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A study on evaluation of correlation of BMI with autonomic function

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Abstract
Introduction: The present study has been attempted to assess relationship between sympathetic nervous system activity and body mass index using autonomic function tests as diagnostic tools, which would thus help in detecting subclinical alteration of autonomic functions.
Methods: Data such as name, age, gender etc. was recorded. The body mass index was calculated by using the formula wt[kg]/Ht[m^2]. Weight was measured with help of weighing machine and height with the help of anthropometer.
Results: There was significant difference in valsalva test, deep breadth test, orthostatic test and hand grip test in subjects with different BMI (p<0.05).
Conclusions: Authors found that there is a relationship of cardiovascular autonomic function with BMI. Sympathetic imbalance was seen in moderately obese and obese subjects.

Keywords: BMI, autonomic function, ANS

Introduction

Any factor that leads to inappropriate activation of the sympathetic nervous system can be expected to have an adverse effect on this measures. Any factor that augments vagal tone tends to improve outcome [1]. Factors linking obesity to increase BP and blood volume and cardiac output that is caused by increased metabolic demand. There is enough previous study to prove that sympathetic activity has been enhanced in obesity and increased vagal tone in people with underweight [2]. The autonomic nervous system (ANS) contributes to the modulation of the energy expenditure of the human organism.

Weight of an individual depends on the balance between one's energy intake and energy expenditure. The autonomic nervous system (ANS) plays a major role in the integrated regulation of food intake, involving satiety signals and energy expenditure; thus, ANS dysregulation could be the factor favouring body weight gain. ANS dysfunction has a two-way relationship with obesity; alterations of the ANS might be involved in the pathogenesis of obesity whereas on the other hand the excess weight induces ANS dysfunction [3]. The altered function of ANS in obesity consequently leads to cardiovascular disorders. Hence the study of ANS function in obesity is of considerable clinical interest [4]. Obesity and more specifically visceral obesity has been found to be strongly associated with hypertension and increased cardiovascular risk [5]. Disturbed sympathetic nerve function may be of significance in obesity [6]. SNS is the primary regulator of cardiovascular system activity; obesity might trigger alteration in the sympathetic regulation of cardiovascular function, thus favouring the development of cardiovascular complications and morbidity [7].

BMI is a simple index of weight for height commonly used to classify underweight, normal, overweight and obesity in adults. It is defined as the weight in kgs divided by height in metres square (kg/m^2) [8]. WHO has set standards for overweight and obesity by defining it as BMI ≥25 kg/m^2 and ≥30 kg/m^2 respectively. But, the BMI cut off point for overweight (≥23 kg/m^2) and obese (≥25 kg/m^2) for Asians are lower than the WHO criteria [9]. Autonomic nervous system (ANS) is a vital centre for the coordination of different body systems [10]. Since ANS is involved in energy metabolism and regulation of cardiovascular system [10, 11], Previous studies strongly suggest that obesity might be linked with not only higher risk factor for Cardiovascular Heart Disease (CHD) but also reduced ANS activity [12]. Thus, the present study has been attempted to assess relationship between sympathetic nervous system activity and body mass index using autonomic function tests as diagnostic tools, which would thus help in detecting subclinical alteration of autonomic functions.

Materials & Methods

The study was approved from ethical committee. All were informed regarding the study and written consent was obtained.

Data such as name, age, gender etc. was recorded. The body mass index was calculated by using the formula wt[kg]/Ht[m^2]. Weight was measured with help of weighing machine and height with the help of anthropometer. For parasympathetic function deep breath test and valsalva test were performed. For Sympathetic function hand grip test and orthostatic test were done. Results were subjected to statistical analysis. P value less than 0.05 was considered significant.

Inclusion criteria

The subjects without signs of cardiovascular, endocrinological, neurological, hematological and inflammatory diseases were selected for the study.

Exclusion criteria

- Subjects with history of alcohol intake and tobacco consumption in any form.
- Clinical signs of cardiac failure or ECG changes suggestive of arrhythmia, Ischemia.
- Subjects having diabetes mellitus, hypertension, bronchial asthma, giddiness on standing, syncopal spells, visual disturbances, nocturnal diarrhoea.
- Associated disease or conditions known to affect autonomic function like Guillain Barre syndrome, Poliomyelitis, Diphtheria, Tuberculosis, Syphilis, Amyloidosis, Chronic renal failure.

