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A Formal Analysis of Anthropometric Parameters for Effective Forecasting of Dyslipidemia in Healthy Young Adults

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Background: Obesity in the younger age groups predisposes an individual for a high risk for developing dyslipidemia and cardiovascular disease. Distribution of the abdominal adipose tissue cannot be accurately described by the traditional anthropometric indices.Newer anthropometric indices are better predictors of obesity.
Objective: To compare the ability of different anthropometric indices in predicting dyslipidemia in healthy young adults.
Materials and Methods: The cross-sectional study was performed on 100 subjects (48 males and 52 females) at K S Hegde Medical Academy from 2017 to 2018 (power of study: 80%). Apparently healthy individuals attending the executive health checkup plan and individuals from hospital staff

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aged 18-35 years were selected for the study. The Kolmogorov Smirnov test was used to determine the data's normality. Pearson's correlation test was used to measure the relationship between lipid parameters and various anthropometric indices. The predictive capacity of various anthropometric indices for distinguishing between dyslipidemic and healthy individuals was investigated using ROC curve analysis.

Results: Newer anthropometric measurement approaches such as ABSI, BRI, CI, AVI, VAI, and LAP have been suggested as better instruments for predicting dyslipidemia. The present study found that VAI had the highest predictive efficiency in identifying dyslipidemia among apparently healthy adults using ROC analysis. This discovery may lead to the use of a simple anthropometric index as a screening tool for cardiovascular disease prediction.

Conclusion: The current study has shown that the VAI has emerged as a valuable instrument for dyslipidemia assessment in healthy young adults. Using regular laboratory tests and basic anthropometric measurements, VAI can be easily measured and can therefore be used as relevant dyslipidemia evaluation methods in clinical practice.

Keywords: Dyslipidemia; anthropometric measurement; kolmogorov smirnov test; Pearson's correlation test; ROC analysis.

1. INTRODUCTION

Obesity is known as a significant cardiometabolic potential cause [1]. Prevalence of overweight and obesity is foreseen to reach 30.5% and 9.5% among men and 27.4% and 13.9% in women by the year 2040 [2]. Abnormal levels of Total Cholesterol (TC), Triglycerides (TG), High-Density Lipoprotein Cholesterol (HDL-c), and Low-Density Lipoprotein cholesterol (LDL-c) individually or in combination is defined as dyslipidemia [3]. Evaluating dyslipidemia by measurement of lipid profile can pose a socio-economic burden on the nation [4]. The need of the hour is to establish accessible, relevant, cost-effective, and accurate anthropometric parameters for early identification of risk individuals for cardiovascular disease (CVD) [5]. Studies have implied that limited details on fat distribution have been provided by the classical anthropometric measures of cardiovascular health, such as body mass index (BMI), waist circumference (WC), and waist-to-height ratio (WHtR) [6]. Body mass index (BMI), which was commonly used in the measurement of obesity status, cannot be used to describe the spatial distribution of abdominal adipose tissue [7]. WC has been deemed a good indicator of abdominal adipose tissue [8]. But WC reliance on body size remains undetermined [9].

In the US population, a body shape index (ABSI) was suggested to be superior to BMI and WC as a metric of metabolic changes and risk of disease [10]. Assessment of ABSI is based on WC, BMI and height. ABSI is known to correlate with abdominal adipose tissue and is considered to be a significant risk factor for premature death [11].BRI is a newer anthropometric index that uses a combination of height and waist circumference to estimate body fat percentage [12]. BRI predicts both body fat and percentage of visceral adipose tissue [13]. Visceral adiposity index (VAI) was introduced by Amato et al., which could be considered as a predictor for cardiometabolic risk. The Visceral Adiposity Index (VAI) is a gender-specific empirical-mathematical model based on simple anthropometric (BMI and WC) and functional (triglycerides (TG) and HDL cholesterol (HDL)) parameters that is indicative of fat distribution and function [14] .The Conicity Index (CI) is a metric that considers abdominal circumference, weight, and height [15]. CI is important indicator of fat mass distribution and figure in young adults [16]. Estimation of the overall volume is done by another anthropometric tool called abdominal volume index (AVI) [17]. AVI indirectly measures visceral fat by assessing the abdominal volume and is known to predict impaired glucose tolerance and develpoment of diabetes mellitus [18]. The lipid accumulation product (LAP), which reflects total lipid peroxidation in the body, was proposed by Kahn et al. to estimate metabolic syndrome in adults [19]. LAP indicates the total lipid accumulated in the body, along with the anatomical and physiological changes associated with excess lipid accumulation [20]. Neck circumference (NC) measurement has been established as a possible marker for evaluating upper-body subcutaneous fat distribution as deposition of fat around the neck depicts the amount of upper body subcutaneous adipose tissue [21].

