Assessment of the Ability of the Triglyceride to High Density Lipoprotein Cholesterol Ratio to Discriminate Insulin Resistance among Caribbean-born Black Persons with and without Hispanic Ethnicity

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ABSTRACT

Objective: The objective of this research was to determine if the triglyceride (TG) to high density lipoprotein (HDL) cholesterol (TG/HDL) ratio has similar utility for discriminating insulin resistance in Caribbean-born black persons with and without Hispanic ethnicity.

Methods: Serum lipids, glucose and insulin were determined and compared for 144 Hispanic blacks and 655 non-Hispanic blacks living in the US Virgin Islands. Area under the receiver operating characteristics (AUROC) curve statistics were used to evaluate the ability of the TG/HDL ratio to discriminate insulin resistance in the two ethnic groups.

Results: Hispanic blacks had significantly higher levels of triglycerides and insulin resistance and a lower level of HDL cholesterol than non-Hispanic blacks. The AUROC curve for the ability of the TG/HDL to discriminate insulin resistance was 0.71 (95% CI = 0.62, 0.79) for Hispanic blacks and 0.64 (95% CI = 0.59, 0.69) for non-Hispanic blacks.

Conclusions: Among Caribbean-born black persons living in the US Virgin Islands, the TG/HDL ratio is a useful screening measure for discriminating insulin resistance in those with Hispanic ethnicity but not in those without Hispanic ethnicity.

Keywords: Caribbean-born, Hispanic ethnicity, insulin resistance, triglycerides

Assessment de la Capacidad de la Proporción de los Triglicéridos en Relación con el Colesterol de las Lipoproteínas de Alta Densidad para Identificar la Resistencia a la Insulina entre Personas Negras Nacidas en el Caribe con o sin Etnicidad Hispánica

ES Tull

RESUMEN

Objetivo: El objetivo de esta investigación fue determinar si la proporción (TG/HDL) de los triglicéridos (TG) con respecto al colesterol de las lipoproteínas de alta densidad (HDL) tiene una utilidad similar a la hora de identificar la resistencia a la insulina en personas negras nacidas en el Caribe, con o sin etnicidad hispánica.

Métodos: Se determinaron y compararon la insulina, la glucosa y los lípidos séricos de 144 negros hispanos y 655 negros no hispánicos residentes en Islas Virgenes, USA. Las estadísticas del área bajo la curva de las características operativas del receptor (AUROC) se utilizaron para evaluar la capacidad de la proporción TG/HDL para establecer la resistencia a la insulina en los dos grupos étnicos.
INTRODUCTION
The increasing global prevalence of Type 2 diabetes and high rates of cardiovascular diseases (CVD) warrant efforts to screen populations to identify persons at risk for these diseases so that prevention efforts can be initiated. Therefore, in recent years, researchers have focussed on identifying a screening tool that can be used in clinic settings to discriminate insulin resistance (1), a key risk factor for both Type 2 diabetes and CVD (2). The most promising of these screening tools, the ratio of serum triglyceride (TG) to high density lipoprotein (HDL) cholesterol (TG/HDL ratio), was reported to be particularly useful for discriminating insulin resistance among non-Hispanic whites and Mexican-Americans at a cut-point value of ≥ 3 and among non-Hispanic blacks at a cut-point value of ≥ 2 (3). However, results from other studies indicate that the TG/HDL ratio cannot efficiently discriminate insulin resistance in non-Hispanic blacks (4). It is suggested that features of triglyceride metabolism which allow people of black African descent to maintain low levels of serum triglycerides in the presence of a high level of insulin resistance make triglyceride related markers inefficient screening tools for discriminating insulin resistance in these groups (5).

In the Caribbean, people with black African ancestry belong to various cultures and have varying levels of genetic admixture from Amerindian and European Caucasian groups (6). It has been shown that among black Caribbean persons in the US Virgin Islands (USVI), those with Hispanic ethnicity (primarily of Dominican Republic and Puerto Rican origin) have an increased likelihood of being insulin resistant compared to those without Hispanic ethnicity (7) and that the triglyceride to insulin resistance relationship might vary by the level of genetic admixture among Caribbean-born Hispanic persons (8). Many Caribbean-born black persons with Hispanic ethnicity reside in the United States of America (USA), as well as throughout the Caribbean region. The aim of the current study was to assess the ability of the TG/HDL ratio to discriminate insulin resistance in Caribbean-born black persons with and without Hispanic ethnicity.

