A STUDY OF HEART RATE VARIABILITY IN UNDER WEIGHT AND OVER WEIGHT YOUNG INDIVIDUAL

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Obesity is a state of excess adipose tissue mass and it is generally expressed in terms of Body Mass Index (BMI). The autonomic nervous system plays an important role in regulating energy expenditure and body fat content. Heart rate variability (HRV) is one of the tests which measure the effect of autonomic regulation on the heart. In the present study , we have determined certain HRV related traits among two group of students having BMI>25 kg/m^2, considered as overweight (OW) and BMI<18 kg/m^2, considered as underweight (UW), age ranged 19-24 years with a view to understand the variation of HRV of young individuals as influenced by their body weight. Anthropometric measurements, resting pulse, BP and 5-minute supine HRV are recorded. Unpaired t-test and correlation study is carried out to assess the effect of body weight on HRV spectrum between two groups. This study showed a significant reduction in total power (TP), High Frequency (HF), SDNN (Standard deviation of NN interval) & RMSSD (Square root of Mean Squared differences of successive NN interval) and higher Low Frequency Normalised Unit (LFnu) in the overweight group compared to underweight group. A significant negative correlation between Resting Pulse (RP), LF_{nu} and HF_{nu} among these groups were observed. These findings demonstrate an autonomic dysfunction characterized by a reduction of parasympathetic and increase in sympathetic activity for overweight group of students which may lead to an early heart related complicacy.

Nutritional derangement produces bi-faceted effect on body mass index (BMI), either in the form of obesity due to excess eating or malnutrition due to marginal intake. Obesity can be defined as a state of excess adipose tissue mass (Kasper *et al.,* 2000). The magnitude of the upswing in overweight and obesity prevalence has been alarming (Haslam and James, 2005). It has now become an important health problem in developing countries particularly in India (Mohan and Deepa, 2006). It is estimated that 20 to 40 percent of adults and 10 to 20 percent of children and adolescent in developed countries are overweight (Park, 2011). In India 8.6 percent of women of rural and 28.9 percent of women of urban India are overweight, whereas 7.3 percent of men of rural and 22.2 percent men of urban India are obese (Ojha, 2010).

A convenient and reliable indicator of body fat is the body mass index (Park.....). Obesity results in whole spectrum of subsequent health problems of them cardiovascular, pulmonary, metabolic, orthopaedic, gastroenterological and psychosocial disorders are mention worthy. Obese persons suffer from an increased mortality risk supposedly due to cardiovascular disorders related to either continuously lowered parasympathetic or altered sympathetic activation (Park.....). Despite the relatively consistent findings of increased prevalence of cardiovascular disease in obesity, the reason for this association still remain obscure.

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Various literatures have hypothesised that many factors are associated with development of obesity such as insulin resistance, hypertension and reduced high density lipoprotein. On the other hand it has also been suggested that a reduction in autonomic function might be the mechanism for the increased prevalence of cardiovascular disease in obesity (Ganong, 2005, Laederach-Hoffman, 2000) which also plays an important role in regulating energy expenditure and body fat content (Matsumato *et al*., 1999). Heart rate variability measures the effect of autonomic function on the heart alone. Therefore, it could be the most useful method to investigate the effect of obesity on cardiovascular disease.(Matsumato *et al.*, 1999). On the other hand, malnutrition to many Indians is a age old problem. Many students of our country are going to school/ colleges without sufficient nutrition. It is estimated that approximately 50 percent of adults are undernourished on the basis mass index (BMI; kg/m^2) of less than 18.5. They also have height deficit which may be indicative of stunting brought on by marginal intakes during childhood. With this aim in view, the present study was undertaken to evaluate the correlation between BMI and Heart rate variability in overweight and underweight young adults.

MATERIALS AND METHODS

The study group constitute of thirty (30) adult person (male & female) of each group; i.e.-underweight and overweight of 19-24 years of age from 2nd and 3rd MBBS students of Dr. D. Y. Patil Medical College, Pimpri, Pune. Written and informed consent were taken from each subject. All the subjects were non smoker and non- alcoholic and have no history of any significant illness. Subjects with a history of hypertension, systemic diseases are excluded from the study. The instruments used in the study are: (i) Mercury sphygmomanometer (ii) Stethoscope (iii) Stopwatch (iv) Weighing machine (v) Height measuring stand (vi) Flat comfortable cot and (vii) RMS Polywrite D instrument

BMI : Before conducting the experiment, clinical history of all the subjects were documented and they were given a rest for 5 minutes before commencement of the test. Body mass index (BMI) of the subjects were measured by asking the subjects to stand on height measuring stand and the height is measured in meter. After that weight was measured by using weight machine and weight is recorded in kg. BMI is calculated as kg/ meter (Park....).

