INTRODUCTION

The prevalence of type 2 diabetes and cardiovascular disease (CVD) is significantly higher in African American and African women than White women.\(^1\)\(^-\)\(^3\) Screening tests are designed to detect risk for disease when intervention could improve outcome. As insulin resistance promotes the development of type 2 diabetes and CVD, identifying a screening test that identifies insulin resistance in women of African descent could be beneficial. Hundreds of research articles have discussed the efficacy of the triglyceride/high density lipoprotein-cholesterol (TG/HDL-C) ratio as a marker of insulin resistance for many population groups.\(^4\)\(^-\)\(^5\) But, it is unknown if the TG/HDL-C ratio is able to predict insulin resistance in African women.

Studies in overweight Whites suggest that the TG/HDL-C ratio effectively identifies insulin resistance.\(^4\)\(^-\)\(^5\) Yet, the pattern of the dyslipidemia of insulin resistance differs in African Americans and Whites,\(^6\) and therefore the ability of the TG/HDL-C to predict insulin resistance may vary by race. In Whites, the dyslipidemia of insulin resistance follows the classic pattern of elevated TG and low HDL-C. However, in African Americans, West Africans and Black South Africans, normal TG with low HDL-C is the characteristic lipid profile of insulin resistance.\(^6\)\(^-\)\(^9\) In addition, there are sex differences in the lipid profile. Women have lower TG and higher HDL-C levels than men.\(^9\) Unless sex-specific differences in the lipid profile are recognized, misleading results may occur. For example, in a cohort of 90 overweight African Americans in which men and women were evaluated together, the TG/HDL-C ratio was found to be of no value in predicting insulin resistance.\(^10\) However, when 2000 African Americans from the Jackson Heart Study were stratified by sex, it became apparent that the TG/HDL-C ratio was able to predict insulin resistance in men but not women.\(^11\) Unanswered by the Jackson Heart Study was whether the TG/HDL-C ratio could predict insulin resistance in African women. Therefore, we tested the ability of TG/HDL-C to predict insulin resistance in Black women from South Africa, West Africa and the United States. For comparison, the ratio...

We tested the ability of TG/HDL-C to predict insulin resistance in Black women from South Africa, West Africa and the United States.
was also tested in White women from South Africa.

METHODS

Subjects
Eight hundred one non-diabetic, premenopausal women from four studies were enrolled. Criteria were: age 2491, n-TG/HDL-C R

Knight et al

B 6 m 13–16 n Analyses at three sites: University of Cape Town.

Subjects from the Akan or Gaa tribes, Ghanian from the Ibo or Yoruba tribes or South Africans, 2.0 for the African Americans from TARA, and 2.18 for the Blacks from the HUFS and AADM. These analyses were repeated with the participants divided by quartiles of HOMA-IR, and the results did not change. The data presented are based on tertiles of HOMA-IR.

Statistics

For all analyses, differences in age and BMI were examined using the Student’s t-test. Bonferroni correction was used to examine differences in age and BMI among the three groups. The data presented are geometric means and 95% CI. AUC-ROC curves were used to examine the ability of the TG/HDL-C ratio to identify insulin resistance. Analyses were performed with STATA v. 11 (STATA, College Station, Texas).

RESULTS

All the participants were premenopausal, but both the Black and White South Africans were younger than the African Americans and West Africans (Table). Among the Blacks, West Africans were the oldest and South Africans the youngest. BMI was higher in the Black women than the White women. Among the Black women, African Americans had the highest BMI and West Africans the lowest (Table). Among the Blacks, West Africans had the highest BMI and South Africans the lowest (Table). Among the Blacks, West Africans had the highest BMI and South Africans the lowest (Table). Among the Blacks, West Africans had the highest BMI and South Africans the lowest (Table). Among the Blacks, West Africans had the highest BMI and South Africans the lowest (Table).

Due to differences in age and BMI among groups, lipids and HOMA-IR

THE TG/HDL-C RATIO IN BLACK WOMEN - Knight et al

The TG/HDL-C ratio was calculated as: 0.5 for no discrimination, 0.7–0.9 for acceptable, 0.8–0.9 for excellent, >0.9 for outstanding. Analyses were performed with STATA v.11 (STATA, College Station, Texas).
Table. Participant Characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>White South Africans (WSA)</th>
<th>All Blacks</th>
<th>Black South Africans (BSA)</th>
<th>African Americans (AA)</th>
<th>West Africans (WA)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n=143</td>
<td>n=658</td>
<td>n=157</td>
<td>n=382</td>
<td>n=119</td>
<td></td>
</tr>
<tr>
<td>Age (y)</td>
<td>32 (30,33)</td>
<td>35 (34,36)</td>
<td>26 (25,27)</td>
<td>37 (36,38)</td>
<td>44 (43,44)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>27.6 (26.4,28.8)</td>
<td>29.7 (29.2,30.3)</td>
<td>29.1 (27.9,30.3)</td>
<td>30.5 (29.8,31.3)</td>
<td>28.0 (27.0,29.0)</td>
<td>.001</td>
</tr>
<tr>
<td>Overweight, n</td>
<td>79 (55)</td>
<td>469 (71)</td>
<td>96 (61)</td>
<td>289 (76)</td>
<td>84 (71)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>TG (mg/dL)</td>
<td>78 (72,84)</td>
<td>71 (69,73)</td>
<td>69 (64,74)</td>
<td>70 (67,73)</td>
<td>79 (73,86)</td>
<td>.02</td>
</tr>
<tr>
<td>HDL-C (mg/dL)</td>
<td>58 (56,61)</td>
<td>51 (50,52)</td>
<td>53 (51,56)</td>
<td>52 (50,53)</td>
<td>43 (41,46)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>TG/HDL-C</td>
<td>1.34 (1.22,1.47)</td>
<td>1.40 (1.34,1.47)</td>
<td>1.29 (1.17,1.42)</td>
<td>1.34 (1.27,1.42)</td>
<td>1.83 (1.64,2.04)</td>
<td>.52</td>
</tr>
<tr>
<td>HOMA-IR</td>
<td>1.60 (1.44,1.78)</td>
<td>1.55 (1.47,1.63)</td>
<td>1.49 (1.33,1.66)</td>
<td>1.57 (1.47,1.67)</td>
<td>1.57 (1.39,1.78)</td>
<td>.52</td>
</tr>
</tbody>
</table>

