Effect of Obesity on Blood Pressure

J.Rose Priyadharshini¹, R. Vinodha²

¹Assistant Professor, ²Professor and Head of the Department, Department of Physiology, Thanjavur Medical College, Thanjavur

Background: Obesity is a huge problem because it leads to so many complications such as accelerated atherosclerosis, increased incidence of gallbladder disease, type-2 diabetes mellitus, insulin resistance and many carcinomas. One of the major causes for obesity is excess energy intake in food over energy expenditure. Excess weight gain is an important risk factor for hypertension. Hypertension target major organs of the body leading to coronary heart disease, cerebrovascular disease, kidney damage etc. The aim of the study was to investigate the effect of obesity (Body Mass Index (BMI) and Waist Circumference (WC)) on Blood pressure. Materials & Method: Ethical committee approval was obtained before starting the study. For this study clinical history was recorded and physical examination including body weight, height, waist & hip circumferences were measured. Waist hip ratio (WHR) was calculated. Blood Pressure was recorded. Results: Obesity was statistically associated with increase in both systolic & diastolic blood pressure. Conclusion: This study revealed that abdominal obesity & increase in BMI were significantly associated with increase in blood pressure.

Keywords: Body Mass Index, Waist Circumference, WHR, Hypertension.

Introduction

Obesity is one of the most commonest physical abnormality and a serious health hazard found all over the world in people of all races and all age groups irrespective of any barriers. It lies in the twilight zone between health and diseases. Marked obesity is essentially a repulsive phenomenon. There are so many causes for obesity but basic cause of the obesity is still excess energy intake in food over energy expenditure. Obesity results from interaction of environmental and genetic factors. Hypothalamus and related parts of brain play major role in the regulation of food intake. Hypothalamus has lateral “feeding center” in the median forebrain bundle and a medial “satiety center” in the ventromedian nucleus. A major regulator is the adipocyte derived hormone “leptin”. Decreased physical activity and reduction in leptin receptor sensitivity play major roles. Leptin’s chronic effects to elevate the blood pressure are mostly mediated through the sympathetic nervous system which is again mediated via hypothalamic pro-

Corresponding Author:
R. Vinodha
Professor and Head of the department, Department of Physiology, Thanjavur Medical College, Thanjavur

References:

INTERSALT study explained that for every 10 Kg in body weight there was 3 mmHg rise in systolic blood pressure and 2.3 mmHg rise in diastolic blood pressure (DBP).

WC, BMI, WHR are strongly related to blood pressure.

Various studies suggested that decline in weight leads to blood pressure reduction.

There are three important anthropometric measurements such as weight, height, waist circumference (WC) in the evaluation of obesity degree.

Body Mass Index (Quetelet Number or Quetelet Index) is calculated from weight and height, BMI = Wt (Kg) / Ht (m²), which estimates body fat. BMI is also calculated as weight in lbs / height in inches² × 703. BMI cannot differentiate between fat mass and lean body mass or muscle mass. Excess abdominal fat is measured by WC and waist hip ratio (WHR).

Excess accumulation of abdominal or visceral adipose tissue is associated with high apo-lipoprotein B concentration and reduced plasma HDL level. Visceral fat accumulation causes Insulin resistance and adipokines disorders. This leads to increase in reabsorption of renal sodium,
overactivity of sympathetic nervous system, vascular smooth muscle proliferation, atherosclerosis. Augmented renal tubular sodium reabsorption and impaired pressure natriuresis play significant role in initiating hypertension associated with weight gain. Increased adrenergic activity plays major role in the development and maintenance of obesity hypertension in experimental animals and in humans. The renal sympathetic nerve mediates most of the chronic effects of sympathetic nervous system (SNS) activation on blood pressure in obesity. Weight loss is effective in the prevention of elevated blood pressure \(^{2,3,14,15}\). Even 5–10 % weight loss reduces the blood pressure in normotensive as well as in hypertensive obese individuals. Ohnishi et al\(^{16}\) studied that individuals with Abdominal Obesity (AO) showed increased incidence of hypertension than non-AO. Hypertension is one of the most important reasons for renal, cardiovascular and cerebrovascular impairment.

**Materials and Method**

This case-control study was conducted in the Department of Physiology, Thanjavur Medical College Hospital, Thanjavur. Forty normal healthy subjects and forty obese individuals were recruited from Thanjavur Medical College Hospital, Thanjavur, in the age group of between > 18 years and < 50 years. Before starting our study, we obtained ethical committee approval and clearance from the college. Informed written consent was obtained from all the subjects who were participating in this study. The purpose of this study was explained clearly in their regional language. The history of the subjects was obtained and noted in a separate pro-forma. Subjects with history of malignancies, or with inflammatory disorders, patients with the presence of major cardiovascular events during last 3 months prior to study, Diabetes Mellitus, heart failure and hereditary renal diseases were excluded from this study. Anthropometric measures like height (meters), weight (kilograms), waist circumference (centimeters) and hip circumference (in centimeters) were measured. The optimal waist circumference for males is < 90 cm and for females is < 80 cm. WC is an important measurement of central obesity. Normal BMI is 18.5 – 24.9 Kg/m\(^2\). \(^{17}\) The blood pressure was measured in a quiet and relaxed setting after five minutes of rest. Joint National Committee VII (JNC VII) defined Hypertension as SBP ≥ 140 mmHg and DBP ≥ 90 mmHg.