SUBJECTS AND METHODS
The population for this study consisted of a randomly selected sample of individuals age 20 years and older, without diagnosed diabetes, who participated in a population-based study of the prevalence of diabetes mellitus and cardiovascular disease risk factors on the island of St Croix in the USVI during 1995 to 2000 (9). Each study participant was asked to classify his/her own race (Black, White, etc) and ethnicity (Hispanic, non-Hispanic) according to standard categories used in the 1990 census of the USVI population. Based on these classifications, there were 144 Caribbean-born Hispanic black participants and 655 Caribbean-born non-Hispanic black participants for whom data were analysed for the current report. Each participant signed a consent form approved by the Biomedical Institutional Review Board of the University of Pittsburgh where the Principal Investigator was employed. The participation rate for Caribbean-born black participants in the study was 83%. Demographic information was collected from each participant by face-to-face interview. The weight of each participant was measured on a balance beam scale without shoes, and height was measured with a wall mounted ruler. Body mass index (BMI) was calculated as weight in kilograms (kg) divided by height in meters squared (m²). Blood samples, drawn from participants after an overnight fast of 10 to 12 hours, were measured for serum glucose, insulin, triglycerides and HDL cholesterol. The biochemical analyses were performed at the Heinz Nutrition Laboratory at the University of Pittsburgh. Insulin resistance was estimated by the homeostasis model assessment (HOMA-IR) according to the following formula: \( \frac{\text{fasting glucose} (\text{mmol/L}) \times \text{fasting insulin} (\text{µU/ml})}{22.5} \) (10).

Statistical analyses were conducted using Statistical Analysis System (SAS) software (11). Comparisons of frequencies were performed with the \( \chi^2 \) or Fisher’s exact tests, and the difference between two means was assessed with the \( t \)-test statistic. Logistic regression analyses were used to determine estimates of the areas under the receiver operating characteristics (AUROC) curve for the TG/HDL ratio and other variables used to discriminate insulin resistance. The AUROC is a commonly used index for...
summarizing the ability of a diagnostic test or measure to
discriminate between healthy and diseased subjects (12).
Generally, AUROC curve values of ≥ 0.7 suggest that a test
is acceptable for discriminating disease from non-disease,
while values below 0.7 suggest the contrary. Given the lack
of an established HOMA-IR threshold value for insulin
resistance, values in the upper third of the overall distribution
of HOMA-IR scores were considered to be indicative of
insulin resistance. The logarithm of fasting insulin values
and HOMA-IR scores were used in analyses because of the
skewed distribution of insulin values.

RESULTS

Table 1 compares the means and frequencies for demo-
graphic and metabolic characteristics of the Hispanic and
non-Hispanic groups. There were no significant differences
by age, gender or BMI between the two groups. Hispanic
participants had higher mean levels of triglycerides, insulin,
TG/HDL ratio and HOMA-IR and a lower mean HDL
cholesterol level compared to non-Hispanic participants. As
shown in Table 2, the AUROC curve values for triglyceride
level and the TG/HDL ratio met or exceeded 0.7 for the
Hispanic group and 0.6 for the non-Hispanic group. The
more favourable lipid profile of African origin populations has been linked to several racial differences in
factors associated with lipid metabolism. The frequency of the -514C>T polymorphism of the human hepatic lipase
gene, which is associated with higher levels of HDL
cholesterol, has been shown to be higher in non-Hispanic
black persons in the USA and Caribbean compared to non-
Hispanic white people (17). The level of lipoprotein lipase
(LPL), the enzyme responsible for the clearance of

<table>
<thead>
<tr>
<th>Ethnicity/Variable</th>
<th>Area under ROC curve</th>
<th>95% confidence interval</th>
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</thead>
<tbody>
<tr>
<td>Hispanic (n = 144)</td>
<td>HDL cholesterol (mmol/L)</td>
<td>0.63</td>
</tr>
<tr>
<td></td>
<td>Triglyceride (mmol/L)</td>
<td>0.70</td>
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<tr>
<td></td>
<td>TG/HDL ratio</td>
<td>0.71</td>
</tr>
<tr>
<td>Non-Hispanic (n = 655)</td>
<td>HDL cholesterol (mmol/L)</td>
<td>0.55</td>
</tr>
<tr>
<td></td>
<td>Triglyceride (mmol/L)</td>
<td>0.65</td>
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<tr>
<td></td>
<td>TG/HDL ratio</td>
<td>0.64</td>
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</table>

DISCUSSION

The results of this study show that despite a similar level of
adiposity, Caribbean-born Hispanic blacks were more insulin
resistant and have a worse lipid profile compared to
Caribbean-born non-Hispanic black participants. The Carib-
bean-born Hispanic black participants in the present study
had historical origins in the populations of Puerto Rico and
the Dominican Republic where the current gene pool is
formed from admixture of West African, Amerindian and
white European ancestral populations (13, 14). Genetic
marker studies also show that the gene pool of non-Hispanic
Caribbean black persons comprised genes from these three
ancestral populations, although the proportion of West
African ancestry was significantly associated with a lower plasma
triglyceride level among non-Hispanic black persons
(16). Therefore, it may be that a higher level of “Black” or
West African ancestry contributed to the more favourable
lipid profile of the Caribbean-born non-Hispanic black
participants in the current study.

