Black hispanics have a worse cardiovascular risk profile than mixed hispanics in Venezuela.

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Abstract. In order to characterize components of the metabolic syndrome (MS) in Venezuelan black Hispanics and compare these metabolic abnormalities with those found in the predominant mixed Hispanic population, 2336 mixed Hispanics (69% women) and 281 black Hispanics (60 % women), aged 20-78 years, without prior history of diabetes and/or cardiovascular disease were evaluated in a population-based study in Zulia State, Venezuela. Blood pressure (BP), waist circumference, as well as fasting insulin, fasting blood glucose (FBG), triglycerides (TG) and high-density lipoprotein cholesterol (HDL-C) levels were measured. The criteria proposed by the National Cholesterol Education Program/Adult Treatment Panel III (NCEP/ATP III) to identify those with metabolic abnormalities were used. We found that black Hispanics showed higher frequency of age-adjusted elevated BP than mixed Hispanics in both men (66.9% vs. 52.3%, p < 0.01) and women (39.3% vs. 30.4%, p < 0.05). In men, elevated FBG was also more frequent in black Hispanics (32.7%) than in mixed Hispanics (22.3%), despite the lack of significant differences in fasting insulin, HOMA-insulin resistance and HOMA-beta cell function values. In women low HDL-C and higher abdominal obesity were more common in black Hispanics (71.8% and 54.1%, respectively) than in mixed Hispanics (56.2% and 44.5%, respectively), despite the greater frequency of high TG in mixed Hispanics (22.6%) when compared to black Hispanics (13.3%). Furthermore, in logistic regression analysis black Hispanic race was independently associated with higher risk for hypertension, fasting hyperglycemia, and low HDL-C. These results suggest that black Hispanics have worse cardiovascular risk profile than mixed Hispanics in Zulia State, with higher BP, higher FBG, more abdominal obesity, and lower HDL-C. Iden-

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tification and intervention of these high-risk subjects are important strategies for diabetes and cardiovascular disease prevention in Venezuela.

Los hispanos negros tienen un perfil de riesgo cardiovascular peor que los hispanos mezclados en Venezuela.
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Resumen. Con el propósito de caracterizar los componentes del síndrome metabólico en hispanos negros de Venezuela y comparar dichas anormalidades metabólicas con aquellas encontradas en la población predominante de hispanos mezclados, se estudiaron 2236 hispanos mezclados (69% mujeres) y 281 hispanos negros (60% mujeres), de 20 años o más, sin historia previa de diabetes y/o enfermedad cardiovascular en un estudio poblacional en el Estado Zulia de Venezuela. Se midieron la tensión arterial (TA), circunferencia de cintura, así como insulina y glicemia basal, triglicéridos (TG) y colesterol de las lipoproteínas de alta densidad (HDL-C). Para definir la presencia de anormalidades metabólicas se usaron los criterios del Programa Nacional de Educación del Colesterol/Panel del Tratamiento del Adulto III (NCEP/ATP III). Se encontró que los hispanos negros tenían mayor frecuencia de TA elevada - ajustada para la edad que los Hispanos mezclados tanto en los hombres (69,9% vs. 52,3%, p < 0,01) como en las mujeres (39,3% vs. 30,4%, p < 0,05). En los hombres, la elevación de la glicemia en ayunas fue más frecuente en los hispanos negros (32,7%) que en los hispanos mezclados (22,3%) a pesar de la falta de diferencias significativas en los valores de insulina, HOMA-insulino resistencia y HOMA-célula beta. En las mujeres, el HDL-C bajo y la obesidad abdominal fueron más comunes en las hispanas negras (71,8% y 54,1%, respectivamente) que en las hispanas mezcladas (56,2% y 44,5%, respectivamente), a pesar de la mayor frecuencia de hipertrigliceridemia en las hispanas mezcladas (22,6%) comparadas con las hispanas negras (13,3%). En análisis de regresión logística se observó que la raza hispana negra se asocia independientemente con mayor riesgo de hipertensión, hiperglicemia y HDL-C bajo. Estos resultados sugieren que los hispanos negros tienen un perfil de mayor riesgo cardiovascular que los hispanos mezclados en el estado Zulia con mayor frecuencia de elevación de la TA, glicemia en ayunas, obesidad abdominal y bajo HDL-C. Es importante la identificación e intervención de estos grupos de alto riesgo para la prevención de diabetes y enfermedad cardiovascular en Venezuela.

