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Original Article

Utility of anthropometric traits and indices in predicting the risk of coronary artery disease in the adult men of southern Andhra Pradesh

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ABSTRACT

Background/Aim: Optimal cutoff values are influenced by ethnicity, geography, lifestyles, and physical activity, and hence, there is a need for establishing population- and disease-specific cutoff values to screen individuals/populations. Therefore, the present study was carried out to determine the optimal cutoff values of anthropometric variables for coronary artery disease (CAD) for the population of southern Andhra Pradesh.
Methods: One hundred sixty five patients with CAD and 87 controls were recruited, and 52 anthropometric variables were measured for them.
Results: Higher means in 22 anthropometric variables covering circumferences, skinfold thickness (sft), and indices were observed in patients than those in controls. Receiver operator curve analysis revealed that 18 variables including circumference, sft, and fat measures with an area under curve ranging from 0.61 to 0.72 were found to have the ability of predicting the risk of CAD. A stepwise discriminant analysis showed 9 variables to correctly classify 87.4% of subjects into CAD and controls. In logistic regression analysis, among these 9 variables, only circumferences of abdomen and foot; sft of supratellar, thigh and calf; and sum of subscapular/suprailiac, waist-hip ratio and lean body mass were associated with CAD and explained 73.4% of its variation.
Conclusions: Eighteen anthropometric variables were found to have the ability of predicting the risk of CAD. Longitudinal studies are needed to confirm the use of anthropometric variables in predicting the risk of CAD.

1. Background

Cardiovascular diseases (CVDs), which include diseases of heart and blood vessels, account for 31.5% of all the deaths globally and 80% of those were observed in low- and middle-income countries.[1] Higher incidence of age-standardized CVD deaths in Indians than the global average and earlier onset, higher case fatality, and higher proportion of CVD deaths among the Indians than Europeans were observed. Among CVDs, coronary artery disease (CAD) is a predominant cause of mortality in India. The risk factors for CAD include smoking, obesity, hypertension, type 2 diabetes, dyslipidemia, and physical inactivity.[2] It was observed that 50% of patients with CAD have no conventional risk factors[3] that are stated previously, and the search for novel risk factors that may better explain the disease is in progress.

Anthropometry has been universally used because it is a less resource-intensive and non-invasive technique to determine the size, proportions, and composition of the body. The variables such as body mass index (BMI), waist circumference, and waist-height ratio (WHtR) were found to increase the risk of CAD.[4–9] Phenotype of an individual depends on acculturation, dietary habits, socioeconomic status, physical activity, and geographic location.[10] In resource-poor countries, targeting high-risk people for preventive measures is likely to reduce both the economic and disease burden. High-risk groups can be identified by using anthropometric measurements, but cutoff values vary with country, population, and ethnic group.[11] Finding population-specific cutoff values for anthropometric variables is therefore useful for research and clinical practice.[12] Rising prevalence of obesity and improved

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nutritional status has also made it necessary to revise cutoffs of anthropometric indices.[6] Very few studies were conducted to determine the cutoff values of a few anthropometric variables for assessing the risk of CAD,[5–8] and the use of other anthropometric variables are yet to be assessed. In view of the foregoing examples, in a case control study, we attempt to assess the use of a set of 52 anthropometric variables in the risk prediction of CAD.

2. Materials and methods

One hundred and sixty five CAD patients admitted to the intensive care unit of department of Cardiology, Sri Venkateswara Institute of Medical Sciences, Tirupati, Andhra Pradesh, were recruited for this study. CAD was diagnosed based on the electrocardiogram changes, increased levels of creatine kinase, and coronary angiogram. Gender-matched controls ($n = 87$) were drawn from patient attendants and hospital staff who have no evidence of CAD. This study was carried out in accordance with the Code of Ethics of the World Medical Association. Before initiating the study, objectives were explained to the subjects, and their consent was obtained before taking measurements. All the anthropometric measurements were taken when the patients were shifted to the intermediate coronary care units. Anthropometric measurements were performed following the protocol mentioned by Singh and Bhasin.[13] Anthropometric measurements were made with the help of anthropometer, weighing machine, tape, and Lange skinfold caliper. BMI, waist-hip ratio (WHR), waist-arm ratio (WAR), waist-thigh ratio (WTR) and arm-thigh ratio (ATR) were calculated. Sum of three (TSF3) and six skinfold thickness (SF6), total extremity ratio (TE), relative fat pattern index (RFPI), sum of four skinfold thickness (sft), subscapular/triceps ratio, sum of subscapular/suprailiac sft (mm), sum of biceps/triceps sft (mm), percent of body fat (%BF), total abdominal fat (TAF), intraabdominal adipose tissue (IAAT), subcutaneous abdominal adipose tissue (SCAT), body fat index (BFI), abdominal volume index (AVI), conicity index (CI), lean body mass (LBM), lean body mass index (LBMI), fat mass (FM), and fat mass index were calculated following earlier studies.[12–20] Data on age, family history of CAD, smoking, and alcohol intake were inquired from both the cases and controls. Individuals with blood pressure > 140/90 mmHg or a previously documented history of hypertension and use of antihypertensive drugs were considered as hypertensive. Those with documented history and antihyperglycemic drug usage were considered to have type 2 diabetes mellitus.

