International Journal of Biomedical and Advance Research
ISSN: 2229-3809 (Online); 2455-0558 (Print)
Journal DOI: 10.7439/ijbar
CODEN: IJBABN

Original Research Article

Ultrasonographic assessment of abdominal fat and its correlation with blood pressure

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Abstract

Background: Obesity is a major cause of mortality and morbidity for associated metabolic disorders and cardiovascular disease. The role of fat distribution has received limited attention.

Aims: The aim is to measure subcutaneous adipose tissue (SAT) and visceral adipose tissue (VAT) and to correlate them with systolic blood pressure (SBP) and diastolic blood pressure (DBP).

Materials and Methods: Height, weight, BMI and blood pressure by standard sphygmomanometer were recorded in all subjects. SAT and VAT were measured by ultrasonography (5 MHz).

Results: Out of seventy-five normal subjects, 32 were males and 43 were females. Statistical analysis was carried out using Pearson's correlation. The mean age was 45.57 in males and 45.81 in females. The mean SBP was 123.9±10.05 in males and 114.4±11.67 in females, which was statistically significant. ($p<0.001$). The mean DBP was 82.5±8.45 in males and 78±7.78 in females, which was statistically significant. ($p<0.001$). The mean SAT was 3.3±0.9 in males and 2.2±2.12 in females, while mean VAT was 3.4±1.5 in males and 4.44±1.77 in females which was statistically significant. ($p<0.01$). There was a positive correlation of SBP and DBP with VAT and SAT in males and females. There was positive correlation between SBP and VAT in females and was statistically significant (P value <0.01) than with DBP (p value <0.06).

Conclusion: VAT is a better parameter that correlates with blood pressure.

Keywords: Visceral adipose tissue, Subcutaneous adipose tissue, Prehypertension, Blood pressure

1. Introduction

Obesity is defined as abnormal growth of adipose tissue due to enlargement of fat cell size (hypertropic obesity) or an increase in fat cell number (hyperplastic obesity) or a combination of both.[1] It is one of the common nutritional disorders in human and main cause of mortality and morbidity. Obesity has been linked to diabetes mellitus, hypertension, cardiovascular diseases, stroke, hyperlipidemia, gallbladder disease, osteoarthritis, sleep apnoea and several types of cancer[2]. The extensive research has shown that the location of body fat deposits is a more important determinant than the size of these deposits.[3] The distribution of fat induced by the weight gain affects the risk associated with obesity and the kind of diseases that results. It is useful therefore to be able to distinguish between those at increased risk as a result of "abdominal fat distribution" or "android obesity" from those with the less serious "gynoid" fat distribution, in which fat is more evenly and peripherally distributed around the body. The presence of intraabdominal visceral fat in the omentum and mesentry is a better predictor for coronary heart disease than body mass index.[4] The use of sonography for the determination of fat distribution was introduced by Armellini *et al*[5].

Sonography can be used in the clinical practice for the routine assessment of regional adiposity.

1.1 Aims and Objectives

The aim of the study is to measure subcutaneous adipose tissue (SAT) and visceral adipose tissue (VAT) by ultrasonography & correlate them with systolic blood pressure (SBP) and diastolic blood pressure (DBP) in normal patients.

2. Methodology

This Cross-sectional study was carried over a period of three months in Padmashree Dr. D. Y. Patil Medical College Hospital and Research Centre, Pimpri, Pune after the approval from institution ethical committee.

