Influence of Obesity Assessments on Cardiometabolic Risks in African and European American Women

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Objectives: African American women (AAW) have increased odds of developing cardiometabolic (CME) risks and cardiovascular diseases (CVD) compared with European American women (EAW). The influence of obesity on other CME risks and the CVD disparity is unclear. The purpose of our study was to develop a CME index and evaluate the obesity and CME risk index relationships based on race.

Design: A comparative research design was employed in our study as 213 women (132 AAW; 81 EAW) from the Louisiana Delta were evaluated for CME risk clustering patterns by race, based on BMI, dual energy X-ray absorptiometry % body fat and waist conference. Fasting glucose, triglyceride (TG), high density lipoprotein cholesterol (HDL-C), systolic (SBP) and diastolic blood pressure (DBP) were the measured CME risks.

Findings: In summary, when the CME indexes were evaluated by obesity classification categories the ones that were CVD risk or near risk for the AAW were SBP and TG. The trend of CME index risk for the EAW was SBP and glucose. The stepwise regression equations indicate that HDL-C and SBP/DBP were the best indicators of the effects of obesity on CME risks in AAW and that SBP/DBP and glucose were the best indicators of CME risks in EAW.

Conclusions: Our results indicate that CME risks as evaluated based on obesity categories are different for AAW than for EAW. (*Ethn Dis*.2014;24[4]:475-480)

Key Words: Cardiometabolic Risks, African American Women, Body Mass Index, Waist Circumference, Body Fat Percentage

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Introduction

Current American Heart Association data present a bleak picture of health outcomes in African American women (AAW) who have increased odds of developing cardiometabolic (CME) risks and cardiovascular diseases (CVD) compared with European American women (EAW). The prediction of poor health outcomes is related to the prevalence, location and severity of obesity which has grown to epidemic proportion in AAW in the last couple decades.[1,2] Based on CME risk criteria, central obesity is more related to CVD than overall body adiposity. The relationship of central and total body fat with other CME risks may be population specific and may provide a better understanding of the role of obesity in developing CVD.[1–3]

The disparity between AAW and EAW relative to the prevalence of CME risks and subsequently CVD is not clearly understood.[2] However, obesity, as estimated by body mass index (BMI) of $\geq$30 kg/m^2, has risen for all women during the last couple decades and obesity among AAW is reported to be 43.2% compared to 24% for EAW.[3] Obesity is a CME risk that has been linked to increases in CVD morbidity and mortality.[1,4] Although BMI is typically used to estimate obesity and is a widely accepted measure of overall body mass, some findings suggest that measures of waist circumference (WC), which estimates central adiposity and body fat % may have stronger associations and more consistent relationships with CVD in multiethnic populations.[1,5]

Therefore, the purpose of our study was to develop a CME index and evaluate the obesity and CME risks index relationships based on race. The hypothesis evaluated in our study was that the relationship between obesity and CME risk index values would be the same for AAW and EAW with obesity estimated by BMI, WC and body fat %.

Methods

A comparative research design was employed in our study as 213 women (132 AAW and 81 EAW) from the Louisiana Delta were evaluated for CME risk clustering patterns by race, based on BMI, dual energy X-ray absorptiometry (DXA) body fat % and WC. Cardiometabolic risks include WC ($>$ 88 cm or BMI$\geq$30 kg/m^2); triglyceride (TG$\geq$150 mg/dL); high-density lipoprotein cholesterol (HDL-C$<$ 50 mg/dL); blood pressure (SBP$\geq$ 130 mm Hg or DBP$\geq$85 mm Hg or use of medications for hypertension); and fasting glucose ($\geq$100 mg/dL).[6] The participants were sedentary, 34% had a family history of heart disease, 43% had abnormal blood glucose values and 92% were overweight or obese. Seventy percent had low aerobic fitness scores and 20% were hypertensive. Prior to participation, the women signed institutional approved informed consent forms and completed health history surveys.

