where height was assessed on measuring stand and in meters. For weight assessment, a weighing machine was used to record weight in kilograms. BMI was assessed as kg/m2.

For heart rate variability, 5 minutes of rest was advised followed by HRV determination in each subject in a comfortably lying position on the bed. Using the RMS Polyrite D instrument, continuous ECG tracings were taken for 5 minutes to attain frequency domain (spectral) analysis by TP (total power), Low-Frequency Normalized Unit (LFnu), RMSSD (Square root of Mean Squared difference of successive NN interval), LF/HF ratio and time Domain analysis by SDNN (Standard deviation of NN interval), and High Frequency (HF).

The data gathered were analyzed statistically using SPSS (Statistical Package for the Social Sciences) software version 24.0 (IBM Corp., Armonk. NY, USA) for assessment of descriptive measures, one-way ANOVA (analysis of variance), Fisher exact test, and chi-square test. The results were expressed as mean and standard deviation and frequency and percentages. The p-value of <0.05 was considered statistically significant.

RESULTS

The present prospective clinical study was aimed to assess the variability in the heart rate of overweight and underweight young subjects taken as BMI>25 kg/m2 and <18 kg/m2 respectively. The present study included 60 adult study subjects aged 18-25 years to assess variations of heart rate variability in young subjects as assessed by body weight. In all the subjects from both groups, anthropometric parameters such as 5-minute supine heart rate variability, blood pressure, and resting pulse rate were assessed. The mean age of the study subjects was 20.6±0.95 and 18.3±0.66 years in overweight and underweight groups with p=0.08. Systolic blood pressure was 117.7±8.7mmHg in the overweight group and was significantly higher compared to the underweight group where it was 113.1±5.9mmHg with p=0.03. Diastolic blood pressure was comparable in overweight and underweight subjects with p=0.45. Pulse rate was 87.51±3.0 and 71.44±3.50 beats/min in overweight and underweight

subjects and was significantly higher in overweight subjects with p=0.006. Also, BMI was significantly higher in overweight subjects with 27.2±1.02kg/m2 compared to 18.3±0.55kg/m2 in underweight subjects with p=0.03 (Table 1).

On assessing the HRV (heart rate variability) parameters in two groups of study subjects, it was seen that Sup-HF (ms2) was 516.1±171.7 and 1069.1±345.4ms2 in overweight and underweight groups and was significantly higher in underweight subjects with p<0.0001. Sup LF was statistically comparable in overweight and underweight subjects with p=0.173. Sup-TP was 1292.1±177.6ms2 in the overweight group and 1907.4±366.4ms2 in the underweight group subjects and was significantly lower in overweight group with p=0.003 (Table 2).

It was seen that concerning mean HRV parameters in overweight and underweight study subjects, Sup-RMSSD was significantly higher in underweight subjects compared to the overweight group with p=0.02. Sup-SDNN was significantly higher in underweight subjects compared to the overweight group with p=0.03. Sup LF/HN was significantly higher in an overweight group compared to underweight subjects with p=0.02. Sup-HFnu was significantly higher in underweight subjects compared to the overweight group with p<0.0001, whereas, Sup-LFnu was significantly higher in an overweight group compared to underweight subjects with p=0.001 (Table 3).

The study results showed that for the correlation of physiological traits in underweight and overweight study subjects, a significant negative correlation was seen in overweight and underweight subjects on Sup-HFnu, Sup-LFnu, and RP with correlation coefficients of -0.387, -0.384, and -0.365 respectively. A negative correlation was seen in Sup-HF and Sup-LF with a correlation coefficient of -0.210 and -0.184 respectively in the two groups under study. However, other parameters showed a positive correlation which was non-significant (Table 4).

DISCUSSION

The present study assessed 60 adult study subjects aged 18-25 years to assess variations of heart rate variability in young subjects as assessed by body weight. In all the subjects from both groups, anthropometric parameters such as 5-minute supine heart rate variability, blood pressure, and resting pulse rate were assessed. The mean age of the study subjects was 20.6±0.95 and 18.3±0.66 years in overweight and underweight groups with p=0.08. Systolic blood pressure was 117.7±8.7mmHg in the overweight group and was significantly higher compared to the underweight group where it was 113.1±5.9mmHg with p=0.03. Diastolic blood pressure was comparable in overweight and underweight subjects with p=0.45. Pulse rate was 87.51±3.0 and 71.44±3.50 beats/min in overweight and underweight subjects and was significantly higher in overweight subjects with p=0.006. Also, BMI was significantly higher in overweight subjects with 27.2±1.02kg/m2 compared to 18.3±0.55kg/m2 in underweight subjects with p=0.03. These recordings were similar to the previous studies of Sekine M et al[5] in 2001 and Pal GK et al[6] in 2012 where authors assessed subjects with demographic and disease data comparable to the present study.