INTRODUCTION

Type 2 diabetes constitutes approximately 85% of all cases of diabetes and is more common in African Americans and Mexican Americans than in white non-Hispanics (1). In addition, racial disparities in cardiovascular disease (CVD) morbidity and mortality have been identified (2). Analysis of data from the National Health Nutrition and Examination Survey (NHANES) III indicated that the age-adjusted prevalence of the metabolic syndrome was higher in African-American women (25.7%) than in non-Hispanic white women (22.8%), but lower in African-American men (16.4%) than non-Hispanic white men (24.8%) (3).

Hypertension and obesity are common in African-Americans, and obesity seems to be a particularly important trait in African-American women (4). Obesity is associated with hyperinsulinemia in African American subjects; however there are racial discrepancies in the role played by insulin resistance and compensatory hyperinsulinemia on the pathogenesis of hypertension (5, 6). Although hypertension is commonly found in the presence of hypertriglyceridemia, African Americans have lower triglyceride levels than other race groups (7, 8).

In the Venezuelan Hispanic population there is a mixture of races: Amerindians, blacks and whites (9). Blacks of African origin represent a minority group located in selected regions of the country: along the northern part of the Caribbean coast, the southeastern border with Guyana and the southeastern coast of Maracaibo Lake, in the western state of Zulia. The frequency of hypertension in Zulia state is high (36.9%) (10); similarly, obesity and hyperinsulinemia are also common metabolic traits in this population (11). Since there is scarcity of studies on cardiovascular risk factors in black Hispanics in Venezuela and Latin America (12), we studied the frequency of metabolic abnormalities in a representative group of apparently healthy black Hispanics from Zulia State, Venezuela, and compared them with the predominant mixed Hispanic population.

SUBJECTS AND METHODS

Subjects were evaluated as part of the Zulia Coronary Heart Disease Risk Factor Study (1999-2001), a population-based study in the adult population of Zulia state, Venezuela (13). The current study used data of 2617 subjects apparently healthy without history of cardiovascular disease and/or diabetes: 2336 mixed Hispanics and 281 black Hispanics, aged 20-78 years, 68% women and 32% men. The nature and purpose of the study were carefully explained to each participant before their consent was obtained. This study was approved by the Institutional Review Board of FONACIT, Venezuela. Clinical and metabolic evaluations were performed at the Instituto de Enfermedades Cardiovasculares and Instituto de Investigaciones Clínicas "Dr. Américo Negrette" at the University of Zulia, in Maracaibo, Venezuela.

Demographic and clinical characteristics were obtained from each participant using a standardized questionnaire and race was self-reported (13). Black and mixed Hispanics had similar socio-economic status and cultural background. Blood pressure was measured with subjects in the sitting position, using a standard mercury sphygmomanometer. Anthropometric measurements (height, weight, waist and hip circumferences) were obtained using standardized techniques. Blood was collected for biochemical analysis after an overnight fast. Serum was analyzed for glucose, triglycerides (TG), total cholesterol (TC) and HDL cholesterol (HDL-C) using an automated chemical ana-

lyzer (Dimension, Dade Behring). Insulin was measured with a double-antibody radioimmunoassay technique (Diagnostic Products, USA). Insulin resistance and beta cell function were estimated using the homeostasis model assessment (HOMA) method described by Mathews *et al.* (14).

All calculations were performed using the NCSS 2000 statistical package (Kaysville, Utah). Continuous variable data are presented as mean ± standard error (S.E.). For two group comparisons, significant differences were evaluated using Student's t-test, while analysis of variance (ANOVA) was used for comparison of more than 2 groups. Prevalence data was adjusted for age using a population-standardized rate as previously described (13). Frequency data was analyzed using chi-square statistic. Pearson's correlation was used to evaluate the associations between insulin and other metabolic parameters. All tests were two-sided and an alpha level of 0.05 or less was considered to be statistically significant. Logistic regression analyses were used to identify demographic and clinical factors associated with the presence of each metabolic abnormality, defined based on the NCEP/ATP III criteria (15): waist circumference ≥ 102 cm in men or ≥ 88 cm in women; blood pressure ≥ 130/85 mm Hg; fasting triglyceride ≥ 150 mg/dL; HDL cholesterol level < 40 mg/dL in men or < 50 mg/dL in women; while the presence of elevated fasting blood glucose ≥ 100 mg/dL was based on the 2003 ADA criteria for diagnosis and classification of diabetes and related disorders (16).