Body composition variables were BMI, WC and body fat %. Height and weight were measured using standardized equipment and weight expressed in kilograms divided by height in meters squared was used to calculate BMI. Body fat % was measured by a Lunar DPX-L dual-energy X-ray absorptiometer (model DPX-L with version 3.6R software, Lunar Radiation Corp., Madison, WI). Waist circumference was measured in duplicate, two centimeters above the naval and the

Table 1. Characteristics of the participants, mean ± SD

Variables	African Americans, *n*=132	European Americans, *n*=81	*P*
Age, years	34.0 ± 10.8	42.5 ± 11.0	.000
Height, cm	163.0 ± 6.1	163.5 ± 7.0	.587
Weight, kg	76.5 ± 21.9	81.2 ± 18.3	.105
Body mass index, kg/m^2	28.9 ± 8.4	30.4 ± 6.4	.168
Body fat, %	37.7 ± 10.1	39.7 ± 8.0	.147
Waist circumference, cm	88.8 ± 20.9	93.9 ± 14.6	.078
Systolic blood pressure, mm Hg	115.8 ± 12.2	119.8 ± 13.3	.031
Diastolic blood pressure, mm Hg	75.2 ± 9.5	76.9 ± 8.0	.209
Glucose, mg/dL	88.8 ± 38.1	99.0 ± 15.2	.031
HDL-C, mg/dL	57.9 ± 13.8	54.9 ± 14.7	.141
Triglyceride, mg/dL	113.4 ± 94.2	143.6 ± 93.6	.026

HDL-C, high-density lipoprotein cholesterol.

mean of the two trials was recorded as the WC value.

Resting blood pressure was measured after a 10 minute rest as two blood pressure measurements taken five minutes apart; we used the mean value for our data. Mean arterial blood pressure (MAP = (2DBP+SBP)/3) was calculated based on the SBP and DBP. If participants had elevated blood pressure readings, they were instructed to immediately contact their family physician to have it re-evaluated.

Blood samples (<2 mL) were obtained from a participant's middle finger via finger stick. The samples were collected in Cholestex LDX cassettes for lipid, lipoprotein and glucose analysis and then analyzed via the Cholestex LDX system. All samples were analyzed in duplicate for glucose, HDL-C, and TG.

Data Manipulations and Statistical Analyses

Data manipulation involved calculating the CME index and dividing the groups into the different body fat %, BMI and WC categories. The CME index was calculated as the threshold CME condition risk value (based on ATP III risk criteria) divided by the measured CME condition value. The HDL-C CME index calculation was the measured value divided by the CME risk criteria. Body mass index categories were healthy weight (BMI 18.0 to 24.9 kg/m^2); overweight (BMI 25 to 29.9 kg/m^2); obese (30 to 34.9 kg/m^2) and morbidly obese (BMI≥35 kg/m^2). Body fat % categories were average fat (<27%); over fat (27.0% to 34.9%) and obese (≥35%). Waist circumference categories were healthy values (< 88 cm) and obese or unhealthy values (≥88 cm).

Cardiometabolic cluster patterns were evaluated based on race by plotting the CME index value for each obesity category using the obesity assessment procedures (body fat %, BMI or WC). Groups with ≥3 CME risk index values ≥1.0 were at risk of developing CVD based on the obesity procedure used for plotting the CME risk. Statistical analyses were completed with SPSS version 20. Data analyses included means and standard deviations calculated with descriptive statistics. Differences between morphological assessments, lipids, lipoproteins and blood pressure based on racial/ethnicity were evaluated with a one-way ANOVA. Since the group ages were different, partial correlations with age controlled were calculated to determine relationships between CME and body composition variables. Regression procedures were used to determine the association between the obesity assessment procedures from CME risks.

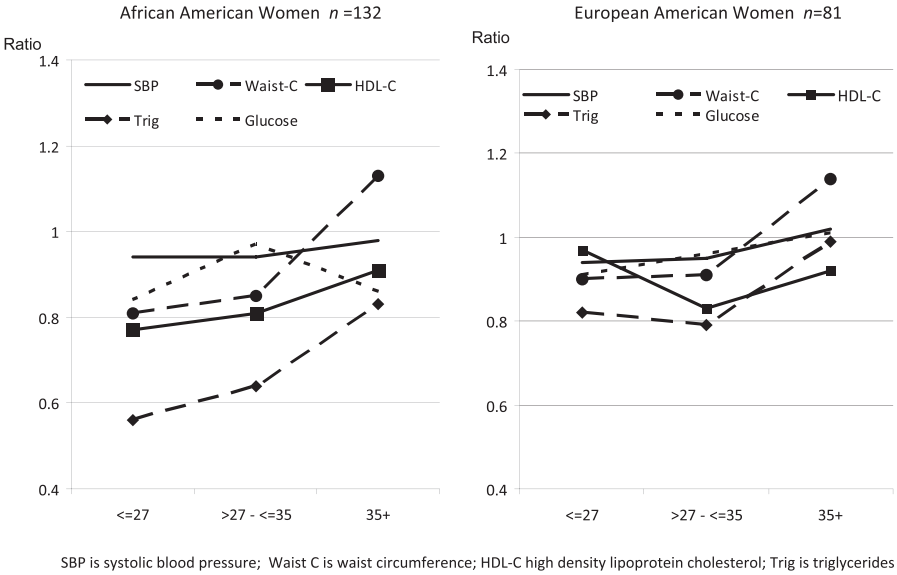

Fig 1. Cardiometabolic index ratio response patterns in African and European American women based on DXA body fat percentage categories

