

# RACE AND EPICARDIAL FAT: THE IMPACT OF ANTHROPOMETRIC MEASUREMENTS, PERCENT BODY FAT AND SEX

**Objective:** Epicardial fat is known to be thicker in White men than in Black men. The impact of sex, % body fat, and other anthropometric measures on epicardial fat thickness has not been described. Therefore we sought to evaluate how the racial differences in epicardial fat thickness would differ by these factors.

**Methods:** We used two-dimensional transthoracic echocardiography to measure the epicardial fat thickness in 150 patients who were admitted to our clinical decision unit for chest pain. Standard anthropometric measurements were performed and body mass index (BMI) and % body fat were calculated. Data were analyzed using analysis of variance and multiple regression.

**Results:** Epicardial fat measured at the mid right ventricular wall was significantly greater in Whites than Blacks ( $4.9 \pm 2.1$  mm vs  $3.8 \pm 1.8$  mm, for males, and  $5.8 \pm 3.2$  mm vs  $3.7 \pm 1.7$  mm, for females). The results from regression analysis showed that after controlling for age, sex, BMI and waist circumference, race remained a significant predictor of epicardial fat, with Whites having higher amounts of fat than Blacks. The difference by race remained even after controlling for % body fat, which was also a significant predictor.

**Conclusion:** Anterior epicardial fat thickness is greater in White than Black men and women of the same race and is independent of anthropometric measurements and % body fat. Race may be an important consideration when analyzing the relationship between epicardial fat and cardiovascular risk. (*Ethn Dis.* 2013;23[3]:281–285)

**Key Words:** Anthropometric Measures, Body Mass Index, Echocardiography, Sex, Epicardial Fat, Race

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## INTRODUCTION

The distribution of visceral fat is associated with known cardiometabolic risk factors.<sup>1–7</sup> Although epicardial fat has also been shown to be associated with intra-abdominal fat and cardiovascular risk,<sup>8–10</sup> relatively little is known about the patterns of epicardial fat in Blacks compared to Whites. One study showed that Black men had less epicardial fat compared to White men<sup>11</sup> but the presence of this disparity in women and its relationship to % body fat, body mass index (BMI) and other anthropometric measures was unknown.

We sought to determine whether the observation of less epicardial fat in Black men than White men was present in our patient population. Further, we evaluated whether this difference was present in women. Finally, we examined specific anthropometric measures, including % body fat and BMI as they related to differences in epicardial fat between races.

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## METHODS

### Patients

The data for this analysis came from a prospective study of individuals with chest pain but no known cardiovascular disease who were referred to our echocardiography laboratory from the clinical decision unit (CDU) at St. John Hospital and Medical Center (SJH&MC) from 10/2009 to 10/2010. Data were collected from the medical record, two-dimensional transthoracic echocardiography, and body composition analysis. The study was approved by the St. John Hospital and Medical Center Institutional Review Board. A total of 150 patients were included in this study. Patients with known cardiovascular disease were excluded.

### Demographic and Anthropometric Data

Indications for echocardiography were obtained from the request forms filled out by the ordering physicians. Age, height, weight were recorded at the time of echocardiography. Body mass index was calculated as weight in kilograms divided by height in meters squared.

Body weight was measured to the nearest .1 kg using a lever balance, with patients dressed in a hospital gown. Height, with shoes off, was measured to the nearest 1 cm. Waist circumference (WC) was measured midway between the lower rib margin and superior border of the iliac crest in the horizontal plane. Neck circumference was measured in the midway of the neck, between midcervical spine and midanterior neck, to within 1 mm, with plastic tape calibrated weekly. In men with a laryngeal prominence (Adam's