Different anthropometric measures can be needed to diagnose dyslipidemia due to racial and ethnic variation within populations of diverse regions. However, no consensus on the best anthropometric indices for assessing dyslipidemia has been achieved. Very few studies in India, have examined the effectiveness of obesity-related parameters in identifying dyslipidemia in apparently healthy young adults.

Present study was conducted to determine the the ability of BMI, WC, HC, WHR, WHt.R, ABSI, BRI, VAI, CI, AVI, LAP, and NC in predicting dyslipidemia young healthy adults.

2. MATERIAL AND METHODS

Between 2017 and 2018, 100 subjects (48 males and 52 females) participated in a cross-sectional analysis at K S Hegde Medical Academy (power of study: 80%).

Apparently healthy individuals attending the executive health checkup plan and individuals from hospital staff aged 18-35 years were selected for the study. Individuals with diabetes or hypertension, as well as those taking lipid-lowering medications, were excluded from the analysis. After fasting overnight, 5 mL of blood was drawn from the antecubital vein using aseptic techniques. Blood collected in plain vacutainer was centrifuged at 3000 rpm for 10 minutes on the same day of collection to obtain serum.

2.1 Biochemical Analysis

- The total cholesterol level was determined using the CHOD- PAP enzymatic process (Cholesterol Oxidase-Peroxidase 4-Amino antipyrine) [22]
- Triglyceride level was estimated by enzymatic (Glycerol kinase, Glycerol- 3-phosphate oxidase-Peroxidase) colorimetric method [23]
- HDL-c and LDL-c level was estimated by enzymatic colorimetric assay [24]
- VLDL was calculated by formula-TG/5.

2.2 Anthropometric Measurements

- A traditional analogue weighing scale was used to determine body weight to the nearest kilogramme. A non-stretchable measuring tape was used to measure the height, waist circumference, and hip circumference to the nearest 0.5 cm.
- At limited respiration, the waist circumference (WC) (cm) was determined in the midsection between the iliac crests and the lower margin of the ribs.
- At the stages of the greater trochanter, the hip circumference (HC) (cm) was determined.
- WHR was calculated as WC/HC
- WHt.R was estimated as WC (Cm)/height (Cm)
- BMI was estimated as weight (Kg)/height (m2)
- ABSI was calculated using the formula:

$$ABSI = \frac{WC(m)}{[BMI]^{\frac{2}{3}}\,[Height]^{\frac{1}{2}}} \quad \text{..... (1)}$$

- BRI was calculated as:

$$BRI = 364.2 - 365.5\,X\,\sqrt{1 - \frac{(WC/(2\pi))^2}{(0.5\,X\,Height)^2}}\ . \text{ (2)}$$

- AVI was calculated as [2WC^2 (cm)+ 0.7(WC - HC)^2 (cm)]/1000
- CI was calculated as 0.109^{-1}WC(m)(Weight (kg) /height (m)$^{-1/2}$
- VAI (Males) was calculated as WC (cm) /39.68- 1.88 BMI (kg/m^2)
- (TG (mmol/L)/1.03(1.31/HDL (mmol/L)
- VAI (Females) was calculated as WC (cm) /36.58-1.89 BMI (kg/m^2)
- (TG (mmol/L)/0.81(1.52/HDL (mmol/L)
- LAP (Males) was calculated as WC (cm - 65×TG (mmol/L)
- LAP (Females) was calculated as WC (cm -58×TG(mmol/L)
- NC was measured between the mid-cervical spine and the mid-anterior neck in the middle of the neck.

