

A Comparative Study of Sympathetic Activity in Normal and Obese Young Adults

Mohd. Noorjahan Begum¹, Vandali Jyothi², Palavardhan P.³

Abstract

Author's Affiliations:

^{1,2}Assistant Professor, Department of Physiology, ³Lecturer in Statistics, Department of Community Medicine, Malla Reddy Medical College for Women, Qutubullapur, Hyderabad, Telangana 500055, India.

Corresponding Author:

Vandali Jyothi,

Assistant Professor, Dept. of Physiology, Malla Reddy Medical College for Women, Suraram, Qutubullapur, Hyderabad, Telangana 500055, India.
E-mail: jyothisrao@ymail.com

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Obesity among children, adolescents has emerged as one of the most serious public health concerns in 21st century together can increase the risk of cardiovascular diseases, insulin resistance and dyslipidemia. *Aims:* A comparative study between BMI & BP with CPT and Isometric handgrip dynamometer test for sympathetic activity. *Objective:* To study the sympathetic activity with normal weight young adults and obese young adults. *Material Methods:* A total of 100, of 50 normal weight and 50 obese medical and dental students in age group of 18-22 years. Each subjects Basal Blood pressure was recorded and evolution of sympathetic function test was done by using cold pressor test (CPT) and Isometric hand grip dynamometer test (IHD). Analysis of data was performed by SPSS 21. *Results:* Sympathetic activity test values between obese non obese students significant differences was observed this indicates deranged sympathetic activity in obese. *Conclusion:* Weight gain will cause sympathetic abnormality and prone to have hypertension & cardiovascular diseases.

Keywords: Cold Pressor Test; Isometric Handgrip Dynamometer; Obese.

Introduction

Obesity is a condition in which imbalance between energy intake and energy expenditure. It may have an adverse effect on health with continued rise in standards of living. Obesity is emerging as a global epidemic in both children and adults. This has been called "New world syndrome" and is a reflection of massive social, economic & cultural problems currently facing developing and developed countries [1]. Obesity can be quantified by using various anthropometric measurements and derivations. Body mass index (BMI) is such an important indicator of obesity. It has been observed that Asians are more prone to obesity - related disorders when compared with BMI - matched individual from others ethnicities [2-4]. Studies Literature suggest the ANS of obese individuals is chronically altered [5-6].

The cold pressor test (CPT) assesses the cardiovascular activity in response to any stress. An

abnormal response to (CPT) cold Pressor test is a predictor to future hypertension [7]. Isometric handgrip is a classical sympathetic excitatory stimulus after used in autonomic testing [8].

The sympathetic Nervous system (SNS) plays an essential role in the regulation of metabolic and cardio vascular homeostasis. Low SNS activity has been suggested to be a risk factor for future weight gain and obesity development (Ravussin & Tatarranni 1996).

Materials and Methods

The present study was carried out on 100 Medical and Dental students of which 50 subjects BMI >30kg /m² were included in study group and 50 subjects were included in control group BMI 18-24.9 kg/m². The age group of 18-22 years leading a sedentary life style was included.

Exclusion Criteria: Suffering from any clinical diseases likely to affect ANS. History of smoking / alcohol / drug abuse.

The present study was conducted at Malla Reddy Health city Suraram, Jeedimetla, Hyderabad. After obtaining the prerequisite approval from Institutional ethics committee. Written informed consent was taken from each participant after describing detail procedure and purpose of the study.

All recording were done in physiology laboratory between 11-1.00pm & 2.00 to 4.00pm.

Cold Pressor Test (CPT)

The subjects were asked to take rest for 10-15min and then the basal blood pressure (BP) was recorded in sitting position by Auscultatory method. The right and of the subject is immersed up to wrist in cold water at a temp of 1-4°C for 1min. Blood pressure was recorded after 30 sec & 1min of submersion of the hand [9,10].

