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Original Research Article

COMPARATIVE ANALYSIS OF SAGITTAL ABDOMINAL DIAMETER AND CONVENTIONAL ANTHROPOMETRIC OBESITY METRICS IN ADULTS WITH A GENETIC PREDISPOSITION TO CARDIOVASCULAR DISEASE

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ABSTRACT

Background: Obesity is a major risk factor for CVD and is usually measured by anthropometric indices like BMI and WHR. However, SAD has been identified as a promising measure of central obesity and visceral fat distribution, especially in individuals with a genetic predisposition to cardiovascular risk factors. This study compares the efficacy of SAD and traditional obesity indices in predicting cardiovascular risk in adults with a family history of CVD. **Objective:** To assess and compare sagittal abdominal diameter (SAD) with other conventional anthropometric indices, including BMI, WHR, and waist circumference, in the detection of obesity-related cardiovascular risks in adults with a family history of CVD.

Material and Methods: This cross-sectional study included 200 adults aged 25–60 years with a family history of CVD. Anthropometric measurements, including SAD, BMI, WHR, and waist circumference, were obtained using standardized methods. Cardiovascular risk markers such as blood pressure, lipid profile, and fasting blood glucose were assessed. Statistical analyses were conducted to determine the associations between anthropometric indices and cardiovascular risk markers.

Results: SAD was more correlated with cardiovascular risk markers, as evidenced by blood pressure elevation, $r = 0.68$; dyslipidemia, $r = 0.64$; fasting blood glucose, $r = 0.61$; compared with BMI, $r = 0.42$, and WHR, $r = 0.49$. Higher SAD tertile participants exhibited a significantly increased likelihood of heightened cardiovascular risk over those in the lower tertiles ($p < 0.001$). The study findings indicate that SAD is a better predictor of CVD risk in people with a family history of cardiovascular conditions.

Conclusion: Sagittal abdominal diameter outperforms traditional anthropometry in predicting cardiovascular risk among adults with genetically predisposed CVD. In this way, establishing the efficacy of SAD as a potential tool for routine clinical assessments to provide targeted interventions in high-risk populations.

Key Words: Sagittal Abdominal Diameter, Cardiovascular Risk, Obesity, Anthropometry, Body Mass Index, Waist-To-Hip Ratio, Family History, Visceral Fat.

INTRODUCTION

Obesity is a well-established risk factor for cardiovascular diseases, contributing significantly to the global burden of morbidity and mortality. The rising prevalence of obesity, driven by sedentary lifestyles and dietary changes, underlines the urgency of identifying reliable metrics for its assessment.[1] Anthropometric indices, such as body mass index, waist-to-hip ratio, and waist circumference, are commonly used for assessing obesity. However, these traditional measures are not perfectly accurate in the reflection of central obesity and visceral fat, which are more closely related to cardiovascular risk.[2]

Sagittal abdominal diameter (SAD) has emerged as a novel anthropometric measure that directly assesses central obesity by quantifying abdominal height.[3] Unlike BMI, which fails to distinguish between fat and lean mass, or WHR, which does not account for fat distribution, SAD provides a direct representation of visceral fat accumulation, making it a superior predictor of obesity-related metabolic abnormalities.[4] Several studies have shown that SAD is associated more strongly with adverse cardiovascular outcomes, including hypertension, dyslipidemia, and type 2 diabetes, than conventional indices.

Patients with a family history of CVD are considered to be at higher risk, both carrying genetic predispositions and shared environmental exposures that contribute to an increased susceptibility for cardiovascular events.[5] Identifying risks due to obesity at an early stage in such patients is of importance to prevent further progression of CVD. Incorporation of SAD into routine clinical assessment along with advanced anthropometric measures might improve the stratification of risk and lead to personalized preventive measures.[6]

The goal of this research is to investigate and compare the ability of SAD and classical anthropometric indexes (BMI, WHR, and WC) to predict the risk of CVD in adults with a history of CVD in their first-degree relatives.[7] The clinical application of SAD as a better predictor of the risk of developing obesity-related risk factors, like blood pressure, lipid profile, and fasting blood glucose, shall be determined based on the strength of association established between these indexes and the given risk markers. These study findings may therefore inform further clinical guidelines on the development and integration of SAD as a component part of comprehensive evaluation for cardiovascular risks.[8]

MATERIALS AND METHODS

This cross-sectional study was conducted for 12 months at a tertiary care hospital to assess the associations between sagittal abdominal diameter and cardiovascular risk markers in adults with a family history of cardiovascular disease. A total of 200 adults aged 25–60 years, with at least one first-degree relative diagnosed with cardiovascular disease, were recruited from outpatient clinics. Participants were selected using purposive sampling to include individuals at high genetic risk for CVD. Exclusion criteria included individuals with a history of diagnosed CVD, secondary causes of obesity such as endocrine disorders, pregnancy, and the use of medications known to influence metabolic parameters.

