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Original Research Article.

Comparison of Autonomic Function in Obese and Non-Obese Medical Students

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ABSTRACT

Background: Prevalence of overweight and obesity is increasing in adolescents in India which is a concern in terms of the complications being seen in the later stage of life if not taken care of in time. Obesity is a condition in which excess body fat accumulates to the extent that it may have an adverse effect on health.

Subjects and Methods: Total of 50 Students in the age group 18-25 years were randomly selected to obtain mixed group of students from Hi-Tech Medical College and were screened to identify, (i) Non obese group- A: healthy with BMI 18.5-24.9kg/m^2; and (ii) Study group-B (obese): healthy with BMI > >30kg/m^2.

Results: Two groups for the study were similar in age in terms of basic characteristics. Group A and Group B showed significant difference in Height, Weight and BMI ($p<0.01$) Conclusion: Person with obesity with higher BMI are at high risk for autonomic dysfunction as compared to person with normal weight.

Conclusion: These findings suggest that in person with obesity with higher BMI are at high risk for autonomic dysfunction as compared to person with normal weight. This paves the way for implementation of early interventional programs (weight reduction, life style changes, and physical exercises) to prevent the onset of obesity related cardiovascular sequelae in the future by early intervention.

Keywords: Obesity, Body Mass Index (BMI), Blood Pressure, Autonomic Nervous System, Cold Pressure test.

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INTRODUCTION

The prevalence of obesity is rising in developed and developing nations and has been called as “New World Syndrome”.[1] Prevalence of overweight and obesity is increasing in adolescents in India which is a concern in terms of the complications being seen in the later stage of life if not taken care of in time. Obesity is a condition in which excess body fat accumulates to the extent that it may have an adverse effect on health.[2]

Obesity has been a common and significant health hazard.[3] At an individual level, an excess of energy intake and an inadequacy of energy expenditure is thought to explain most cases of obesity.[4,5] A complex interlink among different factors like endocrine, nervous, metabolic factors maintains constant energy storage.[6] Obesity is considered to be a risk factor for a variety of cardiovascular conditions like hypertension, ischemic heart disease and stroke and is characterized by hemodynamic and metabolic alterations.[7]

Autonomic nervous system is a centre for coordination of different body system.[8] Since the ANS is involved in energy metabolism and in the regulation of the cardiovascular system[9-11], it is conceivable that one or more subgroups of persons with idiopathic obesity have an alteration in their autonomic nervous system that may account for several clinical consequences of obesity.[8] Laitinen et al.[12] showed that total body fat and central body adiposity are associated with altered autonomic activity. The present study was designed to evaluate any alternation in cardiac autonomic function in obese and non-obese medical students.

MATERIALS AND METHODS

This present study was conducted in the department of physiology, Hi-Tech Medical College and Hospital, Bhubaneswar during the period from October 2012 to August 2018. Total of 50 Students in the age group 18-25 years were randomly selected to obtain mixed group of students from Hi-Tech Medical College and were screened to identify, (i) Non obese group- A: healthy with BMI 18.5-24.9kg/m^2; and (ii) Study group-B (obese): healthy with BMI > >30kg/m^2.

Table 1: WHO Classification of adults according to BMI

Classification	BMI (kg/m²)
<18.5	Underweight
18.5-24.9	Healthy
25-29.9	Overweight
30-39.9	Obese
>40	Morbid obese

Inclusion Criteria: Students in the age group of 18-25 years; Students who are obese to their respective age and sex were selected. 25 obese students and 25 non-obese students were selected according to the parameters mentioned.

