ORIGINAL RESEARCH

The Effect of Parameters of Obesity on Blood Pressure

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ABSTRACT

Introduction: Obesity parameters are easy to record and provide prognostic information about the effect of them on blood pressure. The study was done by screening variables for significant correlation between obesity parameters and blood pressure.

Material and Methods: The subjects for the study were 240, 120 males and 120 females in the age group of 21-60 years from Hyderabad and Secunderabad, Telangana. The subjects were divided into four age groups of 21-30yrs, 31-40yrs, 41-50yrs, 51-60yrs and the number of subjects with hypertension was noted in each group and gender variability was correlated with the incidence of hypertension. Based on waist/hip ratio range (2 groups), based on BMI range (2 groups), based on Skin fold thickness range (4 groups), % of body fat range (4 groups), were taken and in each group the number of subjects with hypertension were noted and tabulated.

Results: The Results were found to be statistically significant for BMI, SFT, W/H ratio, % Body Fat & physical activity with Hypertension

Conclusions: The results showed that the parameters of obesity linearly correlated with the incidence of hypertension.

Keywords: Obesity, Hypertension, Body Mass Index (BMI), Waist/Hip Ratio, Skin fold thickness (SFT), % of Body Fat.

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INTRODUCTION

In developed and developing countries overweight and obesity are most prevalent nutritional problems. Obesity is a chronic disease that is casually related to serious medical illness. It is a problem of energy balance, caused by excessive intake of calories, In relation to energy expenditure over a long period of time. It is a state of excess adipose tissue mass associated with a high rate of morbidity and early mortality, if left untreated.

Adipose tissue in 1987 was identified as a major site for metabolism of sex steroids[1] & production of Leptin, an endocrine factor & considered as an highly active metabolic & endocrine organ[2] The Important endocrine function of adipose tissue is emphasized by adverse metabolic consequences of both adipose tissue excess & deficiency.

According to a study published in journal Lancet India is just behind US and China in this global hazard list of top 10 countries with highest number of obese people. The US topped the list with 13 percent of the obese people worldwide in 2013, while China and India together accounted for 15 percent of the world's obese population. This is one-third of the world's population.5% of the Indian population has been affected by obesity. In South India based on data 2007 NFHS AP has 40.3% obese people. Obesity is correlated with a variety of complications. It is a problem because of its complications like insulin resistance, hyperglycemia and dyslipidemia – Metabolic Syndrome and Hypertension and CVS diseases.

Obesity and Hypertension are common is developed countries.[3] Obesity has been implicated as a risk factor in development of Hypertension (HT) – Bose & Masue -Tayler 1998, Vague at al 1988. The Prevalence of HT in obese individuals is 25% to 50% much higher than that in the general population and the risk of HT appear to parallel the degree of obesity.[4]

The Magnitude of association between obesity and hypertension may vary according to gender and age. Overweight individuals 20 to 45 years old have a greater relative risk of HT than overweight individuals 45 to 65 years old.[5]

Obesity is assessed by parameters like BMI, W/H ratio, Skin fold thickness, % body fat. HT is assessed by recording BP in terms of systolic and diastolic pressure. The present study is done to know the effect of different parameters of obesity on Blood pressure. Objective of the study was to know correlation between obesity variables and hypertension.

MATERIALS AND METHODS

The subjects for the study were male and female in the age group of 21 to 60 years. The study involved 240 subjects, 120 males and 120 females.

The subjects were divided into 4 groups according to their age. Age groups of 21-30, 31-40, 41-50 and 51-60 years. The number of hypertensive subjects was noted in each group.

As Evaluation of anthropometry and body composition of fat is important in the study of human energy metabolism, the commonly employed measurements and calculations are as follows.

1. Height: Standing height is measured using a stadiometer, with an accuracy of 0.1 cm graduations and sliding headpiece. The measurement is taken with the subject wearing no shoes, standing erect on a horizontal surface with heels together, the shoulders relaxed and arms at the sides.
2. Weight: Weight assessment provides important data in assessing status of individuals and serves as an indicator of intentional or unintentional weight loss.
3. BMI (Body Mass Index):- or Quetelet Index: It is a statistical measure of the weight of a person scaled according to height. It Is used as a simple means of classifying inactive individuals of an average body composition.
   BMI was calculated from the following equation (Garrow et al 1985)

   $$\text{Body Mass Index (kg/m}^2\text{)} = \frac{\text{Weight in kg}}{\text{(Height) in m}^2}$$

   The Body Mass Index value ranging between 18to25 is considered as normal, < 18 indicates undernourished, above 25 as overweight and above 30 as obese.
4. % Body Fat: The metabolic rates of human beings are influenced by variation in body fat content. In Lean persons the fat content may be less than 5 %. In obese, the fat content may exceed 50%.
5. Skin Fold Thickness: Most of the fat stored in the body lies under the skin (Edwards, 1950) and thickness of a fold of a skin picked up at strategic sites[6] indicates the amount of subcutaneous fat (Montoye, 1965).A special type of skin caliper is used to measure subcutaneous fat in mm at selected sites on the body with relative accuracy. It works on the principle as the micrometer used to measure distance between 2 points.