2.3 Statistical Analysis

The Kolmogorov Smirnov test was used to determine the data's normality [25]. It's a fast and painless way to see if two samples are substantially different.

2.4 Hypothesis

Null hypothesis H_0: The given data are normaly distributed.

Alternate hypothesis H_1: The given data are not normaly distributed.

This test contrasts the uniform distribution's continuous cumulative distribution (CDF) function

F(x) with the set of N observations' empirical CDF $S_N(x)$.

$$F(x) = x, \quad 0 \leq x \leq 1$$

If the sample from the random number generator is R1, R2, R3,……., R_N, then the empirical CDF $S_N(x)$ is defined by

$$S_N(x) = \frac{number\ of\ R1,R2,\ldots,RN\ which\ are \leq x}{N} \quad .. (3)$$

If the null hypothesis H0 is valid, SN(x) should become a stronger approximation to F(x) as N grows larger.

Algorithm:

1. Sort the data in order of smallest to biggest. Let R(i) stand for the i^{th} smallest observation, so R(1) ≤ R(2) ≤ … ≤ R(N)
2. Compute
   i. D^+ = max(i/N-Ri) for all i in(1, N)
   ii. D^- = max(Ri-((i-1)/N)) for all i in(1, N)
3. Compute the test statistic D = max(D^+, D^-)
4. Find the critical value Dα for the specified level of significance α and the given sample size N
5. If D > Dα
   Reject H_0
   else
   Accept H_0

D is a test statistic that expresses how much the given data varies from the null hypothesis in a single amount. As a result, it reveals how much the observed values deviate from a normal distribution. The rejection of null hypothesis indicates that variable does not follows a normal distribution.

Pearson's correlation test was used to determine the relationship between lipid parameters and various anthropometric indices. The predictive capacity of various anthropometric indices for distinguishing between dyslipidemic and healthy individuals was investigated using ROC curve analysis.p<0.05 was considered to be statistically significant. SPSS 16 was used to analyse the data collected.

3. RESULTS

Table 1 shows the quantitative details of the anthropometric indices as mean±SD for data with a normal distribution or median and interquartile range for distorted data.

- Males had substantially higher mean values for weight, height, BMI, WC, HC, WHR, WHt.R, ABSI, BRI, NC, CI, and AVI than females.
- There was no noticeable difference in VAI or LAP between males and females
- Table 2 shows that there was no substantial difference in mean age between males and females.
- A positive but weak correlation was present between TC and Age, BMI, WC, BRI ($p < 0.05$). Degree of correlation of TC: BRI > AGE> WC > BMI
- A positive but weak correlation was present between TG and Weight, BMI, WHt.R, BRI, NC. ($p<0.05$). Degree of correlation of TG: BMI>WHt.R>NC>BRI>Weight.
- A negative but weak correlation was present between HDL and Weight, BMI, WC, WHR, WHt.R, BRI, and NC. ($p<0.05$) Degree of correlation of HDL: BMI>NC>WHt.R>BRI>WC> Weight>WHR
- A positive but weak correlation was present between LDL and Age, WC, ABSI, BRI ($p<0.05$) Degree of correlation of LDL: Age > WC>BRI>ABSI
- A positive but weak correlation was present between VLDL and BMI, WHt.R, BRI, and NC ($p<0.05$) as shown in Table 3. Degree of correlation of VLDL: BMI>WHt.R>NC>BRI.
- A positive but weak correlation was present between TC and AVI, LAP total ($p<0.05$). A positive and moderate correlation was present between TC and VAI males ($p<0.05$) & LAP males ($p<0.0001$).
- A positive and strong correlation was present between TG and VAI males, VAI females, VAI total, LAP males, LAP females, and LAP total ($p<0.0001$).
- A negative and moderate correlation was present between HDL and VAI males, VAI females, VAI total, LAP males, LAP females, LAP total. (<0.0001). A negative and poor correlation was present between HDL and AVI ($p<0.05$).
- There was a mild correlation between LDL and LAP males ($p<0.05$) and a positive and weak correlation between LDL and CI, AVI ($p<0.05$).
- A positive and strong correlation was present between VLDL and VAI males, VAI females, VAI total, LAP males, LAP females, and LAP total ($p<0.0001$) as depicted in Table 4.