The study was conducted in department of medicine OPD in 75 patients coming for general checkup both males and females of age group 20 - 60 yrs. The questionnaire included detail history of patient regarding education, occupation, smoking, alcohol, physical activity, diet followed by thorough systemic examination. Anthropometric measurements: Height and weight was performed with subjects wearing light clothing but without shoes. BMI was classified according to proposed criteria of World Health Organisation (WHO): Normal -18.5-24.5, Overweight – 25.0-29.9 and Obese – 30 and above[6]. Body mass index (BMI) calculated by weight/height^2[kg/m^2] and BMI more than 25 was considered for present study. BP was measured in lying down position 3 times with 5 min interval by the standard sphygmomanometer and the average of three recording was considered for analysis. According to eighth report of Joint National Committee (JNC 8) and by the American and International societies of Hypertension: Normal blood pressure systolic is < 120 mmHg and diastolic < 80 mmHg. Prehypertension is systolic 120-139 mmHg and/or diastolic 80-89 mmHg[7]. SAT and VAT measurements were taken 1 cm above the umbilicus by ultrasonography (5MHz) in supine position. SAT is measured from anterior abdominal wall to rectus sheath. VAT is measured from rectus sheath to the anterior abdominal aorta.[8][9] Statistical analysis were carried out using mean and standard deviation (SD), Pearson's correlation analysis to assess the degree the relationship of study parameters with systolic and diastolic blood pressure.

2.1 Exclusion criteria

Subjects with history of hypertension, diabetes mellitus, chronic alcoholism, chronic renal failure, pregnancy and those who are on cholesterol lowering medication are eliminated from study.

3. Results

Out of 75 patients, 32 were males and 43 were females. The mean age was 45.57in males and 45.81 in females. Figure 1 and 2 shows measurements in males and females and gender differences for the same. The mean values of Height, weight, SBP, DBP were found to be higher in males than in females, which was statistically significant. (p value < 0.001). The mean values of SAT was3.3±0.9 in males and 2.2±2.12 in females, while mean VAT was 3.4±1.5 in males and 4.44±1.77 in females which was statistically significant. (p<0.01).

