The association between abdominal obesity measures and cardiovascular biomarkers among black and white girls

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Introduction

Cardiovascular disease (CVD) risk is disproportionately higher among black than white women in the US.[1] Abdominal obesity is more strongly associated with coronary heart disease (CHD) than overall obesity,[2,3] likely due to an increased deposition of harmful visceral instead of subcutaneous fat.[4–6] Gold standard assessments of abdominal obesity—magnetic resonance imaging (MRI)[7] and computed tomography (CT)[8]—are very costly and impractical for daily screening. Three anthropometric measures—waist-to-height ratio (WHtR), waist circumference (WC), and body mass index (BMI)—have been presented in the literature as cost-effective alternatives to imaging techniques in assessing visceral fat deposition[9] and predicting cardiometabolic risk,[10,11] with varying levels of effectiveness. However, little is known about the association between abdominal obesity measures (WHtR, WC) and CVD risk factors among black and white girls using longitudinal data.

Objective

1) Examine 1-year time-lagged associations between WHtR, WC, BMI and CVD biomarkers.
2) Examine 1-year time-lagged associations between WHtR, WC and CVD biomarkers after adjusting for BMI residuals.
3) Examine if associations in part 2 differed by race.

Methods

For 10 years, National Heart, Lung, and Blood Institute Growth and Health Study (NGHS) followed black and white preadolescent girls, who were recruited from public and parochial schools in Richmond, California, and Cincinnati, Ohio, and from families enrolled in a large health maintenance organization in the Washington, DC area.[28–30] Each city enrolled approximately similar percentages of black and white girls. Girls were within two weeks of 9-10 years of age at the first clinic visit, self-identified as non-Hispanic black or non-Hispanic white, and their parents/caregivers self-identified as the same race. The final analytic sample consisted of 1,961 girls of the original 2,379 (82%). Linear mixed models was used to examine the 1-year time-lagged associations between obesity measures in years 2, 4, 6, 9 and CVD biomarkers in years 3, 5, 7, 10, respectively. Analysis included subject-specific random intercepts and autoregressive covariance structure to account for serial correlation. BMI was regressed against each abdominal obesity. The resulting BMI residuals were included as a covariate in parts 2 and 3 of the analysis. Race interaction was tested with the likelihood ratio test with 20% significance. Analysis was conducted using Stata 13.

Results

Table 1. Means (Standard Deviation) of baseline characteristics of adolescent girls in the NHLBI Growth and Health Study, stratified by race. (n=1,479)

Variable	White (n=719)	Black (n=760)	p-value
Sociodemographic Characteristics			
Age, y	10.95 (.55)	11.05 (.56)	<0.0004
Two-Parent Household, No. (%)	592 (82.34)	456 (60.00)	<0.0001
Maturation Stage	2.15 (1.10)	2.98 (1.30)	<0.0001
Parental Edu, No. (%)			
≤High Grad	123 (17.11)	205 (26.97)	
≤ 3 Years of College	211 (29.35)	371 (49.82)	<0.0001
≥ 4 Years of College	385 (53.55)	184 (24.21)	
Parental Income, No. (%)			
<$10,000	35 (4.87)	174 (22.89)	
$10,000–$19,999	61 (8.48)	137 (18.03)	<0.0001
$20,000–$39,999	229 (31.85)	245 (32.24)	
≥ $40,000	394 (54.80)	204 (26.84)	
Cardiometabolic Indicators			
WHtR	.43 (.05)	.44 (.06)	<0.0001
WC, cm	63.39 (7.73)	66.23 (9.56)	<0.0001
BMI, kg/m^2	18.78 (3.42)	20.24 (4.53)	<0.0001
TG/HDL, mg/dl	1.87 (1.39)	1.37 (.82)	<0.0001
ApoB/A1	.62 (.18)	.59 (.18)	0.0011