Table 1. Anthropometric Parameters in Study Subjects

	AGE	Wt.	Ht.	BMI	WC	HC	WHR	WHt.R	ABSI	BRI	NC	CI	AVI	VAI (M)	LAP (M)	VAI (F)	LAP (F)
N	100	100	100	100	100	100	100	100	100	100	100	100	100	36	36	64	64
Mean	20.40	58.44	161.60	22.26	75.69	89.64	.84	.36	.076	2.842	32.03	1.16	11.83	1.58	24.39	1.80	18.07
Std. Deviation	2.23	13.13	7.61	4.08	10.49	10.39	.06	.07	.005	1.059	2.32	0.07	3.24	1.21	16.55	1.94	24.56
Minimum	18	36	145	14.79	56	68	.72	.23	.065	1.096	27	0.98	6.37	0.43	0.97	0.50	-1.36
Maximum	35	113	180	35.27	108	123	1.00	.63	.086	6.406	38	1.29	23.37	5.76	65.65	10.16	120.14

Table 2. Comparison of anthropometric parameters between male and female subjects

SEX		AGE	Wt.	Ht.	BMI	WC	HC	WHR	WHt.R	ABSI	BRI	NC	CI	AVI	VAI	LAP
Males	**N**	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36
	Mean	20.47	67.86	168.56	23.78	83.42	93.42	.89	.40	.078	34.03	3.296	1.21	14.11	1.58	24.39
	Std. Deviation	1.38	13.58	6.33	3.78	7.79	8.85	.03	.07	.004	1.874	.759	0.51	2.71	1.21	16.55
	Minimum	18	42	153	17.04	66	78	.79	.27	.070	29	1.439	1.09	8.81	0.43	0.97
	Maximum	23	113	180	35.27	108	123	.97	.63	.086	38	5.667	1.29	23.37	5.76	65.65
Females	**N**	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64
	Mean	20.36	53.14	157.69	21.41	71.34	87.52	.82	.34	.074	30.91	2.593	1.13	10.55	1.80	18.07
	Std. Deviation	2.59	9.45	5.06	4.02	9.28	10.64	.05	.06	.004	1.716	1.124	0.07	2.78	1.94	24.56
	Minimum	18	36	145	14.79	56	68	.72	.23	.065	27	1.096	.98	6.37	0.50	-1.36
	Maximum	35	74	171	35.19	93	115	1.00	.51	.083	35	6.406	1.27	17.64	10.16	120.14
p value		.809	<0.0001	<0.0001	0.005	<0.0001	0.006	<0.0001	<0.0001	<0.0001	0.001	<0.0001	<0.0001	<0.0001	0.539	0.172

Table 3. Correlation of Lipid Parameters with Anthropometric measurements (BMI, WC, WHR.WHt.R, ABSI, BRI, and NC)

		CORRELATION N=100										
		AGE	**Wt.**	**Ht.**	**BMI**	**WC**	**HC**	**WHR**	**WHt.R**	**ABSI**	**BRI**	**NC**
TC	Pearson Correlation	.227*	.162	-.019	.207*	.214*	.180	.145	.188	.109	.237*	.102
	Sig. (2-tailed)	.023	.107	.851	.039	.032	.073	.150	.061	.280	.017	.314
TG	Pearson Correlation	.013	.209*	-.046	.311**	.179	.176	.112	.263**	-.146	.242*	.254*
	Sig. (2-tailed)	.896	.036	.650	.002	.075	.079	.266	.008	.148	.015	.011
HDL	Pearson Correlation	-.032	-.232*	-.029	-.271**	-.233*	-.176	-.199*	-.257**	-.014	-.255*	-.269**
	Sig. (2-tailed)	.755	.020	.774	.006	.019	.080	.048	.010	.893	.010	.007
LDL	Pearson Correlation	.263**	.170	.022	.178	.249*	.183	.195	.179	.220*	.247*	.094
	Sig. (2-tailed)	.008	.090	.829	.077	.013	.069	.052	.074	.028	.013	.350
VLDL	Pearson Correlation	.021	.193	-.056	.298**	.167	.158	.118	.247*	-.142	.232*	.246*
	Sig. (2-tailed)	.838	.054	.580	.003	.097	.117	.244	.013	.159	.020	.014