The estimated sample size required for the study was 61 for case and 31 for control samples when the following assumptions were made: (1) $\alpha = 0.05$, (2) $\beta = 0.20$, (3) mean difference = 10, (4) standard deviation = 16 in cases or controls, and (5) the number of cases are double to that of controls. Normal distribution of data was evaluated by Shapiro–Wilk's test. Owing to nonrandom distribution in variables, means between cases and control were compared by Mann–Whitney *U* test, and categorical variables between cases and controls were tested for significance by Chi-square test. CAD patients and normal subjects were treated as cases and controls. Cutoff values and area under curve (AUC) of anthropometric variables were estimated. The confidence interval for AUC was calculated using binomial exact confidence interval. Youden index J–associated criterion was followed for selecting cutoff value. For calculating the positive and negative predictive value of the cutoffs, prevalence of CAD reported for male subjects in Tirupati urban population (6.86%)[21] was used. Discriminant analysis was performed to know which variables discriminate cases and controls most significantly. Microsoft Excel, IBM SPSS version 20, and MedCalc version 15.2 were used for computations.

The percentage of people with disease is known as sensitivity, whereas the percentage of people without disease is called specificity. The proportion of people with the disease and also tested positive is known as positive predictive value, whereas the proportion of those without disease and also tested negative is known as negative predictive value.[22]

3. Results

The relative prevalence of conventional CAD risk factors in the cases and controls is given in Table 1, and mean values for different anthropometric measurements are presented in Table 2 (only for those who show significant mean difference); the remaining ones are presented in Supplementary Table S1. Significantly higher prevalence of hypertension, type 2 diabetes mellitus, smoking, alcoholism, high waist circumference, central obesity, IAAT ($p = 0.000$), high TAF ($p = 0.01$), and high %BF ($p = 0.04$) were observed in CAD patients than those in controls (Table 1). Significantly higher mean values of age; circumferences of shoulder, chest, and waist; WHR; abdominal circumference; WAR; wrist, midaxillary and suprapatellar sft; CI; WHtR; AVI; IAAT; RFPI; %BF (all p values < 0.01); thigh circumference ($p = 0.01$); minimal neck circumference ($p = 0.02$); ATR; forearm circumference ($p = 0.03$); and TAF ($p = 0.04$) were observed in CAD than those in healthy controls. In case of controls, significantly higher mean values of thigh sft, BFI, foot circumference ($p = 0.00$), and calf sft ($p = 0.03$) were observed than those in CAD patients (Table 2).

The cutoff values of anthropometric parameters determined in terms of AUC are shown in Table 4 (cutoff values of 18 variables are given in Table 2 and the remaining in Table S2), and the corresponding receiver operating characteristic (ROC) curves are shown in Fig. 1 (ROC of only 18 variables that showed AUC ≥ 0.6 are given

Table 1
Prevalence of coronary risk factors in male CAD patients and male controls.