HRV: After a rest period of 5 minutes, HRV was determined for each of the subjects after comfortably lying down on bed (supine condition). By using RMS Polyrite D instrument continuous ECG tracing was taken for 5 minutes to obtain Frequency domain (Spectral) analysis by Total Power (TP), High Frequency (HF), High Frequency normalized unit (HFnu), Low Frequency (LF), Low Frequency normalized unit (LFnu) & LF/HF ratio and Time Domain analysis by SDNN (Standard deviation of Two Successive NN interval) and RMSSD (Square root of Mean Squared differences of successive NN interval).

Statistical analysis: Statatistcal analysis of data was done by using SPSS software. Data were expressed as Mean + SD. The level of significance between two groups was evaluated with *unpaired t-test*. Significant differences in values between two groups were accepted at p-value < 0.05. To determine correlation between HRV datas of underweight group & overweight group, *correlation study* was performed.

RESULTS

Distribution and comparison of data of the subjects under study are shown in Table 1 to Table 4. Data are expressed as Mean ± SD.

Table 1
Average values of age, BMI and basal cardiovascular parameters between Overweight and Underweight group. (N=30)

Parameters	Over-weight (OW) Mean ± SD	Under-weight (UW) Mean ± SD	OW vs UW *P-values*
Age (Years)	20.8 + 0.97	18.5 + 0.68	0.07
BMI (kg/m2)	27.4 ± 1.04	18.1 ± 0.57	0.032*
Pulse (BPM)	87.53 ± 3.2	71.46 ± 3.52	0.0071**
Systolic BP (mm of Hg)	117.9 ± 8.9	113.3 ± 6.1	0.032*
Diastolic BP (mm of Hg)	79.2 ± 4.71	79.9 ± 4.24	0.43

Data showed that there are significant differences in BMI, Resting Pulse, Resting- SBP between overweight and underweight group.

Table 2
Average values of HRV parameters of the subjects under study (N=30)

Parameters	**Over weight (OW) Mean± SD**	**Under weight (UW) Mean± SD**	**OW vs UW: *P-values***
Sup-TP (ms^2)	1292.3± 177.8	1907.6± 366.2	0.0032**
Sup-LF (ms^2)	798.1± 63.8	813.9± 58.9	0.195
Sup-HF (ms^2)	516.3± 171.9	1069.3± 345.6	0.00025**

From Table 2, it is observed that there are highly significant statistical differences in Total Power (TP), and HF between overweight and underweight group as *P-value<0.01* was accepted as statistically highly significant.

Table 3
Average values of HRV parameters [LFnu, HFnu, LF/HF, SDNN and RMSSD] between Overweight and Underweight group in Supine (Sup) position.

Parameters	Over weight (OW) Mean± SD	Under weight (UW) Mean± SD	OW vs UW: *P-values*
Sup-LFnu	57.65± 14.5	44.1± 10.5	0.0019**
Sup-HFnu	39.3± 7.3	56.93± 10.53	0.0009***
Sup LF/HF	1.37± 0.31	0.98± 0.24	0.021*
Sup- SDNN	45.9± 5.46	63.2± 2.16	0.036*
Sup-RMSSD	50.57± 7.31	74.14± 2.43	0.026*

Result obtained from Table 3 depicts that there are significant statistical differences between overweight and underweight group in Sup LFnu, LF/HF ratio, SDNN, RMSSD and highly significant statistical differences in Sup HFnu.

Table 4
Correlation coefficient (r) of certain physiological traits between Overweight(O) and Underweight(U) group

	BMI (U)	RP (U)	Sup-TP (U)	Sup-LF (U)	Sup-HF (U)	Sup-LFnu (U)	Sup-HFnu (U)	Sup LF/ HF (U)
BMI (O)	0.124							
RP(O)		-0.367*						
Sup-TP (O)			0.076					
Sup-LF (O)				-0.182				
Sup-HF (O)					-0.212			
Sup-LFnu (O)						-0.382*		
Sup-HFnu (O)							-0.389*	
Sup LF/HF (O)								0.021

***Significant at P <0.05**

A significant negative correlation is obtained between Underweight and Overweight subjects on RP, Sup-LFnu and Sup-HFnu **(Table 4)**. Sup-LF and Sup-HF showed a negative correlation only between the two group of subjects under study while other parameters show a positive but insignificant relationship.