Table 4. Correlation of Lipid Parameters with Anthropometric measurements (CI, AVI, VAI, and LAP)

		CI	AVI	VAImales	VAIfemales	VAItotal	LAPmales	LAPfemales	LAPtotal
N		**100**	**100**	**36**	**64**	**100**	**36**	**64**	**100**
TC	**Pearson Correlation**	.194	.205*	.504*	.152	.237	.594*	.195	.302*
	Sig. (2-tailed)	.053	.041	.002	.230	.018	<0.0001	.123	.002
TG	**Pearson Correlation**	.001	.176	.970*	.966*	.944*	.798*	.801*	.792*
	Sig. (2-tailed)	.991	.079	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
HDL	**Pearson Correlation**	-.129	-.238*	-.528*	-.594*	-.536*	-.459*	-.432*	-.446*
	Sig. (2-tailed)	.202	.017	.001	<0.0001	<0.0001	.005	<0.0001	<0.0001
LDL	**Pearson Correlation**	.283*	.243*	.261	-.158	-.046	.421*	-.082	.077
	Sig. (2-tailed)	.004	.015	.124	.212	.648	.011	.519	.448
VLDL	**Pearson Correlation**	-.001	.162	.949*	.963*	.939*	.759*	.802*	.783*
	Sig. (2-tailed)	.993	.107	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001

Table 5. Comparison of anthropometric parameters (BMI, WC, HC, WHR, WHtR, ABSI, BRI, and NC) between dyslipidemic and non-dyslipidemic subjects

Categories		AGE	WEIGHT	HEIGHT	BMI	WC	HC	WHR	WHt.R	ABSI	BRI	NC
Dyslipidemia	N	44	44	44	44	44	44	44	44	44	44	44
	Mean	20.73	61.14	161.23	23.36	78.11	92.18	.85	.38	.0757	3.1489	32.39
	Std. Deviation	3.12	16.21	8.68	5.04	11.72	12.53	.06	.09	.0048	1.2189	2.45
	Minimum	18	36	145	14.79	56	68	.73	.23	.068	1.0964	27
	Maximum	35	113	180	35.27	108	123	1.00	.63	.086	6.4060	36
Non-Dyslipidemia	N	56	56	56	56	56	56	56	56	56	56	56
	Mean	20.14	56.32	161.89	21.39	73.79	87.64	.84	.35	.0752	2.6075	31.75
	Std. Deviation	1.09	9.73	6.72	2.89	9.08	7.89	.06	.05	.0044	.8536	2.19
	Minimum	18	37	148	15.81	56	71	.72	.24	.065	1.1916	27
	Maximum	23	78	176	28.25	91	106	.93	.44	.084	5.2304	38
p value		0.195	0.069	0.666	0.016	0.040	0.029	0.564	0.032	0.598	0.010	0.175

Table 6. Comparison of anthropometric parameters (CI, AVI, VAI, and LAP) between dyslipidemic and non-dyslipidemic subjects

Categories		CI	AVI	VAImales	VAIfemales	VAI	LAPmales	LAPfemales	LAP
Dyslipidemia	N	44	44	14	30	44	14	30	44
	Mean	1.17	12.63	2.47	2.69	2.62	38.28	27.43	30.88
	Std. Deviation	0.07	3.76	1.52	2.54	2.25	17.21	32.86	29.05
	Minimum	1.02	9.55	0.43	0.57	0.43	14.41	-1.36	-1.36
	Maximum	1.29	15.41	5.76	10.16	10.16	65.65	120.14	120.14
Non-Dyslipidemia	N	56	56	22	34	56	22	34	56
	Mean	1.15	11.20	1.01	1.02	1.02	15.56	9.82	12.07
	Std. Deviation	0.08	2.63	0.38	0.38	0.38	7.93	7.24	7.97
	Minimum	0.98	6.55	0.51	0.50	0.50	0.97	-1.18	-1.18
	Maximum	1.29	16.72	1.98	2.05	2.05	33.22	26.85	33.22
p value		0.166	0.028	<0.0001	<0.0001	<0.0001	<0.0001	0.003	<0.0001