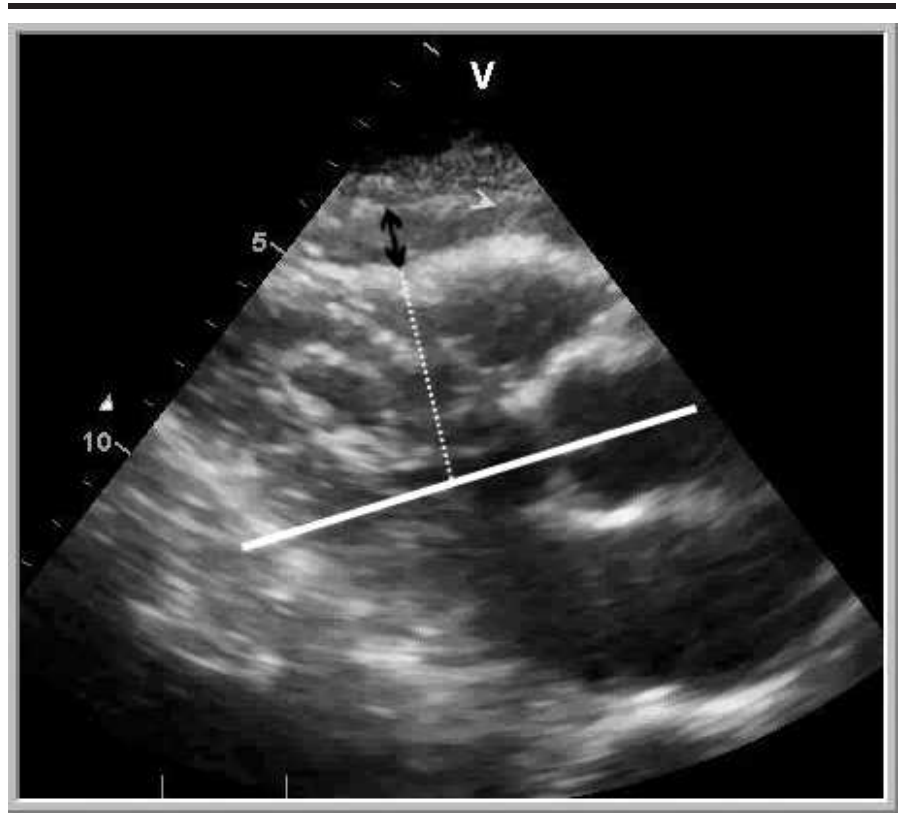
apple), it was measured just below the prominence. All circumferences were taken with the patients standing upright and shoulders relaxed. The waist-to-height ratio (WHtR) is calculated by dividing waist size by height. Body mass index is defined as the individual's body weight divided by the square of his or her height and recorded as kg/m<sup>2</sup>. All anthropometric measurements were taken in accordance with World Health Organization standards.<sup>12</sup>

Percent body fat was obtained using the RJL system-Quantum IV BIA analyzer (Clinton Township, Michigan) which measures electrical impedance. Resistance and reactance data from the BIA analyser were then used to estimate the % body fat from manufacturers' equation by BC software.

### Echocardiographic Methods

Complete transthoracic two-dimensional echocardiograms with harmonic imaging were performed by using commercially available equipment M4S transducer, GE Vivid 7 (Horten, Norway) and images were digitized. Epicardial fat, which is located anterior to the right ventricular free wall between the visceral and parietal pericardium, was measured in the parasternal long axis view in end-systole.<sup>13</sup> In most patients the epicardial fat was hypochoic relative to the myocardium but more echo-dense than blood. Also, because epicardial fat is not evenly distributed along the curved right ventricular free wall in this view, we made 3 to 5 measurements along the mid-right ventricular free wall ignoring the distal-right ventricular free wall and accepted the maximum thickness. Measurements were made perpendicular to the long axis of the aorta.

Figure 1 shows the parietal pericardium (double arrowheads) and demonstrates how the maximum epicardial fat thickness (single arrowheads) was measured from the parasternal long axis view of a White patient with large amounts of epicardial fat.