Statistical Analysis

Statistical analysis was performed by the SPSS program for Windows, version 17.0. Continuous variables are presented as mean ± SD, and categorical variables are presented as absolute numbers and percentage. Normally distributed continuous variables were compared using Student's *t*-test assuming standard assumptions regarding variability. Categorical variables were analyzed using the chi square test. For all statistical tests, a p- value less than 0.05 was taken to indicate a significant difference.

Results

Table 1 shows that out of 140 subjects, males were 80 and females were 60.

Table 1: Distribution of patients

Total- 140		
Gender	**Males**	**Females**
Number	80	60

Table 2, graph 2 shows that there was significant difference in valsalva test, deep breadth test, orthostatic test and hand grip test in subjects with different BMI (p<0.05).

Table 2: Autonomic function test according to BMI

BMI	Valsalva test	Deep breadth test	Orthostatic test	Hand grip test
<19.3 (16)	1.56	23	11.3	12.2
19.3-25.6 (81)	1.59	20.1	10.4	19.1
26-30.2 (16)	1.52	20.4	9.6	23.5
31-42 (6)	1.47	19.5	8.3	24.1
P value	0.06	0.05	0.01	0.03

Discussion

There is evidence that sympathetic activity has been enhanced in obesity and an enhanced vagal tone in chronically undernourished subjects. Previous studies show complex relationships between various body mass indices, body fat and autonomic control of the heart. No BMI status was related to LF power but HF (high frequency) power and the LF/HF ratio differed among various body weight groups classified into underweight, normal weight, overweight and obese [13]. The present study was conducted to assess relation of BMI with autonomic function.

In present study, out of 140 subjects, males were 80 and females were 60. We found that there was significant difference in valsalva test, deep breadth test, orthostatic test and hand grip test in subjects with different BMI (p<0.05).

Hazarika *et al*. 2012 [14] conducted a study to establish the relation of BMI on cardiovascular autonomic functions. Patients were divided into four groups according to BMI, normal, moderately obese, obese and underweight. Various autonomic tests such as deep breadth and valsalva ratio for parasympathetic function, and hand grip test and orthostatic hypotension test for sympathetic function were performed. It was seen that sympathetic activity increased as BMI increased and parasympathetic activity decreased as there was significant decrease in the valsalva ratio and deep breadth test in moderately obese and obese compared to the normal BMI. On the other hand there was a significant increase in handgrip test and orthostatic hypotension test in obese compared to that of normal BMI.

Other studies have reported different results. Colak *et al*. 2000 [15] and Pal *et al*. 2015 [16] reported hypoactivity of sympathetic nervous system and normal parasympathetic system activity in obese individuals. Shetty *et al*. 2015 [17] and Yakinci *et al*. 2000 [18] found decreased parasympathetic activity but no significant difference in sympathetic activity in overweight individuals. Lower sympathetic and parasympathetic activity in obese children and adolescents was reported by Nagai *et al*. 2003 [19] These conflicting results could be because of the fact that different age groups were recruited in the study and there was difficulty in controlling variables such as family history, diet, level of physical activity and stress [20]. The physical activity profile of the subject affects the cardiorespiratory fitness and hence parasympathetic nervous activity.

Another reason for varying results could be duration of obesity and the fact that autonomic alterations may be more related to body fat percentage rather than BMI which does not differentiate between fat weight and fat free weight [21]. Also, different guidelines are taken for classification of obesity by different authors. Recent comparative studies have shown that Indians have a higher percentage of body fat for a given BMI compared with white Caucasians and African-American but lower muscle mass [22]. In a review study, William *et al*. [23] reported evidence of association between central obesity (increased waist to hip ratio) and dysregulation in cardiac autonomic functions, consequently leading to cardiovascular autonomic neuropathy (CAN). Similar observations were reported by Oliveira *et al*. [24] in their study. The authors of these studies emphasize upon the screening and diagnosis of autonomic dysfunction at an earlier stage when risk factors modification and reversibility is possible.

Conclusion
Authors found that there is a relationship of cardiovascular autonomic function with BMI. Sympathetic imbalance was seen in moderately obese and obese subjects.

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