RESULTS

The mean age for the AAW was 34.0 ± 10.8 years and 42.5 ± 11.0 years for the EAW with a range from 18–60 years. Both groups of women were obese based on body fat %, but their body fat % was not different (AAW 37.7% and EAW 39.7% - Table 1). Based on BMI, the EAW were obese (30.4 kg/m^2) with the AAW (28.9 kg/m^2) approaching obesity. The CME index indicated the women

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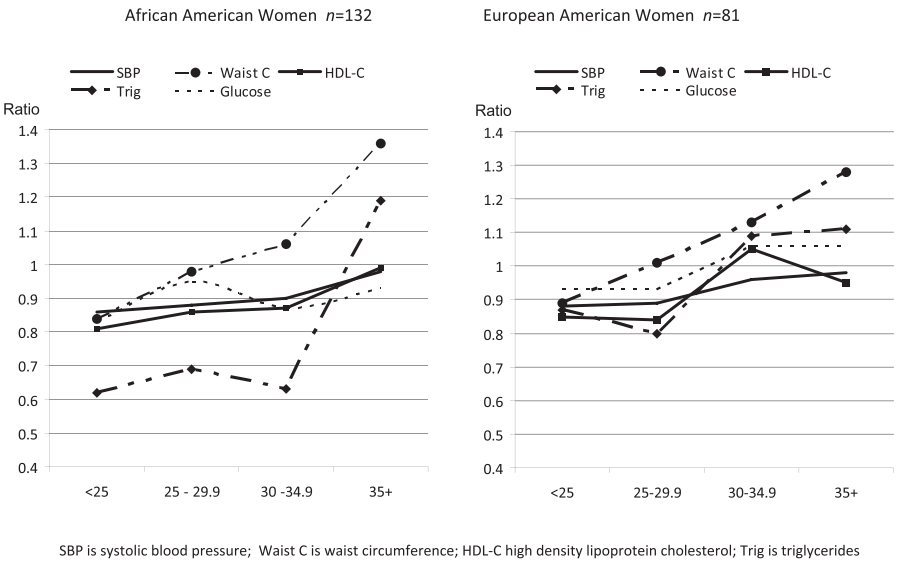
sampled were not at CVD risk, but were different ($P<.05$) on all CME variables except for DBP and HDL-C with the EAW having less healthy values.

Neither average fat nor over fat AAW or EAW were at risk for developing CVD (CME index < 1.0). The morbidly obese EAW were at risk of developing CVD as they had three CME index values above the CVD risk threshold (CME index ≥1.0 - Figure 1). A similar trend of increasing CME index values with increased adiposity was observed for both AAW and EAW, but the EAW were closer to the CVD risk threshold. However, based on non-morphological assessments the AAW CME risk profile did not change (CME<1.0) as body fat % increased.

As illustrated in Figure 2, obese and morbidly obese EAW were at risk of developing CVD and the morbidly obese AAW were approaching risk of developing CVD based on BMI classifications. Blood pressure was the least affected CME condition in both AAW and EAW and TG was the most affected non-morphological CME index in AAW.

Central adiposity as evaluated by WC had a trend similar to the other obesity assessment procedures with CME conditions for both AAW and EAW (see Figure 3). The unhealthy weight EAW women were at risk of developing CVD, while the AAW had two CME conditions that were risks. Triglyceride was a non-morphological CME risk for AAW while central obesity and glucose and triglyceride



