

# A study of sympathetic function tests in obese females

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## Abstract

**Background:** Obesity is a medical condition in which excess body fat accumulates to an extent that it poses a negative effect on health, leading to decrease in life expectancy and increased health problems. The present study is designed to see the effect of adiposity and body mass index (BMI) on sympathetic function tests to avoid further cardiovascular complications. **Aims and Objectives:** The aim of the study is to carry out sympathetic function tests in obese females. **Materials and Methods:** The study was carried out in 50 obese females of BMI >30kg/m<sup>2</sup> and W/H ratio >0.85 of age between 30 -40 years. Non Obese females having BMI < 25kg/m<sup>2</sup> and W/H ratio < 0.85 were selected. They undergo the sympathetic function tests such as blood pressure (BP), orthostatic variation in BP, and cold pressor test. Statistical analysis was done by student paired t-test. **Result:** BMI and W/H ratio were significantly higher in obese females. Response to various sympathetic tests was altered in obese females as compared to non obese females reflecting highly significant increase in the sympathetic activity. **Conclusion:** Obesity leads to autonomic dysfunction in the form of sympathetic excitation

**Key Words:** Autonomic Nervous System; Body Mass Index (BMI), Waist Hip ratio (W/H ratio), Sympathetic Activity, Obesity

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## INTRODUCTION

Obesity is a serious health problem considered as a global epidemic.<sup>1</sup> It has been called as New world Syndrome and is reflection of massive social, economic and cultural problems currently facing developing and developed countries.<sup>2</sup> It is suggested that obesity resulted an imbalance between energy intake and expenditure resulting from complex interaction of genetic, physiological, behavioural and environmental factors. In particular, obesity in the female population rapidly increases after middle age. Various explanation put forward for this that reduced basal metabolic rate due to

lack of physical activity, decrease in the growth hormone and oestrogen, and overeating.<sup>3</sup> Chronic exposure to environmental stress may play a role in the development of obesity through hyperactivation of the hypothalamo-pituitary-adrenocortical axis.<sup>4</sup> Abdominal obesity and its metabolic consequences are significantly correlated with stress related conditions.<sup>5</sup> It is mentioned that one or more sub groups of obesity have an alteration in their autonomic nervous system (ANS) that may promote obesity.<sup>6</sup> ANS of obese individuals is chronically altered.<sup>7,8</sup> It is frequently said that the purpose of the sympathetic system is to provide extra activation of the body in states of stress this is called as the sympathetic stress response.<sup>9</sup> Very less research studies available for stress response (sympathetic function tests) in obese females. Hence in this research work we have studied the sympathetic function tests in obese female to assess the stress response in them.

## MATERIALS AND METHODS

The study of sympathetic function tests was carried out in 50 obese and equal number of non obese female volunteers between the age group of 30-40 years from general population of town area. All were from the

middle socioeconomic class. The approval for the study was obtained from Institutional Ethics committee.

**Exclusion Criteria**

**Volunteers** All the volunteers were assessed for sympathetic function tests during proliferative phase. All tests were carried out in the morning hours. They were asked to abstain from tea or coffee for 12 h before the procedure. Before starting the procedure, physical examination of all the females was done with the help of predesigned proforma and written informed consent form was signed by all of them. The procedure was explained to all participants to alleviate fear. Blood pressure (BP) was recorded with sphygmomanometer by auscultatory method. After giving rest for 5 min, the following parameters were recorded.

**Sympathetic Function Tests<sup>11</sup>**

1. Arterial Blood Pressure (mm Hg): Procedure: The individual was asked to sit comfortably in a chair for 5 min. The BP was measured from the left arm with the help of sphygmomanometer by auscultatory method. BP recording was taken three times and average value is taken as baseline BP.
2. Orthostatic variation in arterial BP: Procedure: BP recording was taken three times in supine position and average value is taken as baseline BP. After recording the baseline BP in supine position by auscultatory method, the individual was asked to stand up and after 50 s the BP was recorded. Any change in BP is determined as the difference between the recording while supine and standing position. A decrease in systolic BP (SBP) >20 mm Hg and decrease in diastolic BP (DBP) >10 mm Hg during 1 min standing suggest autonomic dysfunction.

3. Cold pressor test Procedure: The baseline BP was recorded from the left arm by auscultatory method in sitting position. Then, the individual was asked to immerse the hand in ice cold (4°C) water for 1 min and the BP was recorded every 30 s for 1 min by auscultatory method. The maximum BP recording obtained with a hand in 4°C water was taken as an index of response. Normally, both SBP and DBP should increase at least by 10 mm Hg at the end of 1 min of immersion. This is used to evaluate the peripheral sympathetic vasoconstrictor mechanism.

- Having history of diabetes mellitus and cardiovascular diseases.
- Those having history of addiction of tobacco, alcohol, and smoking.
- Volunteers with irregular menses.

The body mass index (BMI) was calculated as <sup>10</sup>

$$BMI = \frac{\text{weight (in kilograms)}}{\text{height (in square meters)}}$$

Waist –Hip ratio (W/H ratio) was calculated as<sup>10</sup>

$$W/H \text{ ratio} = \frac{\text{Waist circumference at the level of iliac crest}}{\text{Hip circumference at the fullest point around buttocks}}$$

**Selection Criteria for obese females<sup>10</sup>**

- Age group between 30 to 40 years.
- BMI greater than 30 kg/m<sup>2</sup>
- W/H ratio greater than 0.85.