RESULTS

Table I shows demographic and metabolic characteristics in the study population by gender and race using two-way ANOVA. Although black Hispanics were slightly older than mixed Hispanics, no dif-

TABLE I
CLINICAL CHARACTERISTICS OF STUDY SUBJECTS BY RACE AND GENDER

Gender	Black Hispanics		Mixed Hispanics		p values for Race	
	Men (n = 114)	Women (n = 167)	Men (n = 725)	Women (n = 1611)		
Age (years)	46.0 ± 1.5	45.8 ±1.2	42.1 ± 0.6	41.6 ± 0.4	< 0.001	NS
BMI (kg/m²)	26.2 ± 0.5	27.0 ± 0.5	27.4 ± 0.2	26.9 ± 0.1	NS	NS
Waist (cm)¶	91.1 ± 1.3	89.7 ± 1.0	97.1 ± 0.5	89.0 ± 0.3	< 0.01	< 0.001
SBP (mmHg)	136.7 ± 1.9	131.9 ± 1.6	132.7 ± 0.8	124.5 ± 0.5	< 0.001	< 0.001
DBP (mmHg)	79.5 ± 1.1	75.8 ± 0.9	78.1 ± 0.5	71.7 ± 0.3	< 0.01	< 0.001
FBG (mg/dL)†	102.4 ± 3.0	87.9 ± 2.4	92.2 ± 1.2	90.7 ± 0.8	< 0.01	< 0.001
TG (mg/dL)	125.3 ± 9.0	99.9 ± 7.2	170.0 ± 3.6	124.4 ± 2.4	< 0.001	< 0.001
HDL-C (mg/dL)	39.3 ± 1.3	43.7 ± 1.1	39.4 ± 0.5	46.1 ± 0.4	NS	< 0.001
TC (mg/dL)	199.3 ± 5.0	199.5 ± 4.0	161.0 ± 2.1	169.8 ± 1.4	< 0.001	< 0.001
Ins (μU/mL)	19.3 ± 3.4	25.8 ± 2.9	24.6 ± 1.7	22.9 ± 1.1	NS	NS

All data are expressed as means ± SE.
BMI = body mass index.   SBP = systolic blood pressure.   DBP = diastolic blood pressure.   FBG = fasting blood glucose.   TG = triglycerides.   HDL-C = high density lipoprotein cholesterol.   TC = total cholesterol. NS= not significant.   ¶ Significant interaction (p < 0.01) (higher in mixed Hispanic men than in black Hispanic men).   † Significant interaction (p < 0.01) (higher in black Hispanic men than in mixed Hispanic men).

ferences in body mass index (BMI) values were observed between race groups, with an overall combined frequency of overweight/obesity (i.e., BMI ≥ 25 kg/m²) of 60% for mixed Hispanics and 57.9% for black Hispanics. In women, the age-adjusted prevalence for abdominal obesity was higher in black (54.1%) than in mixed (44.5%) Hispanics, while the reverse was seen in men (33% in mixed compared to 19.2% in black Hispanics) (p < 0.05) (Table II).

Both systolic and diastolic blood pressure values were higher in black Hispanics than in mixed Hispanics, particularly in women. Furthermore, the prevalence of age-adjusted elevated blood pressure (BP) was significantly higher in black Hispanic men (66.9%) compared to mixed Hispanic men (52.3%) and similar racial differences were observed in women (39.3% in black vs. 30.4% in mixed Hispanics). In addition, the prevalence of age-adjusted low HDL-C in women was particularly higher in black Hispanics (71.8%) compared to mixed Hispanics (56.2%) but no differences were observed in men. In contrast, triglyceride levels were lower in black Hispanics compared to mixed Hispanics in both men (prevalence of high TG was 22.7% vs. 41.2%, respectively) and women (prevalence of high TG was 13.3% vs. 22.6%, respectively).