Results

Table 2. Adjusted mean change in cardiovascular risk biomarkers and 95% confidence interval (CI) for 1-year time-lagged associations of BMI, WHtR, and WC among black and white girls in the NHLBI Growth and Health Study. (n=1,961)

	TG/HDL		ApoB/A1	
No. of observations	5,067		5,067	
No. of girls	1,961		1,961	
Variable	Mean Change (95% CI)^a x 10	p-value	Mean Change (95% CI)^a x 10	p-value
BMI-z	3.34 (2.77, 3.92)	<0.001	.54 (.47, .61)	<0.001
WHtR-z	3.51 (2.96, 4.07)	<0.001	.55 (.48, .61)	<0.001
WC-z	3.64 (3.07, 4.22)	<0.001	.55 (.48, .62)	<0.001

Table 3. Mean change in cardiovascular risk biomarkers and 95% confidence interval (CI) for 1-year time-lagged associations of abdominal obesity measures with BMI-residuals adjustment among black and white girls in the NHLBI Growth and Health Study. (n=1,961)

	TG/HDL		ApoB/A1	
No. of observations	5,067		5,067	
No. of girls	1,961		1,961	
Variable	Mean Change (95% CI)^a x 10	p-value	Mean Change (95% CI)^a x 10	p-value
WHtR-z	3.93 (2.87, 4.99)	<.001	.37 (.26, .49)	<.001
BMI residual	-.09 (-.28, .01)	.34	.04 (.02, .07)	.001
WC-z	4.69 (3.53, 5.85)	<.001	.40 (.28, .53)	<.001
BMI residual	-.23 (-.43, -.02)	.03	.03 (.01, .06)	.01

Table 4. Adjusted mean change in cardiovascular risk biomarkers and 95% confidence interval (CI) for 1-year time-lagged associations for abdominal obesity measures by race among girls in the NHLBI Growth and Health Study. (n=1,961)

No. of observations	5,067			
No. of girls	1,961			
	TG/HDL Mean Change (95% CI)^a x 10			
Variable	Black	p-value	White	p-value
WHtR-z	2.67 (1.58, 3.75)	<0.001	5.59 (4.24, 6.95)	<0.001
WC-z	3.64 (2.47, 4.81)	<0.001	6.02 (4.63, 7.41)	<0.001
	ApoB/A1 Mean Change (95% CI)^a x 10			
Variable	Black	p-value	White	p-value
WHtR-z	.27 (.14, .40)	<0.001	.51 (.36, .65)	<0.001
WC-z	.34 (.20, .48)	<0.001	.49 (.34, .64)	<0.001

Likelihood ratio p-value for multiplicative interaction for TG/HDL: <.001 for both WHtR and WC
Likelihood ratio p-value for multiplicative interaction for ApoB/A1: .001 (WHtR) and .02 (WC)

Abbreviations: CI, confidence interval; BMI, body mass index; WHtR, waist-to-height ratio; WC, waist circumference; TG/HDL, triglycerides/high-density lipoproteins; ApoB/A1, apolipoprotein B/A1; z, Z-score.
^{a}Associations adjusted for age, age^2, two-parent household, maturation, parental education, parental income, race and BMI residuals for each abdominal obesity measure.

Conclusion

1) All three obesity measures are significantly associated with CVD biomarkers, providing evidence that increased obesity among adolescent girls is correlated with CVD risk factors.

2) Abdominal obesity measures remain significantly associated with CVD biomarkers after adjusting for BMI residuals and other covariates. This provides evidence to support the notion that abdominal obesity may be a more effective measure of CVD risk factors than overall obesity among black and white girls.

3) We found evidence that abdominal obesity measures captures CVD risk factors differently by race. Abdominal obesity measures may be a stronger marker of CVD biomarker scores among white girls than black girls.

In summary, abdominal obesity measures are simple, affordable assessments that clinicians can use to estimate cardiometabolic health and public health advocates, researchers, and clinicians should continue to examine their utility in clinical practice.

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