Handgrip Dynamometer Test (1HD)

Basal Blood pressure (BP) values were recorded in the sitting position. The subjects were asked to perform maximal voluntary contraction (MVC) by gripping the handgrip dynamometer as hard as possible for few seconds & the maximum force exerted was noted. The subjects were made to perform isometric exercise at 30% of the maximal voluntary contraction to the point of fatigue for 5 min then Blood pressure was recorded [9,10].

Statistical Analysis

Data was analyzed by SPSS (statistical package of social science version 21) mean standard deviation used to summarize.

The results of study were expressed in mean standard deviation and study group were compared with the control group mean standard deviation (SD).

Significant value show as $p < 0.05$, non Significant value show as $p > 0.05$

Result

About 50 study (obese) and 50 control (normal weight) subjects (medical & dental students) Participated in this study.

Control group: Normal weight – subjects BMI is 18.5- to 24.9 kg/m^2

Study group: Obese – BMI is – more than 30 kg/m^2

The mean standard deviation BMI of cold presser test & Handgrip dynamometer study group was $30.03 \pm 3.42 \text{kg/m}^2$ and that of control group was $22.58 \pm 1.57 \text{kg/m}^2$. The difference between groups was statistically significant $p < 0.05$

Table 1: Cold pressor test (CPT). Mean SD basal systolic blood pressure in study group is $116.5 \pm 13.35 \text{mmHg}$ and control group is $113.96 \pm 10.66 \text{mmHg}$ and this was statistically non significant $p > 0.05$.

Table 1: Cold Pressor Test

| Parameters | Control (Normal) Mean \pm SD | Study (Obese) Mean \pm SD | P- Value |
|---------------------|--------------------------------|-----------------------------|----------|
| BMI | 22.58 \pm 1.57 | 30.03 \pm 3.42 | <0.05 |
| Basal SBP | 113.96 \pm 10.66 | 116.5 \pm 13.35 | >0.05 |
| Basal DBP | 69.3 \pm 6.45 | 77.14 \pm 7.69 | <0.05 |
| CPT after 30sec SBP | 135.28 \pm 9.08 | 130.82 \pm 9.70 | <0.05 |
| CPT after 30sec DBP | 83.62 \pm 6.52 | 86.28 \pm 8.07 | >0.05 |
| CPT after 1 min SBP | 133.26 \pm 10.45 | 121.98 \pm 8.74 | <0.05 |
| CPT after 1 min DBP | 82.4 \pm 8.17 | 84.08 \pm 7.10 | >0.05 |

Note: CPT – Cold pressor test

Table 2: Isometric handgrip dynamometer

| Parameters | Control (Normal) Mean \pm SD | Study (Obese) Mean \pm SD | P value |
|---------------------|--------------------------------|-----------------------------|---------|
| BMI | 22.58 \pm 1.57 | 30.03 \pm 3.42 | <0.05 |
| Resting SBP | 113.96 \pm 10.66 | 116.5 \pm 13.35 | >0.05 |
| Resting DBP | 69.3 \pm 6.45 | 77.14 \pm 7.69 | <0.05 |
| 1HD after 5 min SBP | 108.22 \pm 8.78 | 117.2 \pm 9.02 | <0.05 |
| 1HD after 5 min DBP | 90.76 \pm 5.14 | 88.88 \pm 7.13 | >0.05 |

NOTE: Isometric Hand grip Dynamometer

The mean SD of basal diastolic Blood pressure is in study group is 77.14±7.69 mmHg and control group is 69.3±6.45 mmHg and was statistically significant p<0.05.

Cold Pressure Test (CPT) after 30sec:

Mean SD SBP in study group is 130.82±9.70 mmHg in control group is 135.28±9.08 mmHg P<0.05 statistically significant.

Mean, SD Diastolic (DBP) is 86.28±8.07 mmHg in study group, in control group 83.62±6.52 mmHg .P> 0.05 which is not significant.

Cold Pressor Test after 1 min

Mean SD SBP in study group is 121.98±8.74 mmHg & in control group mean SD SBP 133.26±10.45 mmHg. p<0.05 significant.