Common Sites

Triceps: - Vertical fold measured at the midline of the upper arm halfway between the tip of the shoulder and tip of the elbow.

Biceps: - Front of the upper arm exactly as triceps.

Sub scapular: - Oblique fold measured just below the bottom tip of the scapula.

Supra iliac: - Oblique fold measured just above the hip bone.

The relation between the sum of the four skin folds and the percentage of body fat, derived from density were calculated from regression equations.

Calculations

Percentage of body fat was calculated from density by using the equations of SIRI (1965).

% Fat = (4.950/d-4.500)X100

Where 4.95 and 4.50 were constants for specific gravity.

Density (d=Log of sum of four skin fold thickness measurements) according to prediction equations of Durmin and Womersely (age and sex specific).

Density values are used in the equation to calculate % of body fat. The relationship between the sum of the four skin folds and the percentage of the body fat derived from density were calculated from regression equations given in the table.

6. Waist Hip Ratio: The ratio of waist circumference is the measurement of the intra abdominal fat.
   Waist: Circumference of the waist is measured one inch above the naval.
   Hip: Circumference of the highest part around the hips.
   Both values joined together by a scale and point were the scale crosses the waist Hip ratio Line is the Ratio taken.
7. Activity Level: - The physical activity considered either sedentary or active level from a self reported questionnaire.
8. Blood Pressure: - was measured using a sphygmomanometer using different cuffs as required. Normal = 120/80 mm Hg.

The study was done by screening variables for significant correlation between obesity parameters and Blood Pressure.

RESULTS

The Chi-square statistic is 35.9404. The P value is 0. This result is significant at $p < 0.05$. With BMI <25 the % of Hypertensive's was 36.61 where as with BMI >25 the % of Hypertensives was 75% showing the risk of Hypertension with increased BMI.

The chi-square statistic is 118.7503. The *p*-value is < .00001. The result is significant at $p < .05$.

With W/H ratio <1 the % of Hypertensives was 25% as compared to W/H ratio >1 the % of Hypertensives was 96% showing that with increased W/H ratio the risk of Hypertension is high.

The Chi-square statistic is 28.6088. The P value is 0. This result is significant at $p < 0.05$.

The % of Hypertensives was 38.6 with SFT <40 and 85% Hypertensives with SFT >40 in males showing that high SFT is associated with increased risk of Hypertension in males.

The Chi-square statistic is 13.3185. The P value is 0.000263. This result is significant at $p < 0.05$.

In Females the risk of Hypertension was 33.9% with SFT <50 and 67.2% with SFT >50 showing the risk of Hypertension with high SFT.

The chi-square statistic is 83.5123. The *p*-value is < 0.00001. The result is significant at $p < .05$.

As the % of body fat was increasing the risk of Hypertension also increased, the % of Hypertension being highest with % of body fat between 40 and 45.

The chi-square statistic is 16.0517. The *p*-value is .000062. The result is significant at $p < .05$.

Sedentary lifestyle is associated with increased risk of Hypertension compared to active lifestyle with only 44% being Hypertensive.

BMI	Blood Pressure				
	Normal	%	Hypertension	%	Total
<25	71	63.39	41	36.61	112
>25	32	25.00	96	75.00	128
Total	103		137		240

Table-1: Variable BP with BMI

W/H	Blood Pressure				
	Normal	%	Hypertension	%	Total
<1	101	74.26	35	25.74	136
>1	4	3.85	100	96.15	104
Total	105		135		240

Table-2: Variable BP With W/H ratio

SFT	Blood pressure				
	Normal	%	Hypertension	%	Total
<40	35	61.40	22	38.60	57
>40	9	14.29	54	85.71	63
total	44		76		120

Table-3: Variable bp with skinfold thickness - Male

SFT	Blood pressure				
	Normal	%	Hypertension	%	Total
<50	39	66.10	20	33.90	59
>50	20	32.79	41	67.21	61
Total	59		61		120

Table-3: Variable bp with skinfold thickness - Female

%Bodyfat	Blood pressure				
	Normal	%	Hyper-tension	%	Total
<25	76	63.87	43	36.13	119
25-30	6	30.00	14	70.00	20
30-40	20	21.51	73	78.49	93
40-45	1	12.50	7	87.50	8
total	103		137		240

Table-4: Variable BP with % of bodyfat

Physical activity	Blood pressure				
	Normal	%	Hyper-tension	%	Total
Active	66	55.93	52.00	44.07	118
sedentary	37	30.33	85.00	69.67	122
total	103		137		240

Table-5: Variable BP with physical activity

Among all these parameters of Obesity the highest % of Hypertension was found to be associated with >W/H Ratio.

