Racial Differences in Blood Lipids Lead to Underestimation of Cardiovascular Risk in Black Women in a Nested Observational Study

The authors had no potential conflicts of interest, and the University of Florida received compensation for data collection. The other authors had no potential conflicts of interest to disclose.

**ABSTRACT**

**Background:** During screening for enrollment in a clinical trial, we noticed potential racial disparities in metabolic syndrome variables in women who responded to our study advertisement. We designed a nested observational study to investigate whether metabolic syndrome variables differed between non-Hispanic blacks and non-Hispanic whites.

**Methods:** The cohort comprised of women who have met the preliminary clinical trial criteria (body mass index [BMI] 25-45, age 20-75 years, and no use of lipid-lowering medications or supplements). These women, including 116 blacks and 138 whites, provided fasting blood samples for analysis of serum lipid profile.

**Results:** Blacks had lower mean triglycerides (81.1 ± 3.3 mg/dL vs 140.6 ± 5.9 mg/dL; *P* < .0001), total cholesterol (176.1 ± 3.6 mg/dL vs 201.6 ± 3.3 mg/dL; *P* < .0001), and low-density lipoprotein (111.7 ± 3.3 mg/dL vs 128.2 ± 2.9 mg/dL; *P* < .0001) and higher mean BMI (37.2 ± 0.5 vs 35.2 ± 0.5; *P* < .0001) and diastolic blood pressure (82.4 ± 0.8 mmHg vs 79.4 ± 0.7 mmHg; *P* < .0001) than whites. Only 7% of blacks, compared with 41% of whites, had triglycerides ≥150 mg/dL; as a result, fewer black women met metabolic syndrome criteria than white women. Additionally, in women with waist circumference ≥88 cm (*N* = 215), high-density lipoprotein was higher in blacks than in whites (48.3 ± 1.5 mg/dL vs 44.2 ± 1.3 mg/dL; *P* < .05).

**Conclusions:** Due to racial differences in blood lipids, current metabolic syndrome criteria may result in underestimation of cardiovascular risk in blacks.

**Key Words**

Women, metabolic syndrome, triglycerides, cholesterol, race, cardiovascular disease

**Disclosure**

The authors completed the ICMJE Form for Disclosure of Potential Conflicts of Interest, and Drs McIntosh and Kumar, Ms Kalynych, and Ms Lott disclosed that the University of Florida received compensation for data collection. The other authors had no potential conflicts of interest to disclose.

**Citation**

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terios de síndrome metabólico. Además, en mujeres con perímetro de la cintura igual o superior a 88 cm (N = 235), la concentración de lipoproteínas de alta densidad en mujeres negras era superior a la de las mujeres blancas (48.3 fíl 1.5 mg/dl frente 44.2 fíl 1.3 mg/dl; P < 0.05).

**Conclusiones:** Debido a las diferencias raciales en los lípidos sanguíneos, los criterios activos de síndrome metabólico pueden resultar en una infravaloración del riesgo cardiovascular en las personas de raza negra.

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**INTRODUCTION**

Metabolic syndrome (MetS) afflicts an estimated 69 million people in the United States, and its incidence worldwide continues to increase. MetS is accompanied by a two-fold increased risk of cardiovascular disease (CVD) and a five-fold increased risk of type 2 diabetes. Because MetS represents a cluster of co-occurring metabolic risk factors, differences in its definition exist. For example, the National Cholesterol Education Program Adult Treatment Panel III report (NCEP ATP III) defines MetS as having three or more of the following components: abdominal obesity, assessed by waist circumference (≥88 cm for women and ≥102 cm for men); triglycerides ≥150 mg/dL; high-density lipoprotein cholesterol (HDL-C) <50 mg/dL for women and <40 mg/dL for men; elevated blood pressure (BP; ≥130/85 mm Hg); and fasting blood glucose ≥100 mg/dL. On the other hand, the International Diabetes Federation included central obesity (waist circumference ≥80 cm to 88 cm for women and ≥90 cm to 102 cm for men) and BP by using a chi-square test. Triglycerides were analyzed adjusting for potential confounders (BMI, waist circumference, and BP) by using a general linear model; none of these variables had a significant influence on triglycerides levels in either blacks or whites (data not shown). Data were analyzed using SAS (software version 9.1, SAS Institute Inc, Cary, North Carolina), with the type I error set at a nominal 5%. The numerical data are reported as means fíl standard error (SE), and the dichotomous data are reported as percentage based on sample size of each race.

**STATISTICAL ANALYSIS**

Lipid profiles, BMI, waist circumference, BP, and fasting glucose were compared between whites and blacks by using two-sided unpaired *t*-tests. Racial distribution for triglycerides ≥150 mg/dL was analyzed by a chi-square test. Triglycerides were analyzed adjusting for potential confounders (BMI, waist circumference, and BP) by using a general linear model; none of these variables had a significant influence on triglycerides levels in either blacks or whites (data not shown). Data were analyzed using SAS (software version 9.1, SAS Institute Inc, Cary, North Carolina), with the type I error set at a nominal 5%. The numerical data are reported as means ± standard error (SE), and the dichotomous data are reported as percentage based on sample size of each race.

