Prevalence of the Metabolic Syndrome in Jamaican Adults and its Relationship to Income and Education Levels

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ABSTRACT

Objective: *To estimate the prevalence of the metabolic syndrome in Jamaican adults and to evaluate its association with socio-economic status (SES).*

Methods: *A cross-sectional analysis was performed using data from a cohort study of persons, 25–74 years old, living in St Catherine, Jamaica, and who were evaluated between 1993 and 2001. Participants completed an interviewer administered questionnaire and had blood pressure and anthropometric measurements performed by trained observers. Venous blood was collected for measurement of fasting glucose and lipids. The metabolic syndrome was defined using the International Diabetes Federation (IDF) and American Heart Association/National Heart Lung and Blood Institute (AHA/NHLBI) criteria. Income and education were used as markers of SES.*

Results: *Data from 1870 participants (717 males 1153 females) were analysed. Prevalence of the metabolic syndrome was 21.1% (95% CI 19.2, 22.9%) using IDF criteria and 18.4% (95% CI 16.6, 20.2%) using the AHA/NHLBI criteria. Prevalence was higher among females (27.6% [IDF], 23.0% [AHA]) compared to males (10.6% [IDF], 11.0% [AHA]). The prevalence of the metabolic syndrome increased with age. Compared to males with primary/lower education, those with secondary and tertiary education had higher odds of having the metabolic syndrome after adjusting for age; odds ratio 3.12 (1.54, 6.34) and 2.61 (1.33, 5.11) respectively. High income was also associated with increased odds of having the metabolic syndrome among males, OR = 6.0 (2.22, 16.19) adjusting for age-group. There were no significant associations among women.*

Conclusion: *The metabolic syndrome is common in Jamaica. Clinicians should look for this syndrome in their patients and take steps to treat the abnormalities identified.*

Keywords: Blacks, Caribbean, Jamaica, metabolic syndrome, socioeconomic status

Prevalencia del Síndrome Metabólico en los Adultos Jamaicanos y Relación del Síndrome con los Ingresos y el Nivel de Educación

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RESUMEN

Objetivo: *Estimar la prevalencia del síndrome metabólico en los adultos jamaicanos, y evaluar su asociación con el nivel socioeconómico (NSE).*

Métodos: *Se realizó un análisis transversal usando datos de un estudio de cohorte de personas de 25–74 años de edad en Saint Catherine, Jamaica, evaluadas entre 1993 y 2001. Los participantes respondieron una encuesta administrada por el entrevistador. Asimismo, les fueron hechas mediciones antropométricas y mediciones de la presión arteria, por observadores entrenados. Se tomaron muestras de sangre venosa para medir la glucosa en ayunas y los lípidos. El síndrome metabólico fue definido usando criterios de la Federación Internacional de Diabetes (FID) y la Asociación Americana del Corazón y el Instituto Nacional del Corazón, los Pulmones y la Sangre (AHA/NHLBI, en inglés). Los ingresos y la educación se usaron como marcadores del NSE.*

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Resultados: *Se analizaron los datos de 1870 participantes (717 varones y 1153 hembras). La prevalencia del síndrome metabólico fue 21.1% (95% CI 19.2, 22.9%) usando criterios de la FID y 18.4% (95% CI 16.6, 20.2%) usando los criterios de AHA/NHLBI. La prevalencia fue mayor entre las hembras (27.6% [FID], 23.0% [AHA]) en comparación con los varones (10.6% [FID], 11.0% [AHA]). La prevalencia del síndrome metabólico aumentó con la edad. En comparación con los varones con educación primaria/inferior, aquéllos con educación secundaria y terciaria tenían mayor probabilidad de presentar el síndrome metabólico después del ajuste por edad; el cociente de probabilidades (odds ratio) fue 3.12 (1.54, 6.34) y 2.61 (1.33, 5.11) respectivamente. El ingreso alto estuvo también asociado con mayores probabilidades de síndrome metabólico entre los varones, OR = 6.0 (2.22, 16.19) con ajuste por grupo etario. No hubo asociaciones significativas entre las mujeres.*