Exclusion Criteria: Students suffering from any medical ailments; anxious, apprehensive and uncooperative students and any history of smoking, addiction of tobacco, use of any medications to be excluded from the study. Institutional ethical clearance was obtained. Body mass index was calculated as per the formula:

Body Mass Index (BMI) = Weight (Kg) / Height (m^2)

The students having BMI of more than the cut-off value for their respective age and sex were designated as the test/obese group (both overweight and obese students to be clubbed together). Identical number of age and sex matched non-obese medical students served as controls. Students were explained about the procedures to be undertaken. A brief personal history was taken and written consent was obtained as per Helsinki declaration modified according to the test protocol, (i) The subjects were made to rest for 10 min before recording their baseline systolic and diastolic blood pressure along with mean blood pressure as per standard procedure. (ii) Two recordings of blood pressure were taken from which the average baseline blood pressure (systolic or diastolic) was obtained before each of the following test.

FOR ASSESSING PARASYMPATHETIC ACTIVITY

1. Resting heart rate was calculated from ECG by using standard limb leads.[13]
2. Heart rate response to standing (30:15 ratio) was calculated as the ratio between the R-R interval at beats 30 and 15 of the ECG recorded immediately upon standing.[14]
3. The S: L (standing to lying) ratio was taken as the ratio of the longest R-R interval during the 5 beats before lying down to the shortest R-R interval during the 10 beats in the ECG after lying down.[15]
4. The Valsalva ratio. Subjects were instructed to exhale into a mouthpiece connected to a mercury manometer and to maintain the expiratory pressure of 40 mmHg for 15 Sec. ECG was recorded during the manoeuvre and 45 sec after the manoeuvre. The ratio was calculated between the maximum R-R interval (after release of strain) and the minimum R-R interval (during strain)[16]
5. Heart rate response to deep breathing: Heart rate was recorded first during normal. Breathing (at rest), and then during deep breathing (6/min). ECG 3rd & 6th respiration, minimum R-R intervals and corresponding heart rate were calculated.[17]

FOR ASSESSING SYMPATHETIC ACTIVITY

Isometric Hand Grip Exercise Test: Before the exercise, subjects were allowed to rest for 10 minutes in a quiet room to reduce the anxiety. Resting blood pressure of all the subjects was measured by the auscultatory method with the help of a mercury sphygmomanometer (DIAMOND). First Korotkoff sound indicated systolic blood pressure (SBP) and fifth Korotkoff sound indicated diastolic blood pressure (DBP). Isometric handgrip exercise test was done in both the study group and control groups. After recording basal blood pressure, subjects were asked to perform isometric handgrip exercise. Subjects were told to hold the handgrip spring dynamometer in the right (or dominant hand) to have a full grip on it. Handles of the dynamometer were compressed by the subject with maximum effort for few seconds. This whole procedure was repeated thrice with rest in between to prevent fatigue. Mean of the three readings was referred as maximal isometric tension (T max). Then, the subjects were asked to perform isometric handgrip exercise at 30% of T max for 2 minutes. During the test, blood pressure was recorded from the non-exercising arm. Blood pressure was again recorded 5 minutes after completion of the exercise.[18]

Cold Pressor Test: After recording basal blood pressure, subjects were asked to dip left arm in the cold water (temp at 2-4 ^{0}C) for 2 minutes and blood pressure was recorded from the right arm. Blood pressure was once again recorded 5 minutes after hand was taken out from the cold water.[19]

Statistical Analysis

Results were analyzed by using Unpaired Student T-test with "P" value < 0.05 for significance.

Table 2: Anthropometric variables

Parameters	Group-A	Group-B
Height (mts)	168.5 ± 11.24	164 ± 9.2
Weight (kgs)	56.02 ± 8.36	77.21 ± 8.41
BMI (kg/m²)	19.08 ± 2.52	30.21 ± 5.36

Table 3: Parasympathetic function tests in between Group A and Group B

Parameters	Group-A	Group-B	P value
Heart rate response to standing (30:15 ratio)	1.13± 0.1	1.05±0.02	<0.05
S:L (standing to lying)ratio	1.3±0.02	1.12±0.02	<0.05
Valsalva ratio	1.63±0.23	1.46±0.12	<0.05
Heart rate response to deep breathing (HRDB)	22.42±4.21	16.36±2.1	<0.05