**Results**

Statistical analysis was done by using the Statistical Package for Social Sciences (SPSS) X version. The results were analyzed by using student ‘t’ test and ANOVA study. Datas are expressed in mean with standard deviation. P< 0.05 was considered as statistically significant.

Table-1 shows the comparison of all the parameters in the study and the control groups. Mean SBP, mean DBP, mean weight(Kg), waist circumference(cm), hip circumference(cm), waist hip ratio between study and control groups were statistically more significant.

### TABLE-1. DESCRIPTIVE ANALYSIS OF WEIGHT, BMI, WC, HC, SBP & DBP IN STUDY & CONTROL GROUPS

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Mean</th>
<th>S.D</th>
<th>T</th>
<th>Df</th>
<th>Statistical inference</th>
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</thead>
<tbody>
<tr>
<td>WEIGHT(Kg)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Study group (N=40)</td>
<td>59.95</td>
<td>5.383</td>
<td>4.241</td>
<td>78</td>
<td>.0001&lt;0.05 Significant</td>
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<td>BMl(Kg/m(^2))</td>
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<tr>
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<td>2.30549</td>
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<td>.00009&lt;0.05 Significant</td>
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<td>3.36847</td>
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<tr>
<td>WC(cm)</td>
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TABLE-1. DESCRIPTIVE ANALYSIS OF WEIGHT,BMI,WC,HC,SBP&DBP IN STUDY &CONTROL GROUPS

<table>
<thead>
<tr>
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<tr>
<td></td>
<td>88.95</td>
<td>82.10</td>
<td>4.780</td>
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<td>HC(cm)</td>
<td>96.58</td>
<td>85.03</td>
<td>10.030</td>
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<td>.0001 &lt; 0.05</td>
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<td>SBP(mmHg)</td>
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<td>117.05</td>
<td>19.075</td>
<td>78</td>
<td>.0001 &lt; 0.05</td>
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<tr>
<td>DBP(mmHg)</td>
<td>89.95</td>
<td>78.95</td>
<td>16.331</td>
<td>78</td>
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Discussion

Obesity is a risk factor for cardiovascular diseases, hypertension, diabetes mellitus. But awareness of obesity associated diseases is less. Prevalence of obesity is rapidly increasing now a days. Obesity is a chronic disorder that should be treated in a long term basis. The main function of adipose tissue is the storage of triglyceride. Triglyceride is continuously redistributed in the adipose tissue and other parts of the body. Regional distribution of adipose tissue is important than the absolute amount of excess accumulation of adipose tissue.

Excess body fat accumulation accounts for 65% - 75% of essential hypertension. In obesity there is increased sympathetic nervous system activity, Renin-Angiotensin-Aldosterone-System (R-A-A-S) activation, renal compression by accumulation of fat around the kidney. Increased adrenergic activity plays major role in the development of hypertension in obesity. Many factors are released by adipocytes such as hormones-adiponectin, resistin, leptin, cytokines-TNF-α, IL-6, substrates-FFA, glycerol, enzymes-aromatase, complement factors-Factor-D, adipin and also other substances like PAI-1, angiotensinogen, RBP-4. These substances damage the peripheral tissues.

Ohnishi et al\(^{(16)}\) in their study observed that abdominal obesity was associated with increased incidence of hypertension. Albert et al\(^{(18)}\), in their study they induced weight gain in dogs and suggested that increase in weight was associated with increase in heart rate, BP, cardiac output, plasma volume and fasting insulin concentration. Various other studies suggested prolonged high fat diet induced weight gain increased the blood pressure.\(^{(19,20)}\) Various studies reported BP is associated with obesity indices BMI, WC, WHR.\(^{(6,9)}\) Janssen et al\(^{(21)}\) in their study observed BMI coupled with WC does not predict an increased obesity related health risk better than WC alone. Haynes et al\(^{(22)}\) and Jones et al\(^{(9)}\) studied weight loss is associated with decrease in blood pressure.

Conclusion

In our study, we found that obesity was significantly correlated with increase in blood pressure.

Abdominal obesity can be easily measured by simple methods like waist circumference, hip circumference and waist hip ratio with easily available instrument such as inch-tape. The physicians can advise the obese patients to reduce the weight and suggest the patients that weight reduction can reduce the incidence of hypertension and their complications. Although weight loss is helpful in managing hypertension, many obese patients are unable to sustain adequate weight loss through lifestyle modifications and there are few
available drugs that safely and effectively produce adequate long-term weight loss. Specific guidelines are needed for treating obesity-associated hypertension, in addition to the recommendation of reducing weight. The most important therapeutic goal for obese hypertensive patients should be to treat their underlying causes of obesity. Further study is required to measure central obesity accurately.

Conflict of Interest: Nil

Source of Funding: Self

Ethical Committee approval: Obtained

References