Anthropometric measurements were conducted using standardized protocols to ensure accuracy and consistency. SAD was measured using a portable abdominal caliper while participants were in a supine position, targeting the level of the iliac crest. Body mass index (BMI) was calculated using the formula weight in kilograms divided by height in meters squared. Waist circumference (WC) was measured in the middle between the lower edge of the last palpable rib and the top of the iliac crest, and waist-to-hip ratio (WHR) is calculated as WC/hip circumference around its widest area.

The following clinical and laboratory tests were used in assessment: blood pressure was measured twice with a digital sphygmomanometer and recorded as the average of two measurements; an overnight fast preceded blood sampling to estimate fasting blood glucose with the glucose oxidase-peroxidase method, as well as to estimate lipid profiles and total cholesterol, triglycerides, HDL, and LDL by enzymatic methods. Demographic and lifestyle data, encompassing dietary intake, physical activity, and smoking status, have been collected in structured interviews. The analysis of the data was performed with SPSS software. Demographic and anthropometric characteristics among participants were analyzed through descriptive statistics. Pearson's correlation coefficients between anthropometric indices were determined to compare the strength of association with those cardiovascular risk markers. Multiple regressions were utilized to compare and evaluate the predilection by SAD on the risk estimates with BMI, WC, and WHR that adjusted for all confounding variables, including age, gender, and lifestyle variables.

Ethical approval for the study was obtained from the institutional ethics committee, and all participants gave written informed consent. To ensure confidentiality, participant data were anonymized throughout the study.

RESULTS

Demographic and Baseline Characteristics: Table 1 provides an overview of the demographic and baseline characteristics of the study participants. The majority of the participants were between 35 and 50 years of age, with a higher representation of females. Hypertension and diabetes were the most common comorbidities, consistent with the family history of cardiovascular risk.

Anthropometric Indices and Cardiovascular Risk Markers: Table 2 shows the mean values of anthropometric indices and cardiovascular risk markers. SAD had the highest mean value of association with cardiovascular risk markers compared to BMI, WC, and WHR.

Correlation of Anthropometric Indices with Cardiovascular Risk Markers: Table 3 presents the correlation coefficients between anthropometric indices and cardiovascular risk markers. SAD demonstrated the strongest correlation with all markers compared to other indices.

Stratification of SAD by Cardiovascular Risk Tertiles: Table 4 shows the stratification of participants into tertiles based on SAD values. Those in the highest tertile had significantly higher cardiovascular risk markers compared to lower tertiles.

Predictive Value of SAD and Other Anthropometric Indices: Table 5 summarizes the predictive value of SAD and other anthropometric indices for identifying elevated cardiovascular risk. SAD had the highest odds ratio, indicating its superior predictive ability.

Distribution of Participants by BMI Categories: Table 6 Interpretation

Table 6 categorizes participants based on BMI classifications. The majority of participants were classified as overweight or obese, aligning with their elevated cardiovascular risk profiles.

Relationship Between WC and Cardiovascular Risk Markers: Table 7 highlights the relationship between WC quartiles and cardiovascular risk markers. Participants in higher WC quartiles exhibited significantly higher levels of risk markers.

Distribution of Participants by WHR Categories: Table 8 presents the distribution of participants based on WHR categories. A majority of participants exceeded the threshold for central obesity, consistent with their increased cardiovascular risks.

Comparison of Cardiovascular Risk Markers Between Genders: Table 9 compares cardiovascular risk markers between male and female participants. While both genders showed elevated markers, males exhibited slightly higher systolic blood pressure and LDL cholesterol levels.

Diagnostic Accuracy of Anthropometric Indices for High CVD Risk: Table 10 evaluates the diagnostic accuracy of SAD and other anthropometric indices for predicting high cardiovascular risk. SAD demonstrated the highest sensitivity and specificity among the indices.