Mean SD DBP in study group 84.08±7.10 mmHg and in control DBP is 82.4±1.7 mmHg p>0.05 not significant.

Table 2 Isometric Handgrip dynamometer (IHD).

The mean SD BMI of study group is 30.03±3.42 kg/m² and in control group is 22.58 ±1.57Kg/m². p<0.05 is Significant.

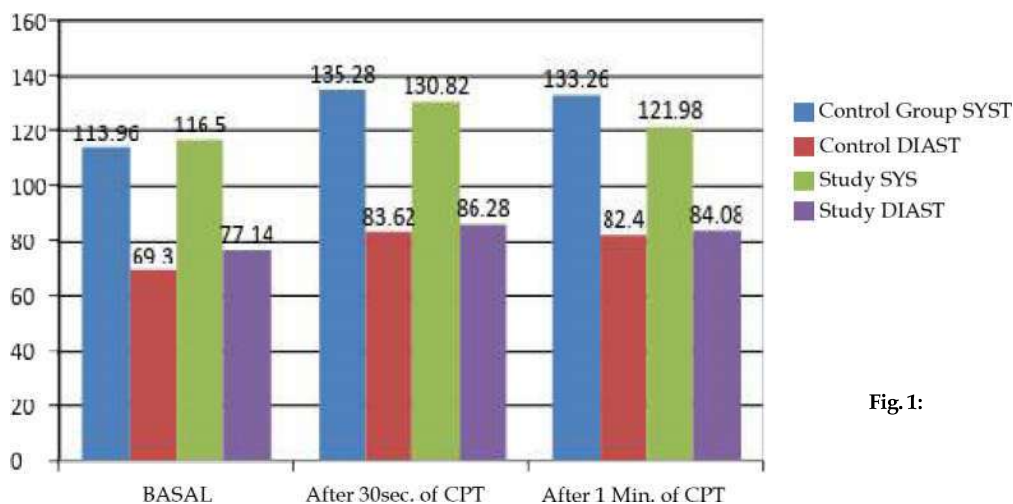


Fig. 1:

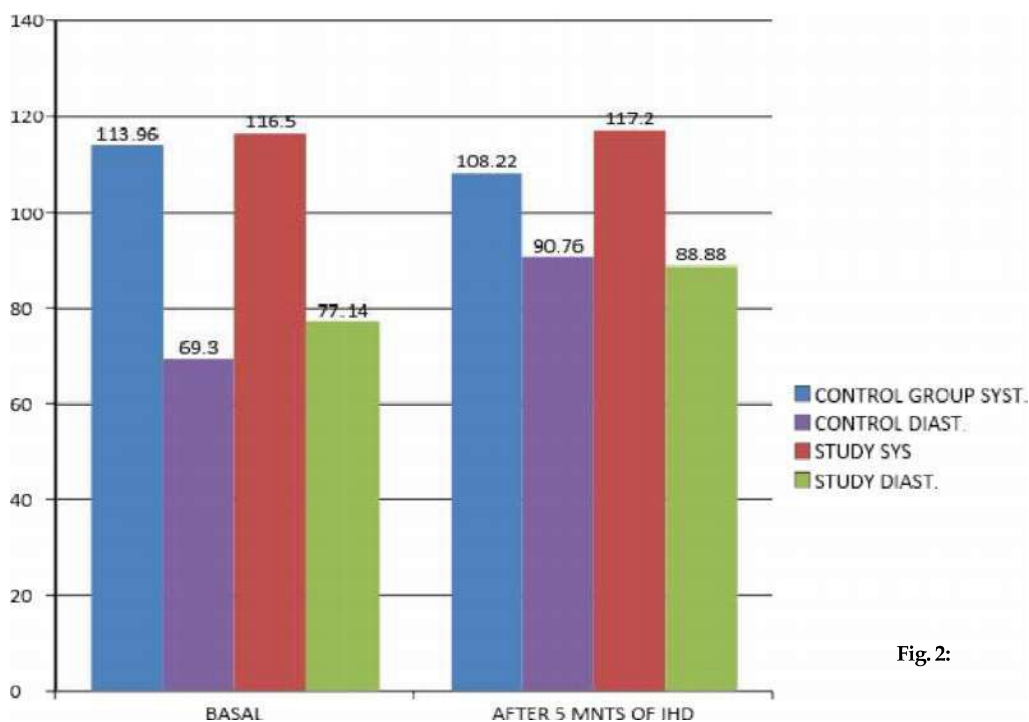


Fig. 2:

Basal SBP mean SD in study group is 116.5 ± 13.35 mmHg and is control group is 113.96 ± 10.66 mmHg $p > 0.05$ not significant.

Basal DBP mean SD in study group is 77.14 ± 7.69 mmHg and control group 69.3 ± 6.45 mmHg $p < 0.05$ significant.

Handgrip Dynamometer after 5mins (IHD)

Mean SD SBP is 117.2 ± 9.02 mmHg in study group in control group is 108.22 ± 8.78 mmHg $p < 0.05$ significant.

Mean SD DBP in study group is 88.88 ± 7.13 mmHg and control group 90.76 ± 5.14 mmHg. $p > 0.05$ not significant.

Discussion

Temperature affects the heart rate and blood pressure (BP). The cold pressor test used to assess a person's response to environmental stimuli. The changes in the BP after the cold pressor test helps in evaluating the cardiovascular autonomic activity to stress [11].

The present study the mean changes in systolic blood pressure & diastolic blood pressure between study group (obese) and control (normal weight) group were compared.

In obese CPT is impaired due to decreased sympathetic Nervous system activity. There was a reduced sympathetic responsiveness associated with thermo regulators demonstrated by abnormal heart rate variability on cold exposure [12].

30sec after cold pressor test raise in SBP in control group when compared to study group. where as in DBP raise is observed in study group compared to control group.

1min after CPT- raise in SBP is observed to control group, when compared to study group. DBP raised in study group but decreased in control group.

Increased in DBP after CPT in obese due to increased peripheral resistance.

Isometric exercise known to increase intramuscular pressure, decreasing active skeletal muscle blood flow and leading to accumulation of metabolites response for stimulating the metaboreflex [13,14,15].

In Handgrip dynamometer test after 5 min in control group decreased SBP was observed when compared with study group but DBP was raised in control group than study group.

Ewing et al. [16] have defined a raise of DBP of 15 mmHg or more as normal, 11-15 mmHg as border line and 10mmHg or less as abnormal, response to hand grip dynamometer test. Hence finding of our study suggested impaired Autonomic Nervous system function (both sympathetic & Parasympathetic) in study group [1].

The literature mentions, in normal healthy persons sympathetic system gets activated leading to

1. Activation in cardiac sympathetic fibres causing increase in heart rate dependent increase in cardiac output and blood pressure.
2. Activation of peripheral sympathetic fibres to blood vessels causing, vasoconstriction and resultant increase in total peripheral resistance.

The obese group showed a decreased response to isometric handgrip exercise test indicating there is cardiac sympathetic activity instability [17].

The lower BP response in Obese group is more likely to be lower cardiac sympathetic activation or to a lower increase in peripheral vascular response to manoeuvres activating sympathetic system [18]. The derangements in sympathetic cardiovascular function in the form of prolonged QT interval, elevated baseline SBP, DBP and decrease in response to handgrip dynamometer exercise test in obese group points towards autonomic imbalance. This autonomic imbalance is a risk factor for CVD in obese Indians in later part of their life.

Conclusion

There was marked difference in sympathetic activity test observed in obese (BMI more than 30 kg/m^2) when compared to normal weight (BMI $18.24.9 \text{ kg/m}^2$) subjects. One of the predisposing factors to life style disease is stress. Medical students they are in stress during their education. CPT and IHD are non invasive, simple tests are used to screening for cardiovascular risk factors. Which helps to prevent the co morbid conditions in advance in obese.

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