Black Hispanic men also showed a higher prevalence of age-adjusted fasting hyperglycemia (blood glucose ≥ 100 mg/dL) (32.7%) compared to mixed Hispanic men (22.3%) but racial differences in women were not evident (19.2% in black Hispanics vs. 16.3% in mixed Hispanics). Fasting blood glucose values 126 mg/dL and above (diabetic range) were present in 12.6% of the black Hispanic men and 3.7% black Hispanic women; 4.6% of mixed Hispanic men and 5.9% of mixed Hispanic women.

In order to determine if racial differences in the degree of insulin resistance (HOMA$_{IR}$) and/or beta cell function (HOMA$_{BC}$, as an indicator of defects of insulin secretion) contributed to the differences in the prevalence of fasting hyperglycemia, we performed the analysis in a subset of those individuals with fasting insulin values available and with fasting blood glucose values of 63 mg/dL and above (i.e., ≥ 3.5 mmol, based on restrictions in the formula for HOMA$_{BC}$ = 20 × fasting insulin (μU/mL)/ (fasting glucose [mmol]/L − 3.5). HOMA$_{IR}$ values were similar between black (6.04 ± 1.0) and mixed (6.08 ± 0.39) Hispanic women and also these values were not different in men (5.51 ± 1.18 in black Hispanics vs. 6.22 ± 0.58 in mixed Hispanics). For the analysis of HOMA$_{BC}$, values were compared in two strata: those with fasting blood glucose below 126 mg/dL and those in the diabetic range (≥126 mg/dL) (Fig. 1). As expected, lower HOMA$_{BC}$ values

TABLE II
AGE-ADJUSTED PREVALENCE OF METABOLIC ABNORMALITIES BY GENDER AND RACE

	Black Hispanics		Mixed Hispanics	
	Men (n = 114)	Women (n = 167)	Men (n = 725)	Women (n = 1611)
Large WC	19.2 (12.5-27.7)[a]	54.1 (46-61.6)	33 (29.5-36.5)	44.5 (42-46.9)
High TG	22.7 (15.5-31.6)	13.3 (8.4-19.3)	41.2 (37.6-44.9)	22.6 (20.6-24.7)
Low HDL-C	50.3 (40.5-59.5)	71.8 (64.4-78.5)	50.8 (47.1-54.5)	56.2 (53.7-58.6)
High BP	66.9 (57.2-75.2)	39.3 (31.5-46.8)	52.3 (48.6-56)	30.4 (28.1-32.7)
Elevated FBG	32.7 (24-41.9)	19.2 (13.5-26)	22.3 (19.2-25.4)	16.3 (14.5-18.2)

WC= waist circumference.   TG = triglycerides.   HDL-C = high density lipoprotein cholesterol.   BP = blood pressure.   FBG = fasting blood glucose.   [a] Percentage (95% confidence interval).

were observed in those with fasting blood glucose ≥ 126 mg/dL, with a non-significant trend to much lower values in black Hispanics (68.8 in men and 38.6 in women) compared to mixed Hispanics (195.5 in men and 231 in women).

Insulin levels were directly associated with waist circumference, systolic and diastolic BP, and TG levels and inversely related to HDL-C levels in mixed Hispanics (Table III); however these relationships were only evident with waist circumference and TG levels in black Hispanics.

Demographic and clinical factors associated with each metabolic abnormality are display in Table IV. Black Hispanic race was

independently associated with hypertension, fasting hyperglycemia, and low HDL-C even after adjusting for other risk factors such as age 45 years and older, male gender, the presence of overweight/obesity, and a sedentary lifestyle. In contrast, abdominal obesity was predominantly associated to female gender after accounting for age older than 45, family history of obesity, and sedentary lifestyle.