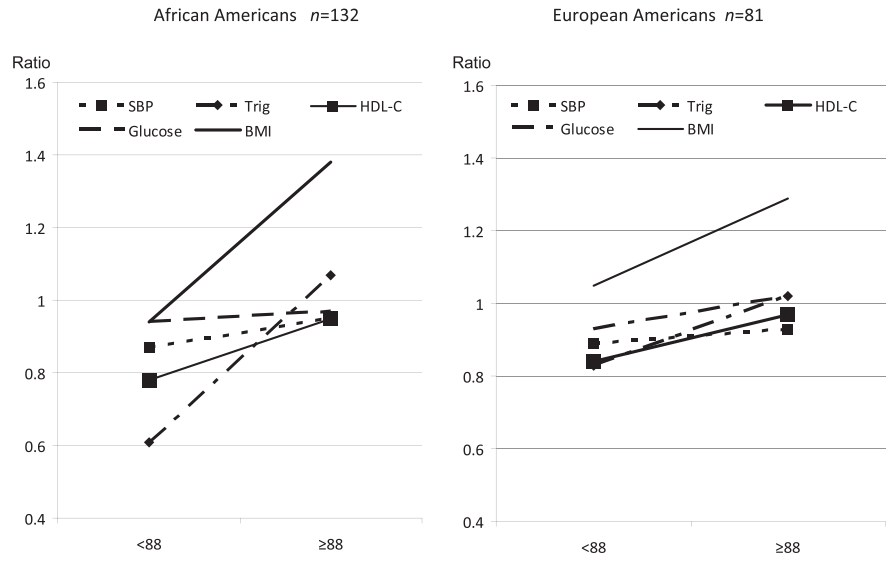
SBP is systolic blood pressure; Waist C is waist circumference; HDL-C high density lipoprotein cholesterol; Trig is triglycerides

Fig 2. Cardiometabolic Index ratio response patterns in African and European American women based on BMI categories

were non-morphological risks in centrally obese EAW.

Significant partial correlations ($P<.05$) were observed between CME conditions, except glucose with all body composition measures in addition to BP variables with DXA body fat in the AAW. Triglyceride was not related to any body composition variables while HDL-C and glucose were not related to DXA body fat in the EAW (Table 2).

A stepwise regression analysis was performed using non-morphological CME conditions and age to predict



SBP is systolic blood pressure; Trig is triglycerides; HDL-C is high density lipoprotein cholesterol; BMI is body mass index

Fig 3. Metabolic response patterns in African and European American women based on waist circumference categories

Table 2. Age controlled partial correlations between body composition variables and cardiometabolic risk conditions in African and European American women

	African American Women, *n*=132			European American Women, *n*=81		
Variable	**DXA % Fat**	**BMI**	**WC**	**DXA % Fat**	**BMI**	**WC**
HDL-C	−.36[b]	−.32[b]	−.48[b]	−.19	−.29[a]	−.36[b]
Glucose	−.02	.08	.04	.24	.30[a]	.42[b]
Triglyceride	.19[a]	.21[a]	.32[b]	.18	.14	.16
Systolic BP	.08	.37[b]	.39[b]	.32[b]	.37[b]	.31[b]
Diastolic BP	.10	.29[b]	.22[a]	.48[b]	.48[b]	.37[b]
MABP	.10	.35[b]	.33[b]	.43[b]	.49[b]	.39[b]

DXA, dual energy X-ray absorptiometry; WC, waist circumference; HDL-C, high-density lipoprotein cholesterol; MABP, mean arterial blood pressure.
[a] $P<.05$.
[b] $P<.01$.

values in each obesity assessment procedure (Tables 3A-C). High-density lipoprotein-cholesterol was a significant predictor for AAW in each of the three equations as R^2 ranged from 23% to 48% and age was a significant predictor in two of the equations. Blood pressure was selected in all three and glucose was selected in two of the three equations for the EAW and the R^2 ranged from 31% to 35%. However, the SEE for the AAW equations was more than 30% higher than for the EAW. While the equations were not strong predictors of body composition, the equations were better predictors for the EAW. These results indicate that CME risks assessed based on measures of obesity are different for AAW than for EAW.

DISCUSSION

The EAW were older than the AAW, but the two groups of women were not different ($P>.05$) on any of the body composition assessments. This suggests that differences observed in CME analyses between the groups are due to factors other than differences in body composition. The AAW and EAW

Table 3A. Regression equations predicting BMI from cardiometabolic risk conditions in African and European American

	African American Women, *n*=132				European American Women, *n*=81			
Variables	***R***	***R*²**	**SEE**	**Probability**	***R***	***R*²**	**SEE**	***P***
SBP, HDL-C DBP, glucose	.56	.31	7.0	.00	.57	.33	5.4	.00

Table 3B. Regression equations predicting % body fat from cardiometabolic risk conditions in African and European American

	African American Women, *n*=132				European American Women, *n*=81			
Variable	***R***	***R*²**	**SEE**	**Probability**	***R***	***R*²**	**SEE**	***P***
Age, HDL-C DBP, age	.48	.23	8.9	.00	.55	.31	6.7	.00

Table 3C. Regression equations predicting waist circumference from cardiometabolic risk conditions in African and European American