Table 4: Sympathetic function tests in between Group A and Group B

Parameters	Group-A	Group-B	P value
IHG SBP	12.3±1.3	8.4±1.2	<0.05
IHG DBP	12.2±1.5	8.2±1.1	<0.05
CPT SBP	12.3±1.5	8.3±1.3	<0.05
CPT DBP	13.2±1.7	9.2±1.6	<0.05

RESULTS AND DISCUSSION

50 subjects [Group A (non-obese): n = 25 and Group B (obese): n = 25) that have satisfied the inclusion and exclusion criteria were selected. Two groups for the study were similar in age in terms of basic characteristics. Group A and Group B showed significant difference in Height, Weight and BMI ($p<0.01$) Table-2. Table 3 shows that there was significant decrease in the Heart rate response to standing (30:15 ratio), Valsalva ratio & Heart rate response to deep breathing (HRDB) in Group B individuals as compared to Group A ($p<0.05$). S:L ratio also decreased, and the decrease was statistically significant ($p<0.05$). Table 4 shows that there was significant decrease in the systolic and diastolic blood pressure in obese subjects (group B) as compared to controls (group A) during the application of isometric handgrip exercise and cold pressor tests ($p<0.05$) and the decrease was statistically significant ($p<0.05$).

The present study was designed to evaluate any alternation in cardiac autonomic function in obese and non-obese person by evaluating the sympathetic and parasympathetic tests. The results of the present study show that the valsalva ratio, heart rate response to deep breathing and heart rate response to standing (30:15) in obese subjects were significantly lower as compared to the control group, it indicates decrease in parasympathetic nerve function and baroreflex sensitivity in obese subjects. Baroreceptors resetting may occur in obese individuals due to atherosclerosis that

hardens the carotid sinus walls. This decreases compliance. Obese group is less responsive to blood pressure changes to posture. Similar results were shown by some other investigators.[20-22] There was less increase of blood pressure response to cold pressor test in the obese people in contrast to the control group. The afferent fibres for this response are the pain fibres which are stimulated by placing the hand in cold water and the efferent fibres are the sympathetic fibres. A lesser increase in the blood pressure after the cold-water immersion points towards sympathetic insufficiency in obese subjects. Obesity impairs autonomic control of heart rate and blood pressure. Obese subjects exhibit lower sympathetic response on exposure to cold. This present study results were in accordance with reported study of Monterio et al.[23] There was also decreased in blood pressure response to isometric handgrip exercise test in the obese people in contrast to the control group. It shows the decreased activity of the sympathetic nervous system[24] or to a lower increase in peripheral resistance to manoeuvres activating sympathetic system.[25] Baek et al.[26] stated that in normal conditions sympathetic activity increases during isometric handgrip exercise and cold pressor test. This reduced sympathetic reactivity in established obesity may be responsible for the maintenance of obese state. Valensi et al.[21] have demonstrated sympathetic insufficiency in obese people. It was shown that glucose induced inhibition of the lipid oxidation rate in obese people is greater in the patients with autonomic dysfunction which could be due to decrease in parasympathetic activity. Decrease in the sympathetic activity may result in a disordered homeostatic mechanism thus promoting excessive storage of energy as suggested by Peterson. It has been shown that increased sympathetic activity induced by cold water stress causes norepinephrine release and elevation of blood pressure more in obese subjects. This greater increase in blood pressure might be contributed by more release of endothelins, prostaglandins and angiotensin II[28,29] in obese. Various investigators have shown that parasympathetic damage or decreased vagal tone may occur due to hyperinsulinaemia or insulin resistance or there may be decreased in baroreflex activity.[27] Therefore our study have found that BMI is a good indicator of cardiovascular autonomic dysfunction risk factors, and should be incorporated into a public message and awareness programs.

CONCLUSION

These findings suggest that in person with obesity with higher BMI are at high risk for autonomic dysfunction as compared to person with normal weight.

This paves the way for implementation of early interventional programs (weight reduction, life style changes, and physical exercises) to prevent the onset of obesity related cardiovascular sequelae in the future by early intervention.

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