DISCUSSION

This study shows that in apparently healthy Venezuelans, without prior history of diabetes and/or cardiovascular disease,
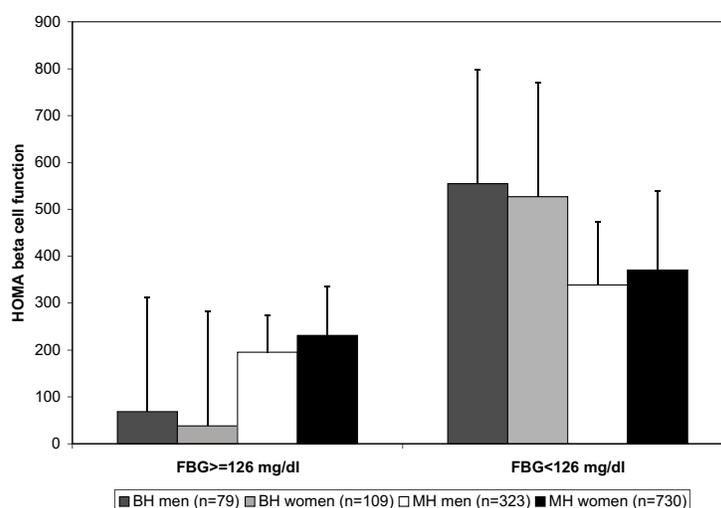
(p = 0.02 for difference between those with FBG   126 mg/dL and those with FBG < 126 mg/dL)

Fig. 1. HOMA beta cell function values according to race, gender and degree of fasting hyperglycemia; FBG = fasting blood glucose, BH = Black Hispanics, MH = Mixed Hispanics.

TABLE III
RELATIONSHIP OF FASTING LOG-INSULIN WITH METABOLIC PARAMETERS IN BLACK AND MIXED HISPANICS

	Black Hispanics		Mixed Hispanics	
Waist circumference	r = 0.37[a]	p < 0.0001	r = 0.25	p < 0.0001
Systolic blood pressure	r = 0.06	p = 0.38	r = 0.08	p < 0.007
Diastolic blood pressure	r = 0.05	p = 0.44	r = 0.08	p < 0.006
Triglycerides	r = 0.15	p = 0.04	r = 0.27	p < 0.0001
HDL cholesterol	r = – 0.13	p = 0.06	r = – 0.12	p < 0.001

[a]Pearson correlation coefficient.

TABLE IV
RISK FACTORS FOR SPECIFIC METABOLIC ABNORMALITIES IN ALL STUDY SUBJECTS

	High BP	Large WC	Elevated FBG	High TG	Low HDL-C
Male sex	2.67 (2.20-3.26)[a]	0.37 (0.29-0.46)	1.49 (1.09-2.04)	2.34 (1.93-2.86)	0.71 (0.60-0.85)
Age > 45y	4.46 (3.69-5.38)	2.07 (1.66-2.56)	3.32 (2.43-4.54)	1.58 (1.31-1.92)	0.68 (0.66-0.93)
Black race	1.99 (1.47-2.69)	1.14 (0.81-1.62)	1.65 (1.08-2.53)	0.58 (0.41-0.81)	1.49 (1.13-1.98)
FmHTN	1.39 (1.14-1.71)	0.95 (0.75-1.19)	0.85 (0.61-1.19)	0.87 (0.71-1.07)	0.94 (0.78-1.13)
FmDM	0.79 (0.64-0.96)	1.04 (0.83-1.31)	1.25 (0.90-1.74)	1.31 (1.07-1.61)	1.02 (0.86-1.23)
FmOB	0.97 (0.79-1.19)	1.51 (1.20-1.90)	1.29 (0.93-1.80)	1.01 (0.82-1.25)	1.00 (0.83-1.21)
Sedentary lifestyle	1.06 (0.84-1.33)	1.83 (1.41-2.38)	1.75 (1.12-2.71)	1.51 (1.17-1.92)	1.26 (1.02-1.55)
Obesity	1.94 (1.59-2.35)	21.3 (16.4-27.7)	1.35 (0.97-1.88)	2.59 (2.10-3.20)	1.55 (1.31-1.85)

BP= blood pressure.   WC = waist circumference.   FBG= fasting blood glucose.   TG = triglycerides. HDL-C = high-density lipoprotein cholesterol.   FmHTN = family history of hypertension.   FmDM = family history of diabetes, FmOB = family history of obesity.
[a]Odds ratio (95% confidence interval). Logistic regression analysis was done using each metabolic abnormality as the independent variable. The odds ratio was determined after adjusting for the variables shown on the first column.

black Hispanics have worse cardiovascular profile than mixed Hispanics. In women, low HDL-C, hypertension, and abdominal obesity were more frequently found in black Hispanics than in mixed Hispanics; while in men, the presence of hypertension and elevated fasting blood glucose was more common in black Hispanics than in mixed Hispanics.