Figure 1: Mean and Standard deviation (SD) measurements in males

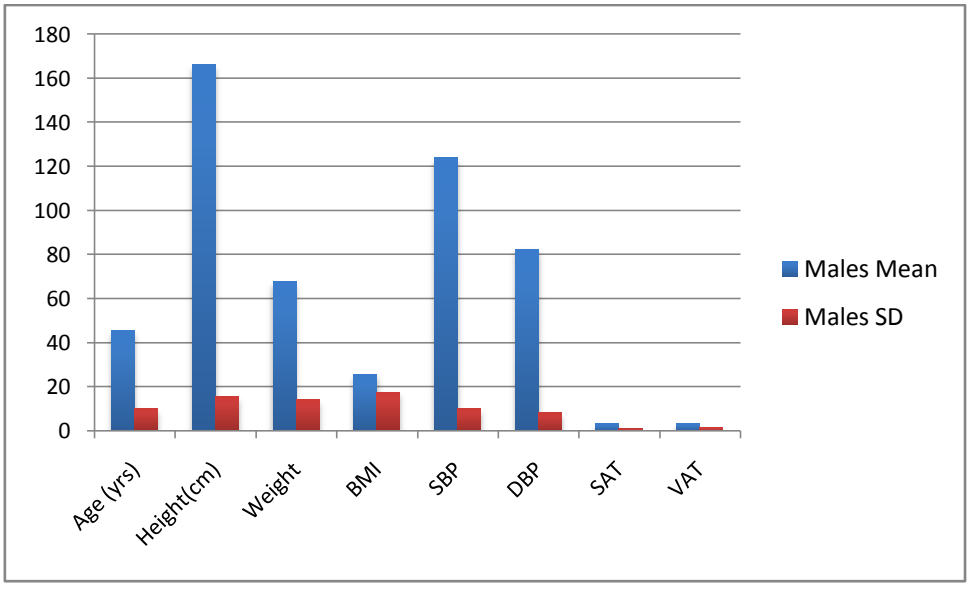


Figure 2: Mean and Standard deviation (SD) measurements in Females

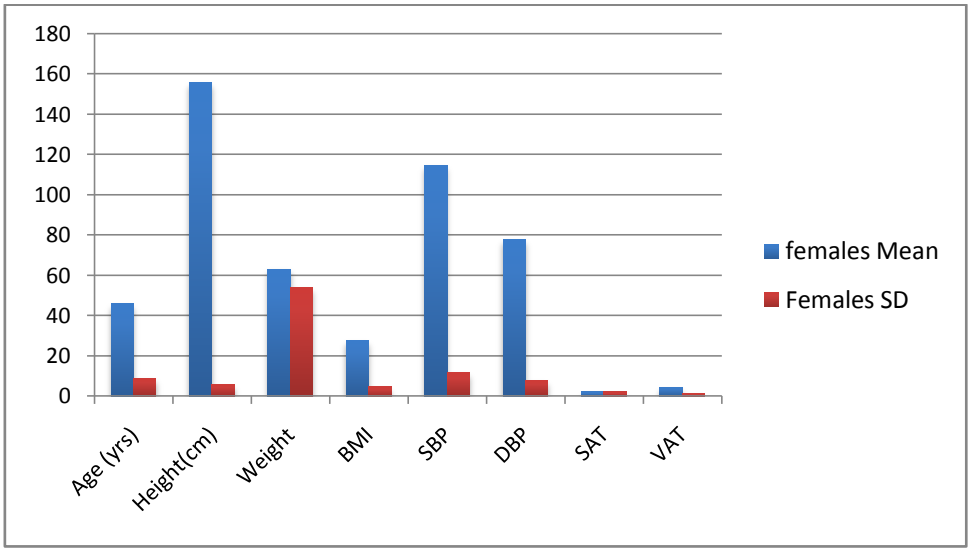
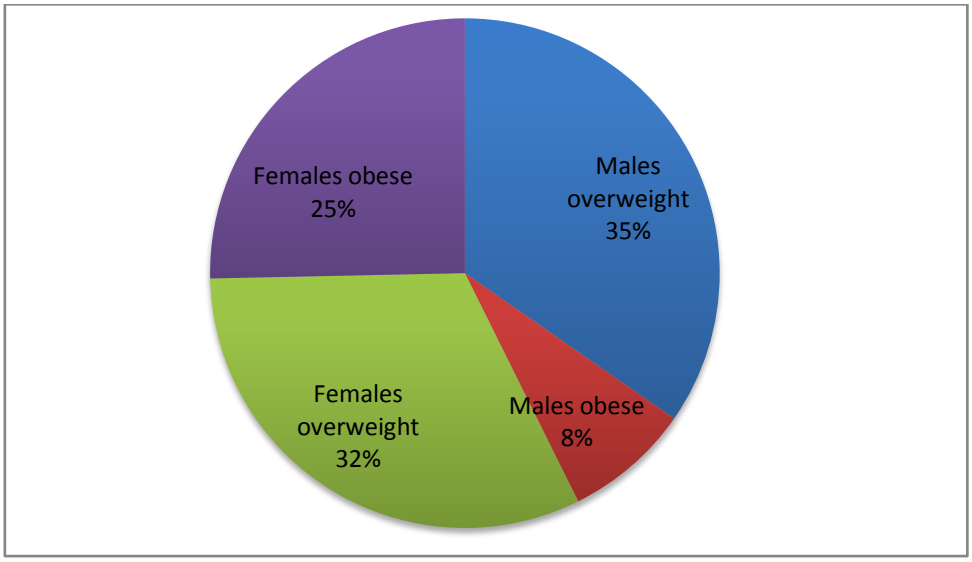
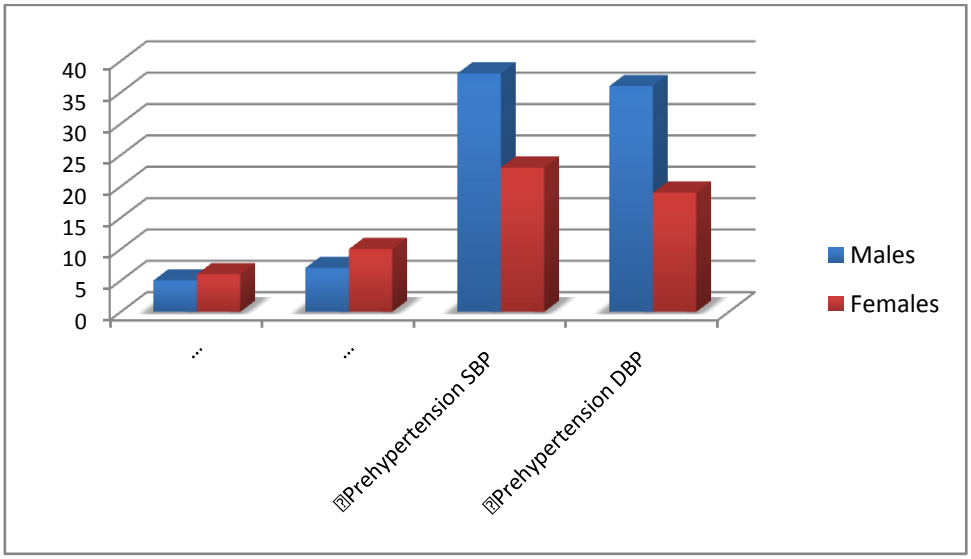