For the assessment of the HRV (heart rate variability) parameters in two groups of study subjects, it was seen that Sup-HF (ms2) was 516.1±171.7 and 1069.1±345.4ms2 in the overweight and underweight group and was significantly higher in underweight subjects with p<0.0001. Sup LF was statistically comparable in overweight and underweight subjects with p=0.173. Sup-TP was 1292.1±177.6ms2 in the overweight group and 1907.4±366.4ms2 in the underweight group subjects and was significantly lower in overweight group with p=0.003. These results were consistent with the findings of Mohan V et al[7] in 2006 and Matsumato T et al[8] in 2001 where heart rate variability parameters similar to the present study were reported by the authors in their respective studies.

The study results showed that concerning mean HRV parameters in overweight and underweight study subjects, Sup-RMSSD was significantly higher in underweight subjects compared to the overweight group with p=0.02. Sup-SDNN was significantly higher in underweight subjects compared to the overweight group with p=0.03. Sup LF/HN was significantly higher in an overweight group compared to underweight subjects with p=0.02. Sup-HFnu was significantly higher in underweight subjects compared to the overweight group with p<0.0001, whereas, Sup-LFnu was significantly higher in an overweight group compared to underweight subjects with p=0.001. These findings agreed with the results of Laederach-Hofmann K et al[9] in 2000 and Sztajzel J[10] in 2004 where mean HRV parameters reported by the authors in their studies were comparable to the present study.

It was seen that for the correlation of physiological traits in underweight and overweight study subjects, a significant negative correlation was seen in overweight and underweight subjects on Sup-HFnu, Sup-LFnu, and RP with correlation coefficients of -0.387, -0.384, and -0.365 respectively. A negative correlation was seen in Sup-HF and Sup-LF with a correlation coefficient of -0.210 and -0.184 respectively in the two groups under study. However, other parameters showed a non-

significant positive correlation. These results correlated with the studies of Rastović M et al[11] in 2017 and Yadav RL et al[12] in 2017 where the correlation of physiological traits in underweight and overweight subjects comparable to the present study was reported by the authors in their respective studies.

CONCLUSIONS

Considering its limitations, the present study concludes an autonomic dysfunction characterized by a decrease of parasympathetic and increased sympathetic activity in overweight group subjects that can result in early heart-related complications. Further studies in the future with longer assessments and larger sample sizes are needed to reach a definitive conclusion.

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TABLES

S. No	Characteristics	Overweight (mean)	Underweight (mean)	p-value
1.	**Age (years)**	20.6±0.95	18.3±0.66	0.08
2.	**Systolic BP (mmHg)**	117.7±8.7	113.1±5.9	**0.03**
3.	**Diastolic BP (mmHg)**	79.0±4.69	79.7±4.22	0.45
4.	**Pulse (beats/min)**	87.51±3.0	71.44±3.50	**0.006**
5.	**BMI (kg/m2)**	27.2±1.02	18.3±0.55	**0.03**

Comparison of demographic data in two groups of study subjects at baseline

S. No	Parameters	Overweight (mean)	Underweight (mean)	p-value
1.	**Sup-HF (ms2)**	516.1±171.7	1069.1±345.4	**<0.0001**
2.	**Sup-LF (ms2)**	798.3±63.6	813.7±58.7	0.173
3.	**Sup-TP (ms2)**	1292.1±177.6	1907.4±366.4	**0.003**

Table 2: HRV parameters in two groups of study subjects

S. No	Parameters	Overweight (mean)	Underweight (mean)	p-value
1.	**Sup-RMSSD**	50.55±7.29	74.12±2.41	**0.02**
2.	**Sup-SDNN**	45.7±5.44	63.0±2.14	**0.03**
3.	**Sup LF/HN**	1.35±0.29	0.96±0.22	**0.02**
4.	**Sup-HFnu**	39.1±7.1	56.91±10.51	**<0.0001**
5.	**Sup-LFnu**	57.63±14.3	44.3±10.7	**0.001**

Table 3: Mean HRV parameters in overweight and underweight study subjects

S. No		BMI (U)	RP (U)	Sup-TP (U)	Sup-LF (U)	Sup-HF (U)	Sup-LFnu (U)	Sup-HFnu (U)	Sup LF/HF (U)
1.	**BMI (O)**	0.122							
2.	**RP (O)**		**-0.365**						
3.	**Sup-TP (O)**			0.074					
4.	**Sup-LF (O)**				-0.184				
5.	**Sup-HF (O)**					-0.210			
6.	**Sup-LFnu (O)**						**-0.384**		
7.	**Sup-HFnu (O)**							**-0.387**	
8.	**Sup LF/HF (O)**								0.023

Table 4: Correlation of physiological traits in underweight and overweight study subjects