**Selection Criteria for non obese females<sup>10</sup>**

- Age group between 30 to 40 years.
- BMI less than 25 kg/m<sup>2</sup>
- W/H ratio less than 0.85.

**Statistical Analysis:** It was done by student paired t-test. P < 0.05 was considered as statistically significant. The software used for it is Graph pad Prism 5.

**OBERVATIONS**

**Table 1:** Comparison of BMI and W/H ratio in obese and non obese females

	Mean ± S.D		t value	P value	Result
	Obese females	Non Obese females			
BMI	31.95 ± 1.38	24.03 ± 0.72	36.00	p < 0.001	Highly significant
W/H ratio	0.91 ± 0.02	0.83 ± 0.01	25.29	p < 0.001	Highly significant

BMI: Body Mass Index, W/H ratio: Waist Hip ratio

**Table 2:** Comparison of sympathetic function tests in obese and non obese females

	Mean ± S.D		t value	P value	Result
	Obese females	Non Obese females			
Systolic blood pressure(SBP)	127.76 ± 2.14	114.44 ± 3.58	22.00	p < 0.001	Highly significant
Diastolic blood pressure(DBP)	79.84 ± 2.25	73.68 ± 2.37	13.00	p < 0.001	Highly significant
Orthostatic variation in SBP	7.4 ± 4.00	12.36 ± 3.16	6.80	p < 0.001	Highly significant
Orthostatic variation in DBP	5.32 ± 3.00	8.24 ± 2.24	5.4	p < 0.001	Highly significant
Cold pressor test Variation in SBP	16.44 ± 1.80	11.36 ± 1.71	14.28	p < 0.001	Highly significant
Cold pressor test Variation in DBP	13.44 ± 1.49	10.16 ± 1.43	11.00	p < 0.001	Highly significant

SBP: Systolic blood pressure, DBP: Diastolic blood pressure, SD: Standard deviation

## RESULTS

In Table 1 BMI and W/H ratio was compared in obese and non obese females. It was seen that BMI and W/H ratio were statistically highly significant ( $P < 0.001$ ) in obese females as compared to non obese females. In Table 2 sympathetic activity was compared in obese and non obese females. It was observed that BP, orthostatic variation in arterial BP, and cold pressor test were statistically highly significant ( $P < 0.001$ ) in obese females.

## DISCUSSION

In the present study, responses to BP, orthostatic variation in arterial BP, and cold pressor test were significantly ( $P < 0.001$ ) altered in obese females as compared to that of non obese females, reflecting a significant increase in sympathetic activity. Won-Mok Son *et al*<sup>3</sup> also showed the increased systolic and diastolic BP. Simon G *et al*<sup>12</sup> in their study found the significant variation in systolic blood pressure during cold pressor test. Diastolic BP and orthostatic response were significantly higher in obese group. As per Uppalapadu Sudarsana *et al*<sup>13</sup> diastolic blood pressure and orthostatic response were significantly higher in the obese group Simran Grewal<sup>2</sup> found the impaired sympathetic response in obese subjects. Middle age causes the onset of the gradual decline of physical activity and women become vulnerable to obesity, hypertension, and cardiac disease. The body secretes less estrogen which promotes fat accumulation leading to obesity. This lead to dyslipidemia and increase the risk of coronary artery disease.<sup>14,15</sup> Increase in body fat percentage and triglycerides in obesity leads to an elevated blood lipid concentration, which affects vascular stiffness. Increased arterial stiffness causes elevated pulse pressure, increasing the afterload on the heart,<sup>16</sup> Arunima Chaudhuri *et al*<sup>17</sup> mentioned that Indians have a higher percentage of body fat for a given BMI compared with the white Caucasians and African-Americans but have a lower muscle mass.. Insulin resistance., diabetes, hypertension and hyperlipidemia in women are linked strongly to intra-abdominal or upper body fat than to overall adiposity. W/H ratio has been found to be more predictive than abdominal obesity.<sup>18,19</sup> Human obesity is characterized by marked sympathetic activation.<sup>16</sup> Increased sympathetic activity induced by cold water stress causes non epinephrine release and elevation of BP. It was seen that forearm vascular resistance is significantly higher in obese individuals when compared with the lean individuals during sympathetic excitation induced by CPT which indicates autonomic instability.<sup>20</sup> The increase in BP might be also due to more release of endothelins, prostaglandins and angiotensin II.<sup>21</sup> Prema joshi<sup>22</sup> in their study observed that obesity is one of the

reason for enhanced sympathetic response in postmenopausal women. Thus it seems that obesity itself is a stress in the form of enhanced sympathetic function tests response.

**Implications:** Although women of the present study did not complain of any physical or psychological symptoms yet significantly increased sympathetic activity responses indicate an increased stress.

## LIMITATIONS

Further study with large samples is required to correlate autonomic nervous system (ANS) functions with body fat percentage.

## CONCLUSION

Obesity itself acts as physical and mental stressful condition resulting in autonomic dysfunction in the form of sympathetic excitation. So body weight must be controlled by dietary management, regular exercise, yoga, meditation and pranayam to relive that stress complication.

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