The more favourable lipid profile of African origin
populations has been linked to several racial differences in
factors associated with lipid metabolism. The frequency of the -514C>T polymorphism of the human hepatic lipase
gene, which is associated with higher levels of HDL
cholesterol, has been shown to be higher in non-Hispanic
black persons in the USA and Caribbean compared to non-
Hispanic white people (17). The level of lipoprotein lipase
(LPL), the enzyme responsible for the clearance of
triglyceride-rich particles from the circulation, is higher in non-Hispanic black persons compared to non-Hispanic white persons (18), and LPL activity is decreased in the presence of insulin resistance in non-Hispanic white persons but not in non-Hispanic black persons (19). Godslad et al (20) suggested that the failure of triglyceride levels to rise in the presence of insulin resistance in people of black African decent might relate to racial differences in the relative proportion of the two sub-fractions of VLDL – the large, triglyceride rich VLDL Sf 400–60 (VLDL₁) and the small, triglyceride poor VLDL Sf 60–20 (VLDL₂) – secreted from the liver. They postulated that people of black African descent may secrete a significantly greater proportion of VLDL as VLDL₂ compared to European whites who secrete a greater proportion of VLDL as VLDL₁ (20), and insulin resistance is associated with an increase in hepatic production of triglyceride-rich VLDL₁ but not VLDL₂ (21).

In the current study, the TG/HDL ratio was acceptable for discriminating insulin resistance among the Hispanic black participants but not the non-Hispanic black participants. Moreover, among the Hispanic black participants, the TG/HDL ratio cut-point of 3.0 did not produce a better estimate of sensitivity for discriminating insulin resistance than the cut-point of 2.0; whereas the 3.0 cut-point was reported to be better for Mexican-Americans (4), another Hispanic group. On average, Mexican-Americans have less West African and more Amerindian genetic admixture than Caribbean origin Hispanic persons (22). The apparent difference between the results for Hispanic black participants in the current study and those for Mexican-Americans might relate to differences in genetic admixture between the groups. Estimates of the per cent of white European admixture in non-Hispanic blacks in the USA have ranged from 3.5% to 25% and have been shown to vary across and within geographic regions (23, 24). Therefore, variations in genetic admixture in non-Hispanic blacks might also account for the lack of concordance between results from previous studies that have estimated the ability of the TG/HDL ratio to discriminate insulin resistance in African Americans.

This study has some strengths and limitations. One of the strengths of the study is the use of population-based samples which allows the study results to be generalized to the relevant populations in the US Virgin Islands. In addition, the current study may be the first to assess the utility of the TG/HDL ratio for discriminating insulin resistance in Hispanic blacks of Caribbean origin. A limitation of the study is that insulin resistance was estimated by a surrogate measure, the HOMA-IR. While the HOMA-IR provides only an estimate, it is widely accepted as a practical tool for use in population-based studies and has been shown to correlate well with the hyperinsulinaemic euglycaemic clamp (25), the gold standard for measuring insulin resistance.

In summary, the results of the current study indicate that the TG/HDL ratio has utility for discriminating insulin resistance among Caribbean-born black persons with Hispanic ethnicity but not among those without Hispanic ethnicity. However, neither the recommended TG/HDL ratio cut-point of ≥ 2.0 nor the cut-point of ≥ 3.0 were very sensitive and would result in a large number of false negatives if applied judiciously in a population of Caribbean-born Hispanic black persons. An additional study with a larger sample of Caribbean-born Hispanic black persons is needed to determine an optimal cut-point for using the TG/HDL ratio to discriminate insulin resistance in this population. What is evident is that Hispanic ethnicity among Caribbean-born black persons is associated with a poorer serum lipid profile; therefore, in the clinical setting, overweight or obese individuals from this ethnic group may need to be monitored more closely for abnormal patterns in serum lipids.

ACKNOWLEDGEMENTS
This study was supported in part by a grant from the US National Institutes of Health, National Institute for Diabetes, Digestive and Kidney Diseases (1 R01 DK46502).

REFERENCES