Figure 3: Prevalence of overweight and obesity in males and females



The prevalence of obesity was more in females than in males. The prevalence of overweight was more in males than in females.

Figure 4: Prevalence of prehypertension in males and females



The prevalence of prehypertension was more in males.

Table 1: **Correlation between systolic BP, Diastolic BP with subcutaneous adipose tissue and visceral adipose tissue in males**

	SAT	VAT
Systolic BP males	0.26	0.17
Diastolic BP males	0.12	0.10

Table 2: **Correlation between systolic BP, Diastolic BP with subcutaneous adipose tissue and visceral adipose tissue in females**

	SAT	VAT
Systolic BP females	0.25	0.41 (p value <0.01)
Diastolic BP females	0.27	0.19 (p value <0.06)

Table 1 and 2 shows positive correlation of systolic and diastolic BP with VAT and SAT in males and females. There was positive correlation between SBP and VAT and was statistically significant (p value <0.01) and with DBP (p value <0.06).

4. Discussion

Both SBP and DBP were found to be significantly higher among men as compared with women in the present study. Gender differences in blood pressure are detectable during adolescence and persist through adulthood. In all ethnic groups, men tend to have higher mean SBP and DBP than women, and through middle age, the prevalence of hypertension is higher among men than women.[10] Prevalence of prehypertension in our study was more in males than in females. Similar studies were found by Ferguson *et al*[11] and Gupta *et al*.[12] Prevalence of obesity was high among females than males in our study. Sugathan *et al*[13] reported that obesity was more in females (33%) than males (17%). Prevalence of obesity was higher in females in a cross sectional survey which was carried out on adults aged 25-60 yrs in Delhi, India.[14][15] Relationship between prehypertension and overweight and obesity are observed in the present study which has been observed in other studies.[16][17] The association between visceral fat and cardiovascular risk factor markers has been described in the literature. Ribeiro-Filho *et al*[18] reported the correlation of ultrasound measurements of visceral fat to cardiovascular disease risks. Similarly in their study in adults, Leite *et al*[19] observed that VAT measurements has greater sensitivity and specificity in identifying individuals with cardiovascular risk factors mainly in individuals classified as having a moderate to high risk of developing cardiovascular diseases. In our study ultrasound measurements of VAT correlated with systolic BP in females. The quantity of VAT seems to increase with age[20]. A review of differences in body composition between males and females according to sexual maturation has indicated that hormonal differences between genders cause the development of muscle tissue in males to surpass the concentration of adipose tissue differently from in females, in whom the amount of adipose tissue is larger.[21] Our study has methodologic constraints and these should be pandered when considering the results. Our sample was selected by convenience and small sample does not allow us to make more elaborate inferences for the general population because the statistical power is restricted to 75 subjects.

5. Conclusion

Visceral fat was the measurement of abdominal fat that showed the best correlation with blood pressure, suggesting that it can be used as a useful parameter in assessing cardiovascular risk. Ultrasonography is a noninvasive, reliable method for the assessment of visceral adiposity and identification of obese subjects with adverse cardiovascular profile. Further studies are needed to establish the usefulness of the ultrasonography visceral fat determination to predict cardiovascular morbidity and mortality.

Acknowledgement

We thank Mr. Dubey for providing statistical analysis.

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