- Tables 5 and 6 show that in dyslipidemic subjects, BMI, WC, HC, WhtR, and BRI were significantly higher than in non-dyslipidemic subjects ($p<0.05$).
- In dyslipidemic subjects, AVI, VAI, and LAP were significantly higher than in non-dyslipidemic subjects ($p<0.05$).
- VAI and LAP were found to be greater in dyslipidemic male subjects. Among female subjects, similar findings of VAI and LAP were observed. ($p<0.0001$).

3.1 ROC Analysis

As per the ROC analysis, VAI is a better predictor of dyslipidemia which is shown in Fig. 1.

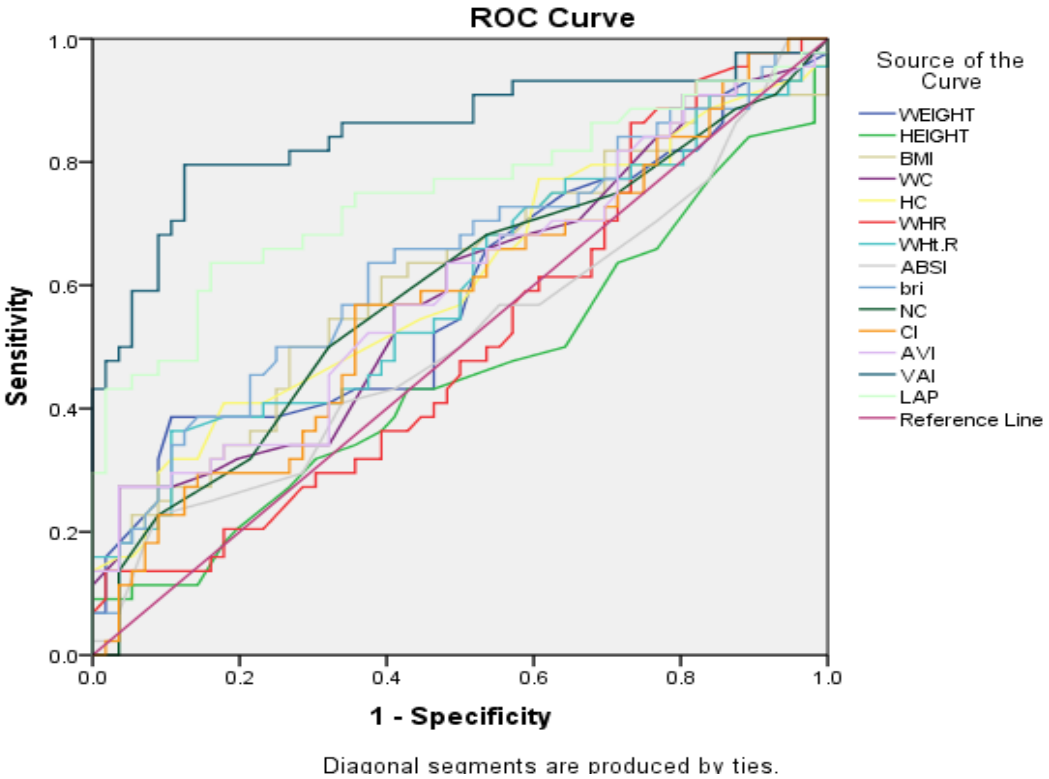

Fig. 1. ROC analysis of different anthropometric parameters

Table 7. Test result between different anthropometric parameters

Test result variable(s)	Area	Std. error [a]	Asymptotic sig.[b]	Asymptotic 95% confidence interval	
				Lower bound	Upper bound
WEIGHT	.587	.059	.135	.472	.703
HEIGHT	.457	.060	.466	.341	.574
BMI	.614	.058	.051	.500	.728
WC	.589	.058	.128	.475	.703
HC	.604	.058	.075	.490	.718
WHR	.511	.059	.857	.396	.625
WHt.R	.595	.059	.106	.480	.710
ABSI	.513	.060	.821	.396	.630
BRI	.637	.057	.019	.525	.749
NC	.590	.058	.124	.475	.704
CI	.575	.058	.199	.461	.689
AVI	.596	.058	.099	.482	.710
VAI	.851	.042	.000	.769	.934
LAP	.748	.052	.000	.645	.850