**Fig 1.** An echocardiogram showing the parasternal long-axis view of a White female, aged 60 years, with increased epicardial fat captured in end-systole. Arrowhead = epicardial fat; bold solid continuous line = long axis of the aorta. Thin broken line = perpendicular axis from which measurements of epicardial fat thickness are taken

### Statistical Analysis

Racial differences in epicardial fat and other variables such as age, BMI, and % body fat were determined using Student's *t* test. Separate analyses were completed for men and for women. Multiple linear regression was used to predict the amount of pericardial fat given the independent predictors that were found to be significant on univariate analysis. All analyses were completed with SPSS v. 19.0 and a  $P \leq .05$  was considered to indicate statistical significance.

### RESULTS

The study group's baseline characteristics are listed in Table 1. The study population included 150 patients, mean age  $46.8 \pm 10.0$  years, 57.3% (86) were female and 68% (102) were Black. The

White women in our study were significantly older than the Black women. Black females had a higher BMI and larger waist circumference and increased waist to height ratio than White women (Table 2). Although there was a trend towards White men having a higher BMI and anthropometric measures compared to the Black men, the only statistically significant difference was seen in the neck circumference. There was also a statistically significant difference between the groups with regards to % body fat (PBF) with the Black women having a higher PBF compared to the White women and a trend towards a higher PBF in the White men compared to the Black men. The difference by race remained after controlling for age and PBF, both of which were also significant predictors.

**Table 1. Patient characteristics of study population (n=150)**

Variable	Mean ± SD or n (%)
Age, years	46.8 ± 10.0
Black race	102 (68)
Male sex	64 (42.7)
Current smoking	45 (30)
Hypertension	61 (40.7)
Hyperlipidemia	37 (24.7)
Family history of CAD	65 (43.3)
Diabetes	23 (15.3)
Waist circumference, cm	102 ± 17.7
Body mass index, kg/m <sup>2</sup>	32.5 ± 8.3

CAD, coronary artery disease.

Ranges of epicardial fat thickness measurements for Black females and males were 3.7 ± 1.7 mm, 3.8 ± 1.8 mm, respectively and for White females and males were 5.8 ± 3.2 mm and 4.9 ± 2.1 mm, respectively.

Two multiple regression models were created, one including BMI along with other predictors and a second model including waist circumference (Tables 3 and 4). The results from the regression show that after controlling for age, sex and either BMI or waist circumference, race remained a significant predictor of epicardial fat, with Whites having higher amounts of epicardial fat than Blacks.

## DISCUSSION

In our study of young to middle-aged men and women with no known cardiovascular disease who were referred

for echocardiography secondary to chest pain, we found that White patients had greater epicardial fat thickness measured by echocardiography than did Black patients. These findings were independent of sex, age, PBF, weight, and BMI or waist circumference. Age and PBF were both strong independent predictors of epicardial fat thickness.

*We found that White patients had greater epicardial fat thickness measured by echocardiography than did Black patients.*

Our data not only confirms the only other available literature looking specifically at this question,<sup>11</sup> but also are

additive in that they show that this racial disparity in epicardial fat is present in women as well as men. This disparity may even be more significant in the female patients, because despite the Black women in this study having higher anthropometric measures and PBF, they still had lower epicardial fat compared to the White female participants.

The mechanisms of these racial differences in epicardial fat accumulation are unknown but given the known correlation of epicardial fat with known cardiometabolic risk factors,<sup>14–20</sup> our findings are paradoxical since Blacks are known to be at an increased risk of developing obesity-related cardiac and metabolic disorders despite having less intra-abdominal and intrathoracic visceral fat.<sup>12,21</sup>

One hypothesis for this paradox is that the association of visceral adiposity with cardiometabolic disorders may differ according to racial origin. In Whites, visceral adipose tissue may be more strongly associated with the insulin resistance, risk of all-cause or coronary heart disease mortality while in Blacks it may be more strongly associated with dyslipidemia.<sup>22–28</sup>