Variable	CAD patients ($n = 165$)	Controls ($n = 87$)	p value
Hypertension	67 (40.60)	1 (1.14)	0.0
Type 2 diabetes	42 (25.45)	0 (0.00)	0.0
Smoking	53 (32.12)	3 (3.44)	0.0
Alcoholism	29 (17.57)	0 (0.00)	0.0
Family history of CAD	14 (8.48)	2 (2.29)	0.06
Obesity (BMI > 25 kg/m^2)	65 (39.39)	31 (35.63)	0.60
Waist circumference (cm) (>90 men and >80 women)	72 (43.63)	12 (13.79)	0.0
Central obesity (WHR > 0.9 men; >0.8 women)	94 (56.96)	19 (21.83)	0.0
% Body fat (>25.5 men; >38 women)	71 (43.03)	26 (29.88)	0.04
Total abdominal fat (cm^2) (>245.6 men; >203.46 women)	89 (53.93)	33 (37.93)	0.01
Intraabdominal adipose (cm^2) tissue (>135.3 men; 75.73 women)	51 (30.90)	7 (8.04)	0.0
Subcutaneous abdominal adipose tissue (cm^2) (>110.74 men; 134.02 women)	108 (65.45)	57 (65.51)	0.99

CAD, coronary artery disease; kg, kilogram; m, meter; WHR, waist-hip ratio; cm, centimeter.

Table 2
Mean and standard deviation of anthropometric parameters between male CAD patients and male controls.

Variable	CAD patients ($n = 165$)	Controls ($n = 87$)	p value
Age (years)	50.68 ± 9.77	42.36 ± 8.36	<0.01
Minimal neck circumference (cm)	39.45 ± 3.05	38.50 ± 3.40	0.02
Shoulder circumference (cm)	106.32 ± 9.96	100.31 ± 8.53	<0.01
Chest circumference (cm)	91.64 ± 7.12	87.75 ± 8.07	<0.01
Waist circumference (cm)	87.78 ± 8.99	81.63 ± 8.93	<0.01
Waist-hip ratio	0.90 ± 0.05	0.86 ± 0.55	<0.01
Abdominal circumference (cm)	94.78 ± 10.50	87.40 ± 9.48	<0.01
Thigh circumference (cm)	47.20 ± 5.77	45.36 ± 5.31	0.01
Arm-thigh ratio	0.59 ± 0.16	0.59 ± 0.05	0.03
Waist-arm ratio	3.18 ± 0.43	3.03 ± 0.20	<0.01
Forearm circumference (cm)	26.13 ± 1.96	25.47 ± 2.26	0.03
Wrist circumference (cm)	19.69 ± 1.37	18.97 ± 1.17	<0.01
Foot circumference (cm)	57.74 ± 4.65	59.77 ± 5.15	<0.01
Midaxillary skinfold thickness (mm)	14.49 ± 3.84	12.83 ± 2.79	<0.01
Thigh skinfold thickness (mm)	18.18 ± 3.49	19.87 ± 4.54	<0.01
Calf skinfold thickness (mm)	13.27 ± 4.03	13.89 ± 2.64	0.03
Relative fat pattern index	0.48 ± 0.07	0.46 ± 0.04	<0.01
Suprapatellar skinfold thickness (mm)	12.84 ± 3.72	9.13 ± 2.58	<0.01
Body fat index	13.11 ± 2.18	13.58 ± 0.39	<0.01
Conicity index	1.20 ± 0.30	1.17 ± 0.21	<0.01
Waist-height ratio	0.52 ± 0.10	0.49 ± 0.05	<0.01
Abdominal volume index (Liters)	15.58 ± 3.43	13.62 ± 2.87	<0.01
% Body fat	26.50 ± 10.97	22.91 ± 6.10	<0.01
Total abdominal fat (cm^2)	245.36 ± 115.41	214.66 ± 107.21	0.04
Intraabdominal adipose tissue (cm^2)	109.13 ± 53.96	85.11 ± 45.96	<0.01

CAD, coronary artery disease; cm, centimeter; mm, millimeter; kg, kilogram.

in Figs. 1 and 2, and the rest are given in Supplementary Figure 1). Anthropometric variables that showed fair degree of discrimination are as follows: (1) suprapatellar sft (0.799), (2) CI (0.720), (3) WHR (0.720), (4) abdominal circumference (0.70), (5) WHtR (0.6695), (6) waist and shoulder circumference (0.684), (7) AVI (0.677), (8) WAR (0.675), (9) foot circumference (0.673), (10) IAAT (0.649), (11) midaxillary sft (0.646), (12) chest circumference (0.637), (13) wrist circumference (0.635), (14) %BF (0.626), (15) RFPI (0.623), (16) BFI (0.622), and (17) thigh sft (0.610).