There is at least one tie between the positive actual state group and the negative actual state group in the test outcome variable(s): WEIGHT, HEIGHT, BMI, WC, HC, WHR, WHt.R, ABSI, BRI, NC, AVI, and LAP, which is shown in Table 7. It is possible that statistics are skewed.

a. Under the nonparametric assumption
b. Null hypothesis: true area = 0.5

4. DISCUSSION

Newer anthropometric measurement approaches such as ABSI, BRI, CI, AVI, VAI, and LAP have been suggested as better instruments for predicting dyslipidemia. The aim of this study is to examine the discriminative performance of anthropometric indices for predicting dyslipidemia by calculating the AUCs.

The VAI had the highest predictive efficiency in detecting dyslipidemia among seemingly healthy adults, according to the current report. In his study, Chiu TH et al. observed that VAI exhibited the best performance in predicting metabolic syndrome with AUC (0.845) with a cut-off value of 1.74 in men and 1.83 in women and is highly correlated with WC, TG, and HDL-c [26]. VAI has been linked to high levels of inflammation-related cytokines and has an inverse relationship with adiponectin, a defensive adipocytokine [27]. VAI has been shown to have a positive relationship with insulin resistance as estimated by the homeostatic model assessment (HOMA-IR) [28]. A systematic review was conducted by Nusrianto R et al which concluded that VAI is an affective anthropometric indice to assess the amount of visceral fat which can be used as a reliable marker for Type 2 diabetes mellitus in Asian population[29]. AUROC value for ABSI (AUC=0.513), was lower than AUROC of BRI, WHt.R, BMI, HC, WC, NC, CI, AVI, VAI, and LAP. This finding is in line with the findings of Fujita M et al., who concluded that ABSI is not appropriate for assessing metabolic syndrome [30]. ABSI was mainly developed using data from the western population, so ethnic differences could account for ABSI's low predictive ability [10]. The Asian population has more abdominal adipose tissue than the western population, and their average height is also shorter, which could alter the impact of ABSI on the detection of metabolic syndrome [31].

The BMI, WC, WHR, WHtR, ABSI, BRI, and NC anthropometric indices all had a positive correlation with TG, TC, and LDL-C levels, but a negative correlation with HDL-C levels. These results are consistent with those of Quaye L et al. [32].

The anthropometric indices (CI, AVI, VAI, and CI) had a positive relationship with TG, TC, and LDL-C levels, but a negative relationship with HDL-C levels. Abulmeaty MMA et al. in their study also demonstrated similar findings [33].

To the state of the art, no systematic research has been conducted in India to establish the relationship between newer anthropometric indices and lipid profiles. The current study supports that VAI is better than the classical anthropometric indices in predicting dyslipidemia. This discovery may lead to the use of a simple anthropometric index as a preventative measure for cardiovascular disease prediction.

5. CONCLUSION

The VAI was found to be a useful method for predicting dyslipidemia in healthy young adults based on the ROC analysis. VAI can be easily measured using conventional laboratory tests and basic anthropometric measurements, and can thus be used as useful dyslipidemia evaluation methods in clinical practice.

6. LIMITATION

Dietary factors that can affect lipid profiles were not taken into account in this analysis. The sample size was small, the subjects were all between the ages of 18 and 35, and they all came from the same area. In a follow-up analysis, ABSI was established to predict mortality risk; however, we used ABSI to estimate dyslipidemia. As a result, more research with a broader randomized community-based population is required to see if the findings are consistent across various parameters.

CONSENT

The informed written consent of the selected participants who agreed to participate in the study was obtained

ETHICAL APPROVAL

The research was approved by the Institutional Ethical Clearance committee (IEC No.INST.EC/EC/047/2018-19).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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