Table 1: Demographic and Baseline Characteristics

Characteristic	Frequency (n = 200)	Percentage (%)
Age Group (Years)		
25–34	42	21%
35–50	98	49%
51–60	60	30%
Gender		
Male	82	41%
Female	118	59%
Comorbidities		
Hypertension	86	43%
Diabetes Mellitus	62	31%
Dyslipidemia	54	27%

Table 2: Mean Anthropometric Indices and Cardiovascular Risk Markers

Parameter	Mean ± SD
Sagittal Abdominal Diameter (SAD)	23.4 ± 2.8 cm
Body Mass Index (BMI)	28.7 ± 3.9 kg/m²
Waist Circumference (WC)	92.3 ± 10.2 cm
Waist-to-Hip Ratio (WHR)	0.88 ± 0.07
Systolic BP	134.5 ± 12.7 mmHg
Diastolic BP	84.6 ± 9.8 mmHg
Fasting Blood Glucose	112.8 ± 15.3 mg/dL
LDL Cholesterol	136.4 ± 20.5 mg/dL

Table 3: Correlation Coefficients Between Anthropometric Indices and Cardiovascular Risk Markers

Risk Marker	SAD	BMI	WC	WHR
Systolic BP	0.68	0.42	0.55	0.49
Diastolic BP	0.63	0.38	0.48	0.46
Fasting Blood Glucose	0.61	0.36	0.50	0.47
LDL Cholesterol	0.64	0.40	0.52	0.48

Table 4: Cardiovascular Risk Markers by SAD Tertiles

SAD Tertile (cm)	Mean Systolic BP (mmHg)	Mean Fasting Glucose (mg/dL)	Mean LDL Cholesterol (mg/dL)
Tertile 1: <21.5	126.4	102.3	124.6
Tertile 2: 21.5–24.5	132.8	110.4	134.7
Tertile 3: >24.5	144.2	122.1	150.3

Table 5: Predictive Value of Anthropometric Indices for Cardiovascular Risk

Parameter	Odds Ratio (95% CI)	p-Value
Sagittal Abdominal Diameter (SAD)	2.82 (2.15–3.71)	<0.001
Body Mass Index (BMI)	1.56 (1.12–2.18)	0.02
Waist Circumference (WC)	1.78 (1.33–2.38)	0.01
Waist-to-Hip Ratio (WHR)	1.65 (1.23–2.22)	0.03

Table 6: Distribution of Participants by BMI Categories

BMI Category	Frequency (n = 200)	Percentage (%)
Underweight (<18.5)	10	5%
Normal (18.5–24.9)	38	19%
Overweight (25–29.9)	92	46%
Obese (≥30)	60	30%

Table 7: Cardiovascular Risk Markers by WC Quartiles

WC Quartile (cm)	Mean Systolic BP (mmHg)	Mean Fasting Glucose (mg/dL)	Mean LDL Cholesterol (mg/dL)
Quartile 1: <85	122.3	100.4	121.8
Quartile 2: 85–95	130.2	108.7	130.2
Quartile 3: 96–105	139.1	118.5	144.9
Quartile 4: >105	148.7	126.9	157.4

Table 8: Distribution of Participants by WHR Categories

WHR Category	Frequency (n = 200)	Percentage (%)
Below Threshold	46	23%
Above Threshold	154	77%

Table 9: Cardiovascular Risk Markers by Gender

Gender	Mean Systolic BP (mmHg)	Mean Fasting Glucose (mg/dL)	Mean LDL Cholesterol (mg/dL)
Male	137.8	113.9	140.2
Female	132.4	111.7	134.7

Table 10: Diagnostic Accuracy of Anthropometric Indices

Index	Sensitivity (%)	Specificity (%)
Sagittal Abdominal Diameter (SAD)	84	89
Body Mass Index (BMI)	68	72
Waist Circumference (WC)	74	78
Waist-to-Hip Ratio (WHR)	71	75

DISCUSSION

The findings of this study underscore the critical role of sagittal abdominal diameter (SAD) as a superior anthropometric measure for assessing cardiovascular risk in adults with a family history of cardiovascular disease (CVD). Traditional indices such as body mass index (BMI), waist circumference (WC), and waist-to-hip ratio (WHR) have been extensively used in clinical practice; however, their limitations in accurately capturing central obesity and visceral fat are well-documented.[9] In contrast, SAD demonstrated the strongest correlations with cardiovascular risk markers, including blood pressure, fasting blood glucose, and LDL cholesterol, highlighting its potential as a reliable tool for obesity-related risk stratification.

Participants in the highest SAD tertile exhibited significantly higher levels of cardiovascular risk markers compared to those in lower tertiles, emphasizing the association between central obesity and metabolic dysregulation. This supports the hypothesis that visceral fat, which is more accurately reflected by SAD, plays a pivotal role in the pathogenesis of cardiovascular diseases.[10] The diagnostic accuracy of SAD, with sensitivity and specificity values exceeding those of traditional measures, further reinforces its clinical utility.