We performed stepwise discriminant analysis to check which of these anthropometric variables and how best can they discriminate cases and controls. Canonical discriminant function coefficients suggest that the 9 anthropometric variables (shoulder, abdomen, foot circumferences, WHR, thigh, suprapatellar and calf sft, LBM, and sum of subscapular/suprailiac sft ratio) correctly classified 87.4% of subjects into CAD and control groups. Stepwise logistic regression (LR; forward) analysis of these 9 variables (Table 3) suggest that 8 variables such as circumferences of abdomen and foot; thigh, suprapatellar, and calf sft; and sum of subscapular/suprailiac; WHR; and LBM were significantly associated, accounting for 73.4% variation in CAD (Nagelkerke $R^2 = 0.734$).

4. Discussion

Earlier studies have observed significantly higher mean of weight, waist and hip circumference, WHR, WHtR, BMI, %BF, and visceral fat in CAD patients than those in controls.[23–26] Besides some of the aforementioned parameters, we observed significantly higher mean value for a number of new variables—such as shoulder, chest, waist, abdominal, wrist, foot ($p < 0.01$), minimal neck,

Table 3
Association of anthropometric variables with CAD in logistic regression analysis.

Variable	B	SE	Wald	Odds ratio	95% CI	p value
Abdominal circumference	0.147	0.035	17.740	1.158	1.082–1.240	<0.001
Foot circumference	−0.158	0.053	8.988	0.854	0.770–0.947	0.003
Waist-hip ratio	22.175	5.425	16.705	42.69	10.28–177.20	<0.001
Thigh skinfold thickness	−0.302	0.086	12.248	0.739	0.624–0.875	<0.001
Suprapatellar skinfold thickness	0.643	0.108	35.242	1.903	1.539–2.353	<0.001
Calf skinfold thickness	−0.364	0.094	14.817	0.695	0.578–0.837	<0.001
Lean body mass	−0.609	0.023	8.528	0.934	0.892–0.978	0.003
Sum of subscapular/suprailiac skinfold thickness	−0.128	0.046	7.680	0.880	0.804–0.963	0.006

CAD, coronary artery disease; B, beta coefficient; SE, standard error; CI, confidence interval.

Table 4
Cutoff values of anthropometric variables for CAD (AUC value ≥ 0.60).

Variable	Cutoff value	AUC	95% CI, significance level	Sen	Spe	PPV	NPV
Shoulder circumference (cm)	>106	0.684	0.62–0.74, 0.0001	55.49	76.74	14.9	95.9
Chest circumference (cm)	>86	0.637	0.57–0.69, 0.0002	79.27	47.67	10	96.9
Waist circumference (cm)	>85	0.684	0.62–0.74, 0.0001	59.76	73.26	14.1	96.1
Waist-hip ratio	>0.87	0.720	0.66–0.77, 0.0001	77.91	58.14	12.1	97.3
Abdominal circumference (cm)	>91	0.700	0.63–0.75, 0.0001	62.20	72.09	14.1	96.3
Waist-arm ratio	>3.2	0.675	0.61–0.73, 0.0001	50	81.40	16.5	95.7
Wrist circumference (cm)	>19	0.635	0.57–0.69, 0.0002	53.70	63.95	9.9	94.9
Foot circumference (cm)	≤58	0.673	0.61–0.73, 0.0001	59.26	74.42	14.6	96.1
Midaxillary skinfold thicknesses (mm)	>15	0.646	0.58–0.70, 0.0001	37.80	89.53	21	95.1
Thigh skinfold thickness (mm)	≤20	0.610	0.54–0.67, 0.0041	77.44	39.53	8.6	96.0
Suprapatellar skinfold thickness (mm)	>9	0.799	0.74–0.84, 0.0001	84.76	62.79	14.4	98.2
Relative fat pattern index	>0.5	0.623	0.56–0.68, 0.0004	38.79	86.05	17	95.0
Body fat index	≤13.31	0.622	0.55–0.68, 0.0006	43.64	81.40	14.7	95.1
Conicity index	>1.22	0.720	0.66–0.77, 0.0001	71.52	73.26	16.5	97.2
Waist-height ratio	>0.52	0.695	0.63–0.75, 0.0001	56.36	77.91	15.8	96.0
Abdominal volume index (Liters)	>14.59	0.677	0.61–0.73, 0.0001	59.39	73.26	14.1	96.1
% Body fat	>26.27	0.626	0.56–0.68, 0.0004	48.48	76.74	13.3	95.3
Intra abdominal adipose tissue (cm^2)	>105.29	0.649	0.58–0.70, 0.0001	55.49	70.93	12.3	95.6

Sen, sensitivity; Spe, specificity; PPV, positive predictive value; NPV, negative predictive value; CAD, coronary artery disease; AUC, area under curve; CI, confidence interval; cm, centimeter; mm, millimeter.