DISCUSSION

This population based study reveals the change of HRV spectrum in accordance with BMI. The evaluation of HRV parameters in the present study also reveals a significant reduction in Total Power (TP), High Frequency (HF), SDNN (Standard deviation of NN interval) and RMSSD (Square root of Mean Squared differences of successive NN interval) and higher Low Frequency Normalised Unit (LFnu) in the overweight group compared to underweight group suggesting a cardiovascular autonomic imbalance in overweight group characterised by increased sympathetic activity and decreased parasympathetic activity.

In this study there is statistically significant increase in RP for overweight group in comparison to underweight group i.e.-tachycardia leading to statistically significant decrease in TP and SDNN which suggested an increased sympathetic activity in overweight group. Both the TP and SDNN (which are counterpart of each other) indicate global variability and sympathetic activity characterised by marked reduction of both of them in tachycardia which could be attributed to decreased variability in sympathetic activity. Sekine *et al*., (2001) had reported the similar observations where obese children and non obese children are taken as study group and control group respectively.

The efferent vagal activity is a major contributor to the HF component in spectral analysis and RMSSD in time domain analysis, as seen in clinical and experimental observations of autonomic manoeuvres such as electrical vagal stimulation, muscarinic receptor blockade, and vagotomy. In this study it is found that, in overweight group there is statistically significant decrease in RMSSD, HF and HFnu, compared to underweight group. Therefore, it can be concluded that a decreased parasympathetic activity will be the hall-mark for the overweight group of people. This finding is consistent with other study by Gutin *et al*. in (2000).

The study revealed that overweight group have statistically significant increased resting sympathetic activity as evidenced by increase in LFnu in comparison to underweight group which is considered by some as a marker of sympathetic modulation (especially when expressed in normalised units and by others as a parameter that includes both sympathetic and vagal influences when expressed as absolute power (ms^2 unit).

LF/HF ratio which indicates sympatho-vagal balance is statistically increased in young overweight subjects compared with underweight indicating obesity is associated with cardiovascular autonomic imbalance. Earlier studies reported that LF/HF, and cardiac acceleration were significantly increased in all obese groups in comparison with normal and lean controls (Akhtar *et al*., 2010; Kaufman *et al*., 2007).

A significant negative correlation was observed between RP (UW) and RP (OW) with r = -0.367* suggesting a progressive increase in RP values in case of overweight group compared to underweight group. This is due to reduced parasympathetic activity. A significant negative correlation was observed between Sup-LFnu (UW) and Sup-LFnu (OW) with r = -0.382* indicating increased sympathetic activity in overweight subjects. Again, a significant negative correlation was observed between Sup-HFnu (UW) and Sup-HFnu (OW) with r = 0.389* indicating a decrease in Sup-Hfnu values for overweight group which may be due to decreased parasympathetic activity. Similar findings were reported by multiple studies conducted by many workers. (Pal *et al*, 2012; Alpert, 2001; Tuck *et al*., 1981; Kaufman *et*

al., 2007; Bhadra *et al*., 2005)

From the above discussion, it can be seen that vagal activity is the major contributor to the HF component. It is also suggested that LF, when expressed in normalized units, could be considered as a quantitative marker of sympathetic modulations. Study conducted elsewhere viewed that LF was reflecting both for sympathetic as well as vagal activity. Consequently, the LF/HF ratio was considered by some investigators to mirror sympathovagal balance or to reflect the sympathetic modulations. The mechanism underlying these changes of parasympathetic nervous activities in overweight is, hitherto, unknown.

CONCLUSION

The present study clearly revealed that young overweight subjects have increased resting sympathetic activity as evident by elevated LF(nu) and RP and depressed TP and SDNN. A decreased parasympathetic activity as evident by decrease in HF(nu), HF and RMSSD under OW subjects indicating obesity is associated with cardiovascular autonomic imbalance. The study indicated that HRV related traits like RP, Sup-LF , Sup-HFnu and Sup-HF values should be periodically monitored for overweight group of people for early detection of heart related complicacy.

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