**Table 1 Cardiometabolic and Body Composition Variables of Onsite Screening Participants**

|                | Blacks |          | Whites |          | P value |
|----------------|--------|----------|--------|----------|---------|
| Age (y)        | 116    | 41.2 ± 0.9 | 138    | 46.6 ± 0.8 | <.01    |
| BMI (kg/m²)    | 116    | 37.2 ± 0.5 | 138    | 35.2 ± 0.5 | <.01    |
| Systolic BP (mmHg) | 116   | 127.3 ± 1.3 | 138    | 124.8 ± 1.2 | NS      |
| Diastolic BP (mmHg) | 116  | 82.4 ± 0.8 | 138    | 79.4 ± 0.7 | <.01    |
| WC (cm)        | 100    | 110.5 ± 1.2 | 122    | 108.1 ± 1.2 | NS      |
| TC (mg/dL)     | 116    | 176.1 ± 3.6 | 138    | 201.6 ± 3.3 | <.0001  |
| TG (mg/dL)     | 116    | 81.1 ± 3.3 | 138    | 140.6 ± 5.9 | <.0001  |
| HDL (mg/dL)    | 116    | 48.2 ± 1.4 | 138    | 45.3 ± 1.2 | NS      |
| LDL (mg/dL)    | 116    | 111.7 ± 3.3 | 138    | 128.2 ± 2.9 | <.001   |
| Glucose (mg/dL)| 116    | 95.6 ± 1.9 | 138    | 97.7 ± 1.5 | NS      |
| TC/HDL         | 116    | 3.9 ± 0.1 | 138    | 4.9 ± 0.2 | <.0001  |
| TG/HDL         | 116    | 1.9 ± 0.1 | 138    | 3.8 ± 0.2 | <.0001  |

Abbreviations: BMI, body mass index; BP, blood pressure; HDL, high-density lipoprotein; LDL, low-density lipoprotein; NS, not significant; SE, standard error; TC, total cholesterol; TG, triglycerides; WC, waist circumference.
RESULTS

Racial Differences in Lipid Profiles

The mean triglycerides level of blacks was significantly lower than that of whites \( (P < .0001, \text{Table 1}) \). Triglycerides ≥150 mg/dL is the threshold for diagnosis of MetS; only 7% of blacks vs 41% of whites had triglycerides ≥150 mg/dL \( (P < .0001) \). Compared with whites, blacks also exhibited lower mean total cholesterol, and LDL but had significantly higher BMI and diastolic BP \( (P < .01) \) and diastolic BP \( (P < .01) \) than whites. No significant differences were found in systolic BP, waist circumference, or fasting glucose levels between the two groups.

Blacks Exhibited Lower Total Cholesterol:High-density Lipoprotein and Triglycerides:High-density Lipoprotein Ratios

The ratios of total cholesterol to HDL (TC:HDL) and of triglycerides to HDL (TG:HDL) are emerging biomarkers for assessing risk for heart disease; a lower ratio equates to lower risk\(^8\)\(^{-10}\). Both the TC:HDL and TG:HDL ratios in blacks were significantly lower than those of whites \( (P < .0001, \text{Table 1}) \).

Few Black Women Met Criteria for the Lipid Triad

Grundy suggested that the combination of elevated triglycerides, increased small LDL particles, and low HDL represent increased cardiovascular risk.\(^1\)\(^4\) A variation of the lipid triad definition posited by Besthorn uses values from a standard lipid profile and includes the following factors\(^1\)\(^2\): triglycerides ≥200 mg/dL, HDL <35 mg/dL, TC:HDL >5. In our study, <1% of blacks met these latter criteria for the lipid triad, and approximately 10% of whites met these criteria.

Subanalysis of Women With Waist Circumference ≥88 cm

Some individuals may have a high BMI without central obesity. We conducted a subanalysis in those with waist circumference ≥88 cm \( (n = 215) \), which included 84% of the blacks and 86% of the whites. Results were similar to those seen in the whole cohort with respect to significantly lower mean triglycerides, total cholesterol, and LDL, and significantly higher BMI and diastolic BP in black women (Table 2). However, HDL levels were significantly higher in the blacks than in whites \( (P < .05) \).