DISCUSSION

In India, although obesity is in the starting phase compared to western countries, it needs to be tackled aggressively, before it assumes serious epidemic properties. In near future obesity would emerge as a challenging problem for India, due to urbanisation and modernization as our lives are becoming more sedentary. So on attempt has been made to determine the effect of different obesity parameters on Blood Pressure which is a common complication associated with it. Both the degree and distribution of excess adipose tissue impart on the risk of Hypertension (HT).[7] Central obesity is considered important in the etiology of metabolic syndrome[8] and HT[9], than those in whom fat is located in lower body(peripheral).[10] Distribution of fat is assessed by measuring W/H ratio and also skin fold thickness (SFT).[6] The relationship between SFT and % body fat was given by Durmin and Womersely[11] In males and females the risk of HT is more with amount of weight gained.[12] Central obesity is characterized by increased degree of sympathetic nervous activity[4] compared to peripheral obesity.

The mechanism that may lead to HT in obese individuals include increased sympathetic nervous system activity (SNS).[13] Normally a sympathovagal balance is maintained in ANS. SNS stimulates energy expenditure and Para sympathetic nervous system (PSN) stimulates energy storage. Studies have shown a significant decrease in PSN activity with increased body weight[14] and increase in SNS activity.[15] Sympathetic predominance in ANS favours and increase in Blood Pressure and decrease in insulin sensitivity.[16] The duration of obesity has a major role to play in determining the level of SNS activity.[17] Increase SNS activity is mediated by diet, with carbohydrates playing a major stimulating role.[18] Modest diet induce weight gain elicits SNS activity.[19]

Landsberg hypothesized that the increase in SNS activity associated with weight gain serves the homeostatic role of stimulating thermo genesis to prevent weight gain.[19] Increased weight gain increases the SNS activity[18] and if left untreated, sustained activation of SNS can contribute to development of HT and other CVS disorders. Bjorntorp and Rosmond suggested that the development of metabolic syndrome is associated with abnormal regulation of HT – Pituitary adrenal axis following increase cortisol secretion, decrease sex steroid and growth hormone secretion and activation of SNS.[20]

Increased SNS activity increases vascular reactivity leading to HT and decrease insulin sensitivity.[21] Insulin resistance and hyperinsulinemia cause the development of HT in obese and non obese as well.[22] Landsberg postulated that the diet induced increase in plasma insulin concentration was the primary mechanism mediating weight gain induced SNS activity.[22] SNS also activates Renin angiotensin system (RAS)[23] which also increases Blood Pressure. RAS increases sodium retention through aldosterone which in turn increases Blood Pressure by increasing ECF and CO.[24]

Masuo et al have reported that plasma norephenephrine concentration increases following weight gain.[25] The result of many studies consistently reveals increase SNS activity in obese compared with non obese individuals.[15]

S.M. Ettinger et al (1996) concluded that SNS out flow is decreased in females compared to males. Gender difference in baroreflex sensitivity is caused by the difference in re-

sponsiveness of PNS component.[26] Estrogen is sympathoinhibiter and vagotonic hormone. Plasma estrogen increased vagal modulation in females according to Makoto Tanake et al (2003).

The present study showed that the parameters of obesity linearly correlated with HT. Early interventional programs like weight reduction[27], life style changes and physical exercise which decrease the fat content of the individual[28] can be advised to decrease the chances of HT and other related CVS disorders and thereby decrease the morbidity and mortality associated with it.

CONCLUSION

The effects of obesity on Blood Pressure were studied by using different parameters. The anthropometrics like weight, height, BMI,W/H ratio, Skin Fold Thickness(SFT), % of body fat were used to assess obesity. Each parameter was correlated with Blood Pressure measurement individually. The study confirmed that each parameter of obesity presented with increased values of blood pressure and that obesity is a predictor of hypertension. The study highlights the critical importance of early intervention directed at treatment of obesity, to avert the long term consequences of obesity on the development of various complications.

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