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

Evaluación 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 Nacidad en el Caribe con o sin Etnicidad Hispánica

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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 hispánicos y 655 negros no hispánicos residentes en Islas Vírgenes, 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.*

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Resultados: *Los negros hispánicos tenían niveles significativamente más altos de triglicéridos y resistencia a la insulina y un menor nivel de colesterol HDL que los negros no hispánicos. La curva AUROC para la capacidad del TG/HDL para establecer la resistencia a la insulina fue 0.71 (95% CI = 0.62, 0.79) para los negros hispánicos y 0.64 (95% CI = 0.59, 0.69) para los negros no hispánicos.*
Conclusiones: *Entre las personas negras que viven en las Islas Vírgenes, la proporción de TG/HDL es una medida útil de tamizaje pata establecer la resistencia a la insulina en las personas de etnia hispana, pero no en las personas de etnicidad no hispánica.*

Palabras claves: Nacido en el Caribe, etnicidad hispánica, resistencia a la insulina, triglicéridos

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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 (m^2). 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: {fasting glucose (mmol/L) × fasting insulin (μU/ml)}/22.5 (10).

Statistical analyses were conducted using Statistical Analysis System (SAS) software (11). Comparisons of frequencies were performed with the χ^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 demographic 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 but not for non-Hispanic participants. The sensitivity and specificity estimates associated with the TG/HDL ratio cut-point of ≥ 2.0, recommended by Li *et al* (3), were 60% and 73%, respectively, for the Hispanic group and 50% and 70%, respectively, for the non-Hispanic group. The corresponding estimates obtained when using the TG/HDL ratio cut-point of ≥ 3 were 45% and 75%, respectively, for the Hispanic group and 24% and 86%, respectively, for the non-Hispanic group.

Table 1: Means and frequencies with 95% confidence intervals of study variables for Caribbean-born black participants, by Hispanic and non-Hispanic ethnicity

	Hispanic	Non-Hispanic	*p*-value
n	144	655	
Age (years)	47.2 (44.8–49.5)	45.6 (44.5–46.7)	0.2446
Gender (female, %)	66.7(58.9–74.4)	68.7 (65.2–72.3)	0.6265
Body mass index (kg/m2)	28.7 (27.7–29.7)	28.8 (28.3–29.3)	0.7906
Glucose (mmol/L)	5.28 (5.03–5.54)	5.29 (5.17–5.41)	0.9619
HDL cholesterol (mmol/L)	1.21 (1.16–1.25)	1.27 (1.25–1.29)	0.0113
Triglycerides (mmol/L)	3.10 (2.87–3.37)	2.36 (2.25–2.47)	< 0.0001
Log insulin (pmol/L)*	2.93 (2.85–3.01)	2.80 (2.76–2.82)	0.0038
Log HOMA-IR score*	1.46 (1.36–1.55)	1.32 (1.26–1.37)	0.0106
TG/HDL ratio	2.84 (2.57–3.11)	2.04 (1.91–2.160)	< 0.0001

*Logarithmically transformed scores

HOMA-IR – homeostasis model assessment for insulin resistance as determined by the formula {fasting glucose (mmol/L) x fasting insulin (μU/ml)}/22.5, HDL cholesterol – high density lipoprotein cholesterol, TG/HDL – the ratio of fasting triglyceride (TG) level in millimoles per litre to high density lipoprotein cholesterol level in millimoles per litre

Table 2: Areas under the receiver operating characteristics curves with 95% confidence intervals for potential markers of insulin resistance among Caribbean-born black participants of Hispanic and non-Hispanic ethnicity

Ethnicity/Variable	Area under ROC curve	95% confidence interval
Hispanic (n = 144)		
HDL cholesterol (mmol/L)	0.63	0.53 – 0.72
Triglyceride (mmol/L)	0.70	0.61 – 0.78
TG/HDL ratio	0.71	0.62 – 0.79
Non-Hispanic (n = 655)		
HDL cholesterol (mmol/L)	0.55	0.50 – 0.60
Triglyceride (mmol/L)	0.65	0.61 – 0.69
TG/HDL ratio	0.64	0.59 – 0.69

ROC – receiver operating characteristics, HDL – high density lipoprotein, TG/HDL ratio – the ratio of fasting triglyceride (TG) to high density lipoprotein (HDL) cholesterol

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 Caribbean-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 genetic ancestry is on average greater than in the Puerto Rico and Dominican Republic populations (6). In a study in Venezuela, Hispanic black persons had lower levels of serum triglyceride than other mixed Hispanics despite similar levels of insulin resistance (15). Also, in the CARDIA study, a higher proportion of West African genetic ancestry was significantly associated with a lower plasma triglyceride level among non-Hispanic black participants (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). Godsland *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 $_{400–60}$ ($VLDL_1$) and the small, triglyceride poor VLDL Sf $_{60–20}$ ($VLDL_2$) – secreted from the liver. They postulated that people of black African descent may secrete a significantly greater proportion of VLDL as $VLDL_2$ compared to European whites who secrete a greater proportion of VLDL as $VLDL_1$ (20), and insulin resistance is associated with an increase in hepatic production of triglyceride-rich $VLDL_1$ but not $VLDL_2$ (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.

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