| Table 2 Subanalysis of Clinical Data From Participants With Waist Circumference ≥88 cm |
|-----------------|-----------------|-----------------|-----------------|-----------------|
| Blacks          | Whites          | P value         |
| N               | Mean ± SE       | N               | Mean ± SE       |                |
| BMI (kg/m\(^2\))| 97              | 37.3 ± 0.5      | 118             | 35.1 ± 0.5     | <.01           |
| Systolic BP (mmHg) | 97             | 127.6 ± 1.4     | 118             | 125.1 ± 1.3    | NS             |
| Diastolic BP (mmHg) | 97          | 82.6 ± 0.8      | 118             | 79.3 ± 8.4     | <.01           |
| WC (cm)         | 97              | 111.3 ± 1.1     | 118             | 109.1 ± 1.1    | NS             |
| TG (mg/dL)      | 97              | 80.3 ± 3.5      | 118             | 147.0 ± 6.6    | <.0001         |
| HDL (mg/dL)     | 97              | 48.3 ± 1.5      | 118             | 44.2 ± 1.3     | <.05           |
| LDL (mg/dL)     | 97              | 111.7 ± 3.7     | 118             | 129.7 ± 3.0    | <.001          |
| Glucose (mg/dL) | 97              | 96.0 ± 2.0      | 118             | 98.3 ± 1.7     | NS             |
| TC/HDL          | 97              | 3.9 ± 0.1       | 118             | 5.1 ± 0.2      | <.0001         |
| TG/HDL          | 97              | 1.8 ± 0.1       | 118             | 4.0 ± 0.3      | <.0001         |

Abbreviations: BMI, body mass index; BP, blood pressure; HDL, high-density lipoprotein; LDL, low-density lipoprotein; NS, not significant; SE, standard error; TC, total cholesterol; TG, triglycerides; WC, waist circumference.

DISCUSSION

In this nested observational study, we found racial differences in lipid variables in women who were screened for a clinical trial. Black women had significantly lower levels in triglycerides, total cholesterol, and LDL but had significantly higher BMI and diastolic BP than white women. Many of these lipid variables are components of clinical guidelines that are supposed to help healthcare practitioners identify high-risk individuals. Therefore, racial differences in these variables appear to negatively impact the effectiveness of some clinical guidelines for a certain racial group, contributing to significant public health consequence.

For example, lower mean levels of triglycerides in black men and women contribute to fewer diagnoses of MetS among the black population.\(^1\)\(^3\) Yet stroke, myocardial infarction, and type 2 diabetes are more frequent in the black population compared with the white population in the United States. This suggests that the standard definition of MetS is inappropriate for predicting CVD risk in the black population, and the risk goes unnoticed until disease progression has occurred. Similarly, based on Besthorn’s definition of lipid triad,\(^1\)\(^2\) we observed a deceptively low CVD risk profile in black compared with white women due to racial disparities in lipid variables. Others have indicated that TC:HDL and TG:HDL ratios are useful indicators of CVD risk in overweight individuals.\(^8\)\(^{10}\) However, discrepancies in both ratios between whites and blacks suggest that they are not reliable indicators of CVD risk for all populations.

Differences in enzyme activities or in lipoprotein biology may explain racial disparities in triglycerides and HDL levels. Indeed, one genotype analysis in a large cohort of black and white women indicated that genetic polymorphisms in the cholesteryl ester transfer protein gene, lipoprotein lipase gene, or hepatic lipase gene correlate with HDL levels;\(^1\)\(^4\) and another study reported higher lipoprotein lipase mRNA levels in the subcutaneous fat of the obese blacks than of the obese whites.\(^1\)\(^5\) Age, education, social economic status, dietary pattern, and other environmental factors also differ widely by ethnicity\(^1\)\(^6\) and are likely contributors to the observed disparities.
Our observational study was based on a small cohort screened for a clinical trial; comprehensive data, including diet diaries, had not been collected at the screening visit. Therefore, we were not able to address whether racial differences in dietary patterns and other lifestyle factors might confound our observation. Nevertheless, a recent study based on the National Health and Nutrition Examination Surveys 1999–2006 data showed that the racial discrepancies in the MetS persisted even after adjusting for social economic status, education, physical activity, and diet quality. We also acknowledge that there are additional limitations in this nested observational study. The cohort is not a result of random sampling, and there may be selection bias. It may not represent the general population, and the findings cannot be extrapolated to both genders and other ethnic groups.

This is not the first report on racial differences in blood lipids in a MetS study cohort; similar findings have been published in the past few years. However, we are alarmed by the lack of awareness of this issue among numerous physicians and healthcare practitioners with whom we have had personal communications. As the incidence of type 2 diabetes and heart disease continues to rise, we are faced with the dual challenge of not only managing the burden of disease but also slowing the onset of disease through preventive measures. Without guidelines that can accurately identify at-risk individuals, healthcare strategies cannot be efficiently implemented. Through this brief report (and supported evidence cited in this report), we hope to renew the awareness among the medical community and Global Advances in Health and Medicine readers on the issue of underdiagnosis of CVD risk in blacks. We believe it is imperative to develop ethnicity-specific guidelines for MetS criteria, TCHDL, TG:HDL, lipid triad, and even thresholds used to define hypertriglyceridemia.

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