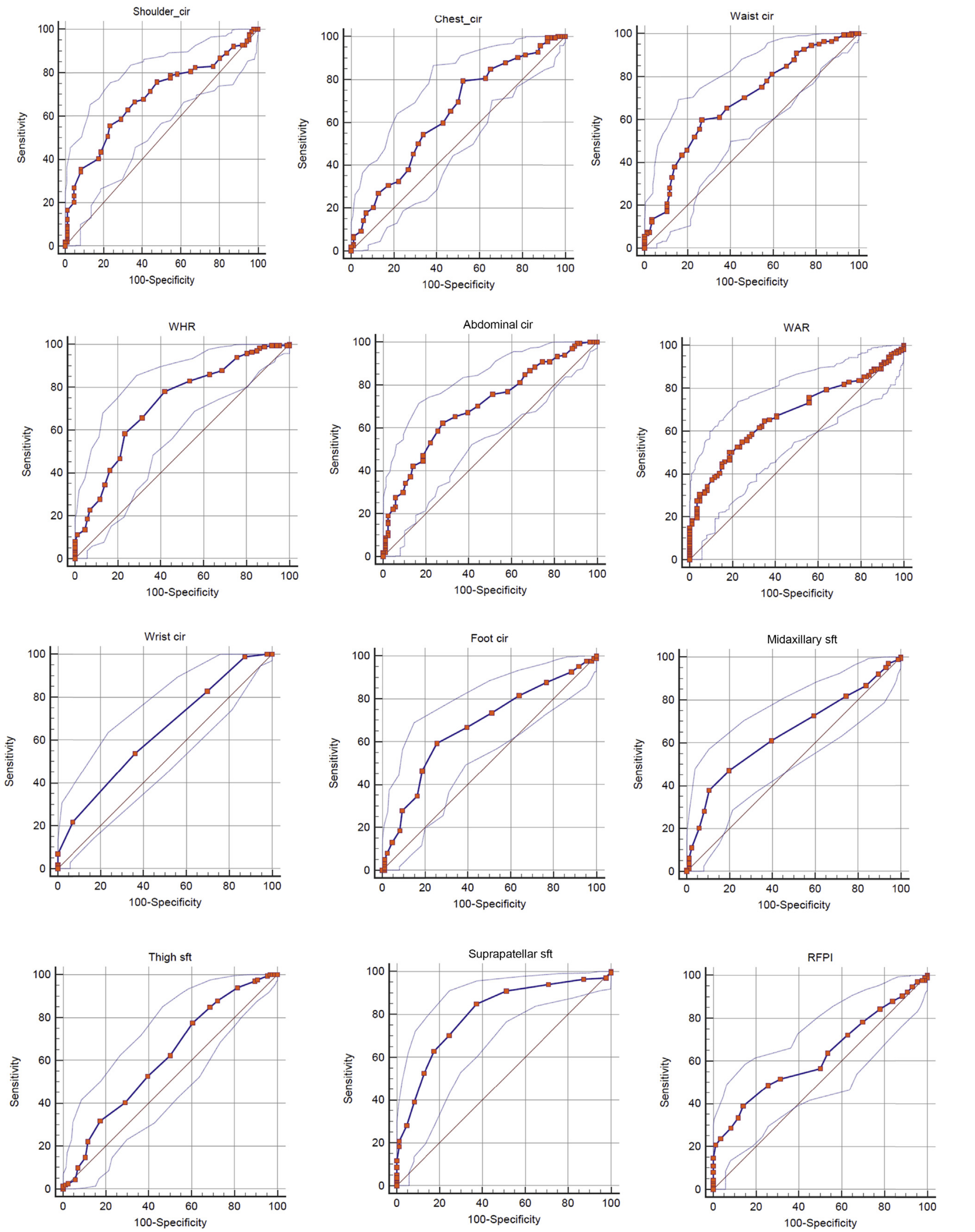

Fig. 1. Receiver operator characteristic curves for circumference and skinfold thickness that showed AUC ≥ 0.6. Cir, circumference; WHR, waist-hip ratio; WAR, waist-arm ratio; RFPI, relative fat pattern index.