Another explanation may lie in the socioeconomic disparity between various ethnic groups. It is unclear if the Black participants in our study were of a lower socioeconomic status than the White participants and how this might impact education status, finances, dietary habits and access to health care.<sup>29–32</sup> A

**Table 2. Age, anthropometric measures, % body fat and epicardial fat of Black (n=102) and White (n=48) participants by sex**

Variable	Male			Female		
	White (n=24)	Black (n=40)	P	White (n=24)	Black (n=62)	P
Age, years	45.5 ± 8.4	44.5 ± 9.6	.654	52.3 ± 10.0	46.6 ± 10.3	.024
BMI, kg/m <sup>2</sup>	33.4 ± 7.6	31.1 ± 8.5	.294	29.9 ± 7.0	34.1 ± 8.7	.039
Waist circ, cm	109.9 ± 19.8	101.4 ± 18.6	.094	94.0 ± 15.9	102.5 ± 15.8	.027
Neck circ, cm	43.5 ± 4.4	41.4 ± 3.3	.029	35.1 ± 2.8	36.1 ± 3.4	.213
Waist to height ratio	.62 ± .12	.57 ± .11	.091	.57 ± .10	.63 ± .10	.011
Body fat, %	28.8 ± 8.1	26.5 ± 7.9	.282	35.1 ± 9.5	40.5 ± 8.9	.016
Epicardial fat, mm	4.9 ± 2.1	3.8 ± 1.9	.04	5.8 ± 3.2	3.7 ± 1.7	.006

Data are mean ± SD.

BMI, body mass index; Circ, circumference.

**Table 3. Multiple linear regression predicting the amount of epicardial fat-body mass index included in this model**

Variable	Regression Coefficient <sup>a</sup>	t-Statistic <sup>b</sup>	P
Age	.09	4.09	<.0001
Sex	.47	1.07	.29
Race	1.04	2.24	.027
Body mass index	.095	3.68	<.0001

<sup>a</sup> Regression coefficient, or slope, for each independent predictor.  
<sup>b</sup> t-statistic is used to test the null hypothesis that the slope is equal to zero.

study correcting for socioeconomic status would be needed to see if this racial disparity in epicardial fat and association with cardiometabolic disorders remains.

Finally, there may not be a paradox and the problem may lie in using a single cutoff value when assigning significance of the epicardial fat thickness to known cardiometabolic risk factors. Perhaps the exact thickness of epicardial fat necessary to show association with known cardiometabolic risk factors is different between Blacks and Whites.

**LIMITATIONS**

Echocardiography only samples a tomographic slice of the epicardial fat and may not reflect the total volume. It has, however, been shown to correlate strongly with MRI-determined epicardial fat and intra-abdominal visceral fat.<sup>19</sup>

Though our study does not address the relationship of epicardial fat to cardiovascular disease, we do believe that it adds to the increasing literature regarding epicardial fat and will allow for future studies looking into this

relationship to account for the possible racial impact.

Finally, our observations are in line with prior studies of visceral fat, whether by echocardiography or by other imaging modalities, which gives additional credence to our hypothesis generated by this study.

**CONCLUSION**

Epicardial fat is strongly related to race, and greater in White relative to Black patients. This racial difference remains even after controlling for anthropometric measurements, % body fat, sex, and age. Recognizing this difference will strengthen future studies attempting to better define the relationship between epicardial fat and cardiovascular disease. Larger cohort studies using MRI or CT are warranted to confirm our observations.

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**Table 4. Multiple linear regression predicting the amount of epicardial fat-waist circumference included in this model**

Variable	Regression Coefficient <sup>a</sup>	t-Statistic <sup>b</sup>	P
Age	.084	3.96	<.0001
Sex	.125	.29	.77
Race	.998	2.20	.03
Waist circumference	.055	4.64	<.0001

<sup>a</sup> Regression coefficient, or slope, for each independent predictor.  
<sup>b</sup> t-statistic is used to test the null hypothesis that the slope is equal to zero.



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