The higher frequency of low HDL-C values is consistent with previous studies in the Venezuelan population (17, 18). This metabolic abnormality was particularly common among black Hispanic women despite the lower frequency of hypertriglyceridemia found in this group. Obesity and sedentary lifestyle also seemed to be important risk factors for low HDL-C.

Hypertriglyceridemia is an independent risk factor for cardiovascular disease (19, 20). This metabolic abnormality is associated with low HDL-C, small-dense LDL particles, a pro-coagulant state, high blood pressure and insulin resistance. Our finding of racial differences in TG levels is consistent with previous reports showing that TG levels are lower in African Americans than in non-Hispanics whites, regardless of gender and prior coronary heart disease. (20). The lower prevalence of hypertriglyceridemia in African Americans may be related to a different threshold at which this metabolic abnormality may contribute to cardiovascular risk (21) or to racial differences in the frequency of genetic abnormalities and activities of key enzymes in the lipid metabolism, such as hepatic lipase (22), or lower levels of apolipoprotein C-III (23).

More than 50% of the black Hispanic women have abdominal obesity, and risk factors such as age, family history of obesity, and sedentary lifestyle were significantly associated with this metabolic abnormality. Sanchez-Johnsen *et al.* (24) examined three potential correlates of obesity (dietary intake, body image and physical activity) in a study of Latin American and black non-Hispanic women. A combined effect of a high-caloric and high-fat diet, with increased sedentary lifestyle, and self-acceptance of body image accounted for higher rates of obesity among black women. A low cardiovascular fitness in African-Americans may be responsible for the cluster of metabolic abnormalities associated with obesity and insulin resistance in this race group (25); however there is scarcity of data on the impact of low physical activity in black Hispanics. In our study 87.8% of black Hispanic women and 75.2% of black Hispanic men reported a sedentary lifestyle, while in mixed Hispanics the frequency of sedentary lifestyle were 82.7 % and 73% for women and men, respectively.

Elevated blood pressure was more common in black Hispanics than in mixed Hispanics, even after accounting for differences by age, gender, obesity, and family history of hypertension. This is consistent with a previous report in the United States population, using the same criteria for elevated blood pressure (3). Differences in the frequency of genetic abnormalities may be responsible for race differences in hypertension. For instance, there are reports that the apo $\varepsilon 4$ allele is associated with higher frequency of hypertension (26). Several epidemiological and clinical studies have reported significant relationship between insulin and blood pressure (27-31), and other studies have shown racial differences in this relationship particularly in African Americans (5). In a study in non-obese Hispanic subjects, without family history of diabetes or hypertension, we previously reported that fasting insulin correlated with blood pressure (32). In the present study, we only found a weak relationship in overweight/obese in mixed Hispanics; and probably the smaller sample of black Hispanics evaluated explain why this relationship was not evident in this group.

Higher frequency of fasting hyperglycemia was found in black Hispanic men, which is consistent with prior reports of more glucose intolerance in African Americans and therefore higher risk for diabetes in this group than in white non-Hispanics (33). We found a significant proportion of black Hispanic men (12.6%) and women (3.7%) with fasting blood glucose in the diabetic range in this population of apparently healthy subjects. Even though we did not find significant differences in $HOMA_{BC}$ values when we stratified using the cutoff of FBG 126 mg/dL, there was a trend to lower beta cell function in black Hispanic men and women with blood glucose in the diabetic range. Future studies of beta cell function in black Hispanics to assess the changes of insulin and glucose values during an oral glucose tolerance test will provide a better answer to this observation. A recent report by Osei *et al.* (34) showed that non-diabetic, first-degree relatives of African American patients with type 2 diabetes have a rapid progression to impaired glucose tolerance and diabetes if they have lower beta cell function ($HOMA_{BC}$) at baseline.

In summary, this study shows that Venezuelan black Hispanics have a worse cardiovascular risk profile than the predominant mixed Hispanic population with higher prevalence of hypertension, low HDL-cholesterol, fasting hyperglycemia, and abdominal obesity. Differences in lifestyle and genetic risk factors may be responsible for the higher frequency of metabolic abnormalities in this population of black Hispanics. Identification and intervention of these ab-

normalities may be important in the implementation of strategies for the prevention of diabetes and cardiovascular disease in Venezuela.

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