a Data presented as geometric mean (95% CI).
b P values were obtained by Student's t-test for WSA vs all Blacks. For the 3 groups of Blacks, one-way ANOVA with Bonferroni correction was used.
c Percent overweight (BMI ≥25 kg/m²). P-values by chi-square.
d Data adjusted for age and BMI with comparison by logistic regression.
e 1: If P value for difference between BSA and AA was significant.
f 2: If P value for difference between BSA and WA was significant.
g 3: If P value for difference between AA and WA was significant.
h 4: If P value for difference b3: If P value for difference between AA and WA was significant.
i 5: If P value for difference between AA and WA was significant.

We report that the AUC-ROC curve was 0.76 for White women. Therefore, the TG/HDL-C ratio would be considered only “acceptable” and not an “excellent” predictor of insulin resistance. We recognize that there is some controversy about the usefulness of the TG/HDL-C ratio as a predictor of insulin resistance, even in Whites. We report that the AUC-ROC curve was 0.76 for White women. Therefore, the TG/HDL-C ratio would be considered only “acceptable” and not an “excellent” predictor of insulin resistance. We recognize that there is some controversy about the usefulness of the TG/HDL-C ratio as a predictor of insulin resistance, even in Whites. We report that the AUC-ROC curve was 0.76 for White women. Therefore, the TG/HDL-C ratio would be considered only “acceptable” and not an “excellent” predictor of insulin resistance. We recognize that there is some controversy about the usefulness of the TG/HDL-C ratio as a predictor of insulin resistance, even in Whites.
do not have prospective data relating the TG/HDL-C ratio to outcomes such as type 2 diabetes and CVD in White or Black women.

Overall, we conclude that research demonstrating the lack of efficacy of the TG/HDL-C ratio as a predictor of insulin resistance in overweight African American women provided an important signal that the ratio may not work in Black African women.\(^{10-11,14}\) For overweight Black women in Africa and the United States, current evidence does not support the use of the TG/HDL-C ratio as a screening tool to identify insulin resistance.

**Figure 1A, 1B.** The AUC-ROC curve to identify insulin resistance by the TG/HDL-C ratio

A. White South Africans vs all Blacks combined
   - White South African: AUC-ROC curve is 0.76±0.06
   - All Blacks (Combined): AUC-ROC curve is 0.63±0.03
B. White South Africans vs each group of Black women
   - White South African: AUC-ROC curve is 0.76±0.06
   - Black South African: AUC-ROC curve is 0.64±0.06
   - African American: AUC-ROC curve is 0.66±0.03
   - West African: AUC-ROC curve is 0.63±0.07

Acknowledgments

The authors thank Ms. Sophia S.K. Yu and Ms. Darleen C. Castillo for their careful review of the manuscript. AES and MR were supported by the Intramural Program of NIDDK, NIH. MGK was supported through the Clinical Research Training Program, a public-private partnership supported jointly by the NIH and Pfizer Inc (via a grant to the Foundation for NIH from Pfizer Inc). The South African study was funded by the South African Medical Research Council, the National Research Foundation of South Africa and the University of Cape Town. The HUFS was supported by grant S06GM008016-320107. African American enrollment from HUFS was carried out at the General Clinical Research Center supported by NCRR grant 2M01RR010284 and the National Human Genome Center at Howard University. The AADM study was supported by grants...
obtained from NCMHD, NHGRI and NIDDK. We thank the HUFS and AADM investigators. Sponsors or funders did not participate in the design and conduct of the study, collection, management, analysis, and interpretation of the data, or preparation, review, or approval of the manuscript.

REFERENCES


AUTHOR CONTRIBUTIONS

Study concept and design: Knight, Ricks, Tulloch-Reid, Sumner
Acquisition of data: Goedecke, Ricks, Evans, Levitt, Sumner
Data analysis and interpretation: Knight, Goedecke, Tulloch-Reid, Sumner, Evans, Levitt
Manuscript draft: Knight, Goedecke, Ricks, Evans, Tulloch-Reid, Sumner
Statistical expertise: Tulloch-Reid, Sumner
Acquisition of funding: Goedecke, Sumner
Administrative: Goedecke, Sumner
Supervision: Goedecke, Sumner