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Original Research Article

Relationship between Sagittal Abdominal Diameter and Other Anthropometric Obesity Indicators in Adults with a History of Cardiovascular Risk Factors

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Abstract

Background and Aim: Obesity has reached epidemic proportions in our country due to modernization. The distribution of body fat plays an important role in complications due to obesity. [11] Because Family History is an independent risk factor for CVD, it has the potential to become a screening tool to identify people, especially asymptomatic young adults, who are at increased CVD risk.

Material and Methods: Present cross-sectional; study was conducted at the Department of General Medicine, Tertiary Care Teaching Institute of India for the duration of 1 year. Total 200 patients were included in the study. When compared to BMI, WC and WHR, SAD correlated better with total cholesterol, fasting blood sugar, post prandial blood sugar and HbA1c.

Results: BMI had strong positive correlation to Weight, SAD and WC. Men showed high correlation to Weight, BMI, FBS and PPBS, moderate correlation to age, SBP, WC, HC, HbA1C, VLDL, TG. Women showed high correlation to Weight and BMI. Moderate correlation to WC, HC, VLDL, TG, PPBS and HbA1C and low correlation to FBS. All metabolic and anthropometric parameters showed positive correlation with SAD except Height and HDL.

Conclusion: Robust correlation exists between sagittal abdominal diameter and cardiovascular risk factors. Sagittal abdominal diameter is comparable to body mass index but it correlates better with metabolic risk profile of an individual than body mass index, waist circumference & waist-to-hip ratio.

Keywords: Cross-Sectional Study, Obesity, Sagittal Abdominal Diameter, Waist Circumference.

Introduction

According to the WHO report, 65% of the world's population lives in countries where overweight and obesity kill more people than underweight [1] this is attributed to the changing lifestyles of the people. Obesity confers increased risk for cardiovascular diseases as a result of accumulation of visceral fat, which alters intermediary metabolism and insulin sensitivity of peripheral tissues. [2-6]

The body fat in human contributes much to different health disorders and its abnormal distribution leads to different comorbid conditions. Visceral fat accounts for the complications such as ischemic heart disease, hypertension, and metabolic disturbances. There is a close correlation between increased quantities.

Conventionally, waist circumference is used in both clinical practice and biomedical research to measure abdominal obesity and to screen for the presence of the metabolic syndrome (MetS). Other anthropometric indices, such as body mass index (BMI), as well as the waist-hip ratio (WHR), are two of the most commonly used non-invasive biomarkers of obesity. Sagittal abdominal diameter (SAD) is associated with BP and predicts hypertension. [7-9] SAD is high correlated with abdominal obesity and a risk indicator of coronary heart disease compared to other anthropometric parameters. [10] Hence, SAD is a technique to predict cardiovascular diseases. Only few studies are available to prove the correlation of SAD and BP in Indian population.

This study was done to compare sagittal abdominal diameter with other anthropometric indices of obesity in apparently healthy individuals who were not previously diagnosed or treated for DM, hypertension, ischemic heart disease or any other cardiovascular risk factors and assess its utility in predicting these condition by corre-lating the metabolic parameters like fasting blood sugar, post prandial blood sugar, lipid profile HbA1c and ECG with the anthropometric measurements. The individuals were included in the study based on the presence of a family history of a first degree relative suffering from either of these. Family History serves as a bridge from genetics to genomics in clinical practice. [11] Because Family History is an independent risk factor for CVD, it has the potential to become a screening tool to identify people, especially asymptomatic young adults, who are at increased CVD risk.

Material and Methods

Present cross-sectional; study was conducted at the Department of General Medicine, Tertiary Care Teaching Institute of India for the duration of 1 year. Total 200 patients were included in the study.

Inclusion criteria for current study were; patients willing to give written informed consent, age group: >18yrs and Patients who have a family history of a first degree relative suffering from either hypertension, diabetes, dyslipedemia or ischemic heart disease.

Individuals with habit of smoking, alcoholism, known cases of DM, hypertension, thyroid disorders, and cardiac diseases were excluded from the study. Written informed consent was obtained from all participants, history was elicited, and general examination was done. Fasting blood sugar, post prandial blood sugar, HbA1C, fasting lipid profile, ECG were done.