While BMI remains the most commonly used index for obesity assessment due to its simplicity, its inability to differentiate between fat and lean mass limits its effectiveness, particularly in populations with high muscle mass or sarcopenia. Similarly, WHR and WC, though indicative of fat distribution, fail to provide a direct measure of visceral adiposity. SAD, by quantifying abdominal height, directly captures the extent of central obesity and its associated risks, making it a more robust predictor of cardiovascular outcomes.[11]

The stratification of cardiovascular risk by anthropometric indices revealed that individuals classified as obese or with high SAD values were more likely to exhibit elevated blood pressure, dyslipidemia, and hyperglycemia.[12] These findings align with previous studies that highlight the impact of central obesity on systemic inflammation, insulin resistance, and endothelial dysfunction, all of which contribute to cardiovascular risk. Furthermore, the higher odds ratio for SAD in predicting CVD risk underscores its value in identifying high-risk individuals within a genetically predisposed population.[13]

Gender-specific analyses revealed slight variations in cardiovascular risk markers, with males exhibiting higher systolic blood pressure and LDL cholesterol levels than females. This may be attributed to differences in fat distribution and hormonal influences between genders. Despite these differences, SAD remained a consistent and reliable predictor of risk across both sexes, indicating its universal applicability.[14]

The findings of this study have important clinical implications. Incorporating SAD into routine assessments for individuals with a family history of CVD could enhance early detection of high-risk cases and guide targeted interventions.[15] Lifestyle modifications, including dietary changes, physical activity, and weight management, can be initiated promptly to mitigate the progression of cardiovascular risks. Additionally, the use of SAD could complement traditional indices in research and public health strategies aimed at addressing obesity-related health disparities.[16]

Despite its strengths, the study has certain limitations. The cross-sectional design precludes the establishment of causal relationships between SAD and cardiovascular outcomes.[17] Additionally, the study population, comprising individuals with a family history of CVD, may not be representative of the general population, limiting the generalizability of the findings. Future longitudinal studies are needed to confirm these associations and evaluate the long-term predictive value of SAD for cardiovascular events.[18]

In conclusion, this study highlights the superiority of SAD over traditional anthropometric indices in predicting cardiovascular risk in adults with a genetic predisposition to CVD. By providing a direct measure of central obesity and visceral fat, SAD offers a valuable addition to the toolkit for assessing obesity-related health risks. Its integration into clinical practice could improve the identification and management of individuals at substantial risk for cardiovascular diseases, ultimately contributing to better health outcomes and reduced disease burden.

CONCLUSION

This study highlights the major advantages of sagittal abdominal diameter (SAD) over traditional anthropometric measures, such as body mass index (BMI), waist circumference (WC), and waist-to-hip ratio (WHR), in predicting cardiovascular risk in adults with a family history of cardiovascular disease (CVD). SAD showed more significant correlations with major cardiovascular risk markers, including high blood pressure, fasting blood glucose, and levels of LDL cholesterol, which further indicates its potential to better assess central obesity and visceral fat distribution. These findings highlight the essential role of SAD in evaluating metabolic risks and its potential in improving risk stratification in populations at substantial risk.

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SAD addresses some of the pitfalls of conventional indices, which could not distinguish visceral from subcutaneous fat, nor account for fat distribution. Indeed, the SAD has also been shown to have high diagnostic accuracy with exceedingly high sensitivity and specificity, placing it at par with other sensitive and specific risk markers for detecting individuals at higher risk of having cardiovascular events. Participants in the highest SAD tertile exhibited significantly higher cardiovascular risk markers, reinforcing its utility in targeted intervention planning and preventive strategies.

The inclusion of SAD in regular clinical practice presents an exciting and optimistic approach to enhancing the early detection and management of cardiovascular risks in patients genetically predisposed to CVD. This will enable timely initiation of lifestyle modifications, including dietary change, weight management and physical activity, in an attempt to mitigate progression in metabolic and cardiovascular complication. Moreover, SAD can complement existing anthropometric measures, providing a more comprehensive assessment of obesity-related risks in research and public health contexts.

Although this study yields convincing evidence regarding the utility of SAD, the findings need to be interpreted within the context of some limitations. The cross-sectional design does not establish causality, and the study population was limited to persons with a family history of CVD, thereby not being as representative of the general population as it could be. Future longitudinal studies with more diverse cohorts will be necessary to validate these findings and to ascertain the long-term predictive value of SAD for cardiovascular events and mortality.

In conclusion, SAD proves to be the best anthropometric measurement for determining the risk of CVD, particularly among high-risk patients with a history of CVD. Its potential is immense when included in the medical and public health models: enhanced early detection will inform prevention at the individual level and improve outcomes regarding cardiovascular events among vulnerable populations.

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