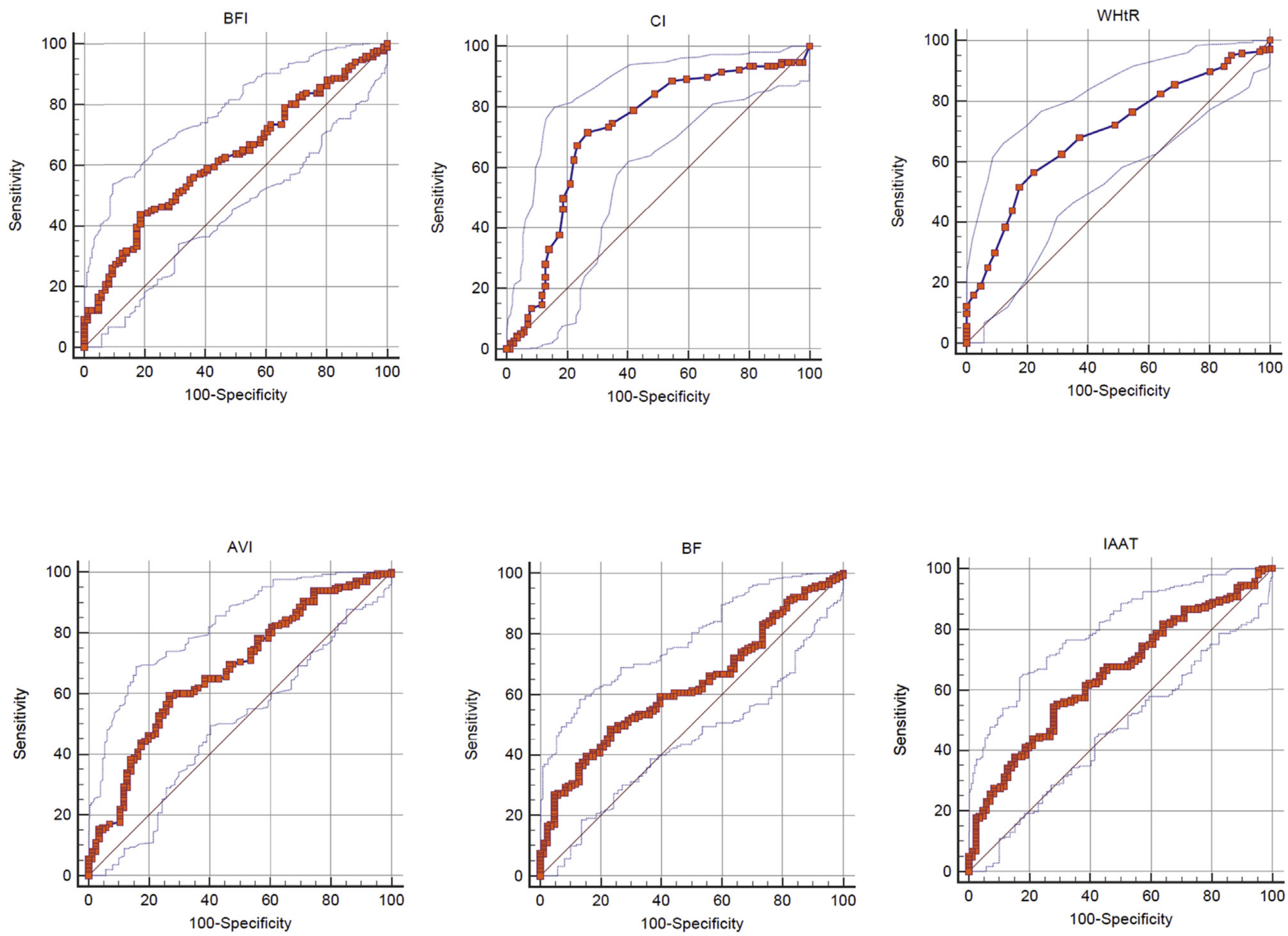

Fig. 2. Receiver operator characteristic curves central for obesity variables that showed AUC ≥ 0.6. Cir, circumference; sft, skinfold thickness; BFI, body fat index; CI, conicity index; WHtr, waist-height ratio; BF, percent of body fat; AVI, abdominal volume index; IAAT, intraabdominal adipose tissue.

and thigh circumference ($p < 0.05$); WHR ($p < 0.01$); ATR ($p < 0.05$); WAR ($p < 0.01$); midaxillary, thigh, and suprapatellar sft ($p < 0.01$); FM; CI; WHtR; AVI; %BF; IAAT ($p < 0.01$); and TAF ($p < 0.05$)—for CAD patients, suggesting probably the role of these new variables in the manifestation of CAD. Given relatively small sample of females, we did not consider them for this study.