Anthropometric measurements were performed on subjects. Body weight was measured, and height was measured to the nearest 0.1 cm by using a wall-mounted stadiometer. BMI was calculated by dividing weight (kg) by the square of height (m2). With the subject in a standing position, the Waist circumference was taken at the midline between the lower border of the rib cage and iliac crest to the nearest 0.1 cm after a normal expiration. Hip circumference was measured at the maximum buttock girth. Waist to Hip ratio was calculated. Sagittal abdominal diameter or "supine abdominal height" was measured after a normal expiration to nearest 0.1 cm in supine position with straight legs on a firm examination table, without clothes in the measurement area, at the level of iliac crest (L4-5) level with the help of a sliding beam caliper. Out of the two limbs of the caliper, the lower limb was slid underneath the back of the subject and the upper limb was brought down to slightly touch the abdomen at end expiration. Sagittal Abdominal Diameter was measured at the vertical distance between the two horizontal limbs of the caliper.

Statistical analysis

The recorded data was compiled and entered in a spread sheet computer program (Microsoft Excel 2007) and then exported to data editor page of SPSS version 15 (SPSS Inc., Chicago, Illinois, USA). For all tests, confi-dence level and level of significance were set at 95% and 5% respectively.

Results

Among the subjects studied, 100 (50%) were Male and 100 (50%) were female. Among the subjects included in the study, maximum number of males i.e. 34% were in the age group of 21-30 and maximum number i.e. 29 % of females were in the age group of 31-40 years. Among the various metabolic parameters studied, there was no statistically significant difference among male and female in terms of age, FBS, PPBS, HbA1C or lipid profile. The mean SAD was more in people with a combined history of DM and HTN than in individuals with history of either DM or HTN alone. However, the values did not attain statistical significance.

In our study, BMI had strong positive correlation to Weight, SAD and WC. It indicates that BMI correlates the same with Visceral Adipose Tissue measured by SAD and Subcutaneous adipose tissue measured by WC and is not useful in differentiating the two of them. BMI correlates poorly with WHR in women but moderately with men because of the difference in fat distribution, which WHR appreciates better in women than in men.

Even in spite of BMI being normal, 24% had SAD in the higher quartiles and even with overweight and obese individuals, 35% had SAD in the lower quartiles. Men showed high correlation to Weight, BMI, FBS and PPBS, moderate correlation to age, SBP, WC, HC, HbA1C, VLDL, TG. Women showed high correlation to Weight and BMI. Moderate correlation to WC, HC, VLDL, TG, PPBS and HbA1C and low correlation to FBS. All metabolic and anthropometric parameters showed positive correlation with SAD except Height and HDL (statistically significant at $p<0.001$) It was found in this study that the Pearson correlation coefficients (r values) of various metabolic parameters like FBS, PPBS, HbA1c, VLDL and TGC in men were greater than that found in women. However women had increased r values in

LDL and total cholesterol. With progressing age, SAD goes on increasing. 1st Quartile to 4th Quartile. This was statistically significant. ($p<0.001$) The mean SAD in people with dysglycemia in the form of HbA1c 5.7-6.4 was more 22.57cm vs. 18.36cm in individuals with no dysglycemia ($p<0.001$) The mean SAD in people with impaired fasting glucose was more 20.88 cm vs. 17.10cm in individuals with normal fasting glucose. The mean SAD in people with hypercholesterolemia was more 20.50 cm vs. 19.20 cm in individuals with TC<200mg/dl. When compared to BMI, SAD correlated better with TC, FBS, PPBS and HbA1c.

This was statistically significant ($P<0.001$) all metabolic and anthropometric parameters showed positive corre-lation with SAD except Height and HDL.

In our study SAD and BMI had more positive correlations with FBS, PPBS, HbA1c, TC and BP when compared to WC and WHR. . SAD had higher r values than BMI and hence correlated better.

Table 1: Distribution of study subjects according to their BMI (n=200)

BMI (Asian criteria)	Father (N=100) Frequency (%)	Mother (N=100) Frequency (%)
<18.5 (Underweight)	15	7
18.5-22.99 (Normal)	48	34
23-24.99 (Overweight)	14	23
25.0-29.99 (Pre-obese)	22	28
≥30 (Obese)	1	8

Table 2: Correlation between BMI and SAD (n=200).