	African American Women, *n*=132				European American Women, *n*=81			
Variable	***R***	***R*²**	**SEE**	**Probability**	***R***	***R*²**	**SEE**	***P***
SBP, HDL-C, age Glucose, SBP	.69	.48	15.3	.00	.59	.35	11.7	.00

SEE, standard error of the estimate; SBP, systolic blood pressure; DBP, diastolic blood pressure; HDL-C, high-density lipoprotein cholesterol; Trig, Triglyceride.

in this study were obese based on body fat %, but metabolically healthy, which is consistent with data published elsewhere.[7] The lipid and lipoprotein in our study were measured with the Cholestech LDX system which has been shown to be a reliable and accurate instrument.[8]

There was a trend for increased CME risk as the BMI, WC and body fat % values increased. This is consistent with findings in the literature as elevated body fat % has been shown to be associated with elevated fasting glucose, hypertension, hypertriglyceridemia, low HDL cholesterol, and higher overall CME risks compared with normal weight individuals.[6,9] Ghandehari et al[10] report that persons with a high WC, adjusted for age, ethnicity and BMI were more likely to have three risk factors. The association of abdominal obesity with CME risk factors is reported to vary by ethnicity and is independently associated with high CVD risk status.[5,10] Greater allocation of abdominal adipose tissue into the visceral compartment occurs more in EAW than AAW and may provide a stronger prediction of CVD in EAW.[11–13] Findings in our study are consistent with that report as the EAW had higher WC and a higher CME risk profile.

The finding in our study that the AAW non-morphological CME risk profile did not change as body fat % increased is supported by the literature. Nelson et al[14] found the prevalence of three or more co-occurring risk factors was similar in obese and non-obese AAW (obese=17.7% and non-obese=13.3%). By contrast, the prevalence among EAW was greater among the obese (26.9%) than the non-obese (13.0%).[14] Possible reasons for differences in CME risks between obese EAW and obese AAW are the relationships between CME risks based on obesity assessment procedure, location of adiposity and HDL-C values.[5,14] The finding that increased body fat does not produce similar increases in CME risks in AAW as it does in EAW does not suggest that obesity is not a major contributor to CVD in AAW, but that the threshold for adverse effects are different.[5,7,15,16]

The greater CME risks for EAW in our study are different than some and similar to other CME body composition relationship trends reported in the literature.[2,5,16] European American women have been reported to have elevated triglycerides and three or more abnormal CME risk factors while AAW were reported to have fewer CME risks and to be less likely to have abnormal HDL-C.[13] Elsewhere, the prevalence of all risk factors except high triglycerides and low HDL-C are reported to be substantially higher in AAW. The higher prevalence rates of CME risks and greater prevalence of CVD at nearly all levels of BMI in AAW, however, suggest that factors other than obesity contribute to the burden of CVD risk in AAW.[2,5]

The finding in our study that body composition and CME variables except glucose in AAW and triglyceride in the EAW were correlated ($P<.05$) is reasonable, and similar to results in the literature.[5,7] Barreira et al observed relationships ($P<.05$) between BMI and WC with the CME conditions similar to those observed in our study in AAW and EAW[7] and the relative strength of the correlations were similar for both groups. Cardiometabolic conditions, except SBP was found to be related to body fat measured by DXA in AAW elsewhere[5] and all CME conditions were related to body fat in EAW. Overall, the relationships observed in our study are reasonably similar to those reported elsewhere.[5,7,18] Our findings indicate that CME risks based on different obesity assessment protocols are different for AAW than EAW when the relationships are assessed within different obesity categories.

CONCLUSIONS

Our data suggest that AAW and EAW experience different relationships between obesity and other CME risks and this is true regardless of the obesity estimates procedure used for the assessment.[5,19] Although obesity and central adiposity of the AAW and EAW were not different, the impact of adiposity on other CME risk factors was shown to be different for the two groups of women. Obesity appears to have a more moderate effect on CME risk factors in AAW. One possible explanation for the relationship between obesity and other CME risks in AAW is a favorable lipid profile.[20] Our data suggest that a population specific criterion to assess how obesity clusters with other CME conditions to predict the development of CVD is warranted. However, further research on this issue is needed to validate these findings.

Our data suggest that African American women and European American women experience different relationships between obesity and other CME risks and this is true regardless of the obesity estimates procedure used for the assessment.[5,19]

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AUTHOR CONTRIBUTIONS

Design and concept of study: Brandon, Proctor, Cole
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Manuscript draft: Brandon, Cole
Statistical expertise: Brandon, Cole
Administrative: Brandon, Proctor, Cole
Supervision: Brandon, Proctor, Cole