Screening of asymptomatic individuals of CAD in appropriate age groups enables early detection, risk estimation, to initiate management strategies, and to arrest disease progression.[27] At the same time, there is search for novel risk factors that can better explain the disease and can be easily measured, inexpensive, noninvasive and affordable in resource-poor settings.[3,11,25] Anthropometry has been in use for identifying high-risk group based on its optimal cutoff values, which are population specific and influenced by lifestyle changes involving diet, physical activity, geography, social and cultural factors.

We initiated this study in view of the limitations associated with presently used anthropometric parameters such as BMI,[19,25,28] waist circumference (WC),[29–32] WHR,[8,33] and CI[34] and the absence of population-specific cutoff values of these parameters for predicting the risk of CAD among the Indians. We used ROC curve to assess the ability of anthropometric variables in predicting the risk of CAD and found 18 anthropometric variables, viz., thigh sft, BFI, RFPI, %BF, wrist circumference, chest circumference, midaxillary sft, IAAT, foot circumference, WAR, AVI, waist and shoulder circumference, WHtR, abdominal circumference, WHR, CI, and suprapatellar sft to show AUC in the range of 0.61–0.72, suggesting their predictive value. To the best of our knowledge, this is the first study to show the cutoff values for predicting the risk of CAD in any Indian population for the known anthropometric parameters such as BMI, WC, WHR, and WHtR and for the many other earlier unused anthropometric parameters. Cutoff value is defined based on the risk association with the disease.[35] BMI showed low ability in predicting the risk of CAD in the present study as shown by AUC of 0.515. The cutoff value was estimated to be >26.35 kg/m^2 in our study. An optimal cutoff value was observed to be 22.7 kg/m^2 and 26.95 kg/m^2 in Korean and Iranian men, respectively.[5,6] The optimal cutoff value of WC for CAD risk in Korean[6] and Iranian men[5] were 83.2 cm and 94.5 cm, respectively. WC is included as one of the components for defining metabolic syndrome (MS). Cutoff values given for defining MS as per European group for study of insulin resistance, National Cholesterol Education Programme adult panel III, and International Diabetes Federation (IDF) for men were ≥94, ≥102, and ≥94, respectively, and ≥90 cm for Asians.[36] In the present study, we have measured WC at the most lateral contour of the body between the ribs and intestine. The AUC of 0.684 obtained is a fair discriminator for the risk of CAD, and the obtained cutoff value is >85 cm and similar to that reported in the study by Snehalatha et al.[35] AUC of 0.75–0.82 was reported for WHR for predicting the risk of CAD in all ethnic groups.[37] The World Health Organization included WHR as a component for the defining MS using the cutoff value of 0.9 in men. In the Iranian men, the cutoff value for predicting the risk of CAD was reported as 0.95.[5]

A cutoff value of WHtR > 0.5 was shown to increase the risk of CAD in 78 studies.[38] A cutoff value of 0.5 in Korean men[6] and 0.55 in Iranian men[5] was observed for predicting the risk of CAD. In our study, a cutoff value of >0.52 for WHtR with AUC of 0.695 was observed. This cutoff value is similar to the earlier studies.[5,6,38,39] A cutoff value of 16.48 L in Indian railway men employees was observed for AVI. In our study, the cutoff value was found to be >14.59 L with a corresponding AUC of 0.677. A cutoff value of 25.5 for %BF was proposed for prediction of coronary risk factors in Asian men.[36] In the present study, we found a cutoff value of >26.27 for %BF with AUC of 0.626. A cutoff value of 15.1 kg was reported for FM in Asian men.[36] We observed a cutoff value of >21.23 kg or FM with AUC of 0.50 in our study. Cutoff values of ≥245.6 cm^2, ≥135.3 cm^2, and ≥110.74 cm^2 were observed for TAF, IAAT, and SCAT in Asian men.[40] In the present study, the cutoff values of >274.58 cm^2 (AUC: 0.577 cm^2), >105.29 cm^2 (AUC: 0.649 cm^2), and >191.5 cm^2 (AUC: 0.53 cm^2) for TAF, IAAT, and SCAT in predicting the risk of CAD were observed.