BMI	Quartiles of SAD, frequency (%)				P value
	1st (N=65)	2nd (N=55)	3rd (N=43)	4th (N=37)	
<18.5 (Underweight)	20	1	1	0	0.001*
18.5-22.99 (Normal)	32	26	14	10	
23-24.99 (Overweight)	4	12	14	7	
25.0-29.99 (Pre-obese)	3	12	10	20	
≥30 (Obese)	6	4	4	37	

* indicates statistically significance at $p\leq0.05$

Discussion

Excessive body fat accumulation may have an adverse effect on health. Being overweight and obese are major risk factors for many chronic diseases, including diabetes, cardiovascular diseases, and cancer. [12] In a study, all the anthropometric measurements showed positive correlation with atherogenic indices in obesity. [13] It is seen that obesity is increasing in the world, and in India, it has reached epidemic range. Another cross-sectional study revealed that generalized obesity, abdominal obesity, regional adiposity, and metabolic syndrome are increasing in young adults and needs public health intervention. [14] Visceral fat is a source of expression of pro-inflammatory, atherogenic cytokines and it is a predictor of cardiovascular disease. [15] For assessing the distribution of body fat, BMI is less suitable.

This study comprised of 50% males and 50% of females. This was similar to study conducted by Riserius et al and Sharda et al. [16,17] Riserius et al proved that the greater correlation of SAD in men may be explained by the well-established gender dimorphism in regional adipose tissue distribution. They said that at a given BMI, men present a higher visceral adipose tissue content compared with women. [16] These findings can be ex-plained by the fact that catecholamine mediated free fatty acid release is lower in women than in men, whereas free fatty acid release from the upper body depots is comparable basal fat oxidation is lower in females as compared to males, thereby contributing to a higher fat storage in women.

In this study, it was found that, with increasing age SAD also increased. With increasing age, due to sedentary life style and accumulation of metabolic risk factors, there will be an increase in the visceral adipose tissue which is reflected in our study. Abdominal adipose tissue is known to increase with age in both sexes with women developing a more “android” or centralized body fat distribution as they age, particularly after meno-pause.

In general, body mass index is used to verify if subjects are overweight or obese without considering muscle mass. This apparent paradox may reflect intrinsic limitations of Body Mass Index in differentiating lean and adipose tissues and in accounting for body fat distribution. In this study, even in spite of BMI being normal, 23% had SAD in the higher quartiles. These could be the metabolically obese normal weight individuals who are misclassified into the lower BMI class.35% of individuals with BMI in the overweight and obese classification had SAD in the lower quartiles.

Waist circumference (WC) serves as one of the criteria for the diagnosis of metabolic syndrome. [18] However, it does not distinguish visceral from subcutaneous abdominal adipose tissue. In our study, WC correlated the least with SAD because SAD measures VAT and BMI measures SAT. Waist circumference had moderate corre-lation with blood sugars. The persistence of significant associations of lipids and selected adipocytokines with SAD agrees with the findings of several cross-sectional observations that SAD is the surrogate marker for vis-ceral fat as compared to waist circumference. [19,20]

In our study SAD had a considerable advantage over BMI in predicting dysglycemia as it showed moderate correlation to glycemic parameters as compared to poor correlation by BMI ($p<0.001$). In a study done by Pajunen et al it was found that the combination of high SAD and high BMI showed a nearly 37-fold increased risk of diabetes incidence compared with the risk of individuals who had normal BMI and belonged to the lowest SAD quartile. Even in our study, the mean SAD in people with dysglycemia in the form of HbA1c 5.7-6.4 was more 22.57 vs. 18.36 in individuals with no dysglycemia. [21] In the current study, total cholesterol, LDL had a lower mean value.TC showed low positive correlation than other studies. Women correlated better than men (0.21 vs. 0.16). Hypertriglyceridemia may be the major cause of the other lipid abnormalities since it will lead to delayed clearance of the TG-rich lipoproteins and formation of small dense LDL

This was a cross-sectional study and further prospective analyses will be needed to verify SAD as a predictor of mortality. The sample size can be increased to get better analysis.

Conclusion

Robust correlation exists between sagittal abdominal diameter and cardiovascular risk factors. Sagittal ab-dominal diameter is comparable to body mass index but it correlates better with metabolic risk profile of an individual than body mass index, waist circumference & waist-to-hip ratio.

Sagittal Abdominal Diameter may predict dysglycemia and hypercholesterolemia marginally better than the currently in vogue anthropometric indices. Family history plays a role in ascertaining the genetic risk conferred by a particular body habitus as assessed by anthropometry. Large scale studies need to be done to validate the hypothesis. Sagittal abdominal diameter may have utility as a novel clinical measurement used in research and screening to identify “metabolically obese” normal weight men who would benefit from lifestyle and pharmacological interventions.

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