Information on the cutoff values of CI is not available for adults. In the present study, the cutoff value for CI is >1.22 with AUC of 0.720. WC, WHR, WHtR, CI, %BF, TAF, IAAT, SCAT, neck circumference, and AVI are parameters used to assess the central obesity. In the present study, WHR and CI showed AUC of 0.72, followed by WHtR (0.695), WC (0.684), AVI (0.677), IAAT (0.649), % BF (0.626), minimal neck circumference (0.587), TAF (0.577), and SCAT (0.530). Comparison of AUC of central obesity parameters suggests that WHR, CI, WHtR, WC, AVI, %BF, and IAAT are better predictors of central obesity than SCAT, TAF, and neck circumference.

Comparison of the AUC of the six central obesity measures—WHR, CI, WHtR, WC, AVI, and IAAT—suggests statistically significant difference between WHR and IAAT ($p = 0.01$), between CI and IAAT ($p = 0.05$), and between WC and AVI($p = 0.02$). IAAT and SCAT were found to be associated with adverse cardiometabolic risk factors.[12] In view of higher mass of SCAT, it was shown to affect metabolic factors.[12] In our study, IAAT was found to have higher ability of predicting the risk of CAD (AUC = 0.649) than SCAT (AUC = 0.530). The foregoing discussion demonstrates that cutoff values vary with population for predicting the risk of CAD and also suggest the need of establishing population-specific cutoff values.

Owing to the colinearity associated with anthropometric variables, we performed discriminant analysis and found that nine out of the 52 variables discriminate cases and controls, correctly classifying 87.4% of the subjects into the respective groups. Examination of AUC of these variables showed that only six variables such as shoulder, abdominal, and foot circumferences; WHR; and thigh and supratellar sft showed >0.6, and the remaining three variables LBM, calf sft, and sum of subscapular/suprailiac sft ratio showed AUC ranging between 0.5 and 0.6. Based on our observations, we propose that six anthropometric variables such as shoulder, abdominal, and foot circumferences; WHR; and thigh and supratellar sft are significant predictors of CAD with fair predictive ability as shown by AUC value of 0.610–0.799.

4.1. Limitations

There are number of limitations however. The present study is based only on male samples, and hence, the results cannot be extrapolated to the female gender.[18] Even though cutoff values vary with age and coronary risk factors,[41] we have not evaluated age- and coronary risk factor–specific cutoff values due to small sample size. For calculating body fat, sum of sfts is used, and it has limitations because of interindividual differences in subcutaneous body fat patterning and variations in intraabdominal fat.[10] Percentage of body fat, TAF, IAAT, and SCAT were calculated using predictive equations and not by imaging tools.[12] Direct methods for assessing FM are better, but they are cost-intensive, available in only few centers, carry the risk of radiation, and not useful in field settings. Anthropometry is still a widely used method for epidemiological studies, albeit interpretation of cutoff values obtained should be done with caution.[42] It is also necessary that the cutoffs are established based on large-scale cross-sectional as well as longitudinal studies.[43]

5. Conclusions

Eighteen anthropometric variables such as thigh sft, BFI, RFPI, % BF, wrist circumference, chest circumference, midaxillary sft, IAAT, foot circumference, WAR, AVI, waist and shoulder circumference, WHtR, abdominal circumference, WHR, CI, and supratellar sft showed AUC ranging from 0.61 to 0.72, suggesting use of these variables in predicting the risk of CAD. However, both stepwise LR analysis and discriminant analyses suggest that a relatively much smaller set of these variable can be more efficiently used in predicting the disease.

Optimal cutoff values determined in the study can be used to screen young and middle-aged asymptomatic men who can be benefitted due to preventive strategies against the lifestyle diseases. The optimal cutoff values should not be used as test in predicting the disease in clinics and for stratifying individual into risk categories.[38] Establishment of optimal cutoff values depends on the study design, geographic area, study population, age of the participant, and expected outcome. Anthropometric variables are surrogate measures of body fat and have limited use in guiding treatment modalities in individual patients. Framingham score, which is used to predict the future risk of CAD, does not contain any anthropometric variable as its component.[31,44] Nevertheless, the AUC of most of the anthropometric variables used for prediction of the risk of coronary risk factors ranged from 0.60 to 0.70,[31,44] which is similar to the range of AUC of 18 variables obtained in the present study (0.61–0.72).

Conflicts of interest

All authors have none to declare.

Appendix A. Supplementary data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.ihj.2018.07.016.

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