Conclusión: *El síndrome metabólico es común en Jamaica. Los clínicos deben buscar este síndrome en sus pacientes y dar pasos a fin de tratar las anormalidades identificadas.*

Palabras claves: negros, Caribe, Jamaica, síndrome metabólico, nivel socio-económico

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INTRODUCTION

The metabolic syndrome is *"...a constellation of interrelated risk factors of metabolic origin that appear to directly promote the development of atherosclerotic cardiovascular disease" (1)*. The syndrome has emerged as an important clinical entity over the last two decades following Raeven's description of 'Syndrome X' in 1988 (2). The specific components of the metabolic syndrome include: glucose intolerance, insulin resistance, central obesity, elevated triglycerides, low levels of high density lipoprotein cholesterol and elevated blood pressure (3). The conditions occur together more frequently than expected by chance and when grouped together they result in an increased risk for cardiovascular disease and diabetes mellitus (3–5). In addition, there appears to be a common underlying pathophysiological mechanism *ie* insulin resistance (3). Despite some controversy regarding its clinical usefulness, several organizations have endorsed its use and have published guidelines for establishing the diagnosis. These include: The World Health organization (WHO), The International Diabetes Federation (IDF) The American Heart Association/National Heart Lung and Blood Institute (AHA/NHLBI) and the American Association of Clinical Endocrinologists (AACE) (1; 6–8).

Several studies have reported estimates of the prevalence of the metabolic syndrome in various populations (9–13). It is however difficult to compare these prevalence estimates because the various studies have used different definitions of the metabolic syndrome and the diagnostic concordance between the various criteria may be as low as 30% (14). Additionally, there is significant heterogeneity between studies with respect to age distribution, sample selection and period of study. Worldwide prevalence estimates in men range from 8% (India) to 24% (United States of America) and for women from 7% (France) to 46% (India) (9). Prevalence estimates varied with age and ethnicity (11, 13).

There are very little published data on the prevalence of the metabolic syndrome in the English-speaking Caribbean. In one study from Trinidad and Tobago, 32% of first year medical students 18–23 years old had at least one metabolic syndrome component, however, the overall metabolic syndrome prevalence was not reported (15). In another study, metabolic syndrome prevalence among diabetic patients in Trinidad and Tobago using IDF criteria, was 66% in Trinidad and 72% in Tobago (16).

The role of socio-economic status in cardiovascular disease epidemiology has been well established (17). In developed countries, most studies report an inverse relationship between socio-economic status and cardiovascular disease; however, the relationship is not as consistent in low and middle income countries, with some studies showing a positive relationship and others a non-linear association (18;19). Research into the impact of socio-economic status on the metabolic syndrome is not yet advanced, although studies have reported associations between the prevalence of the metabolic syndrome and socio-economic status (20–22). There appears to be an inverse relationship between socio-economic status and prevalence of the metabolic syndrome with a stronger association for women compared to men (20, 21, 23–25).

The aim of this study is to estimate the prevalence of the metabolic syndrome in Jamaican adults, using the IDF and AHA/NHLBI criteria and to evaluate the association of this condition with indicators of socio-economic status.

SUBJECTS AND METHODS

This was a cross-sectional analysis of data from an ongoing cohort study in Spanish Town, Jamaica. This study was initiated in 1993 as part of an international study of hypertension, diabetes and chronic disease in people of African ancestry (26–28). A stratified sample of men and non-pregnant women between ages 25–74 years were recruited by

door to door solicitation of eligible residents. Two thousand and six hundred and fifty-four (2654) persons were evaluated between 1993 and January 2001. The protocol for the study was reviewed and approved by the Ethics Committee of the Faculty of Medical Sciences, The University of the West Indies/University Hospital of the West Indies, Jamaica.

Participants completed an interviewer administered questionnaire covering personal, medical, social and family history. Blood pressure (BP) was measured with a mercury sphygmomanometer to the nearest 2 mmHg using the first (systolic) and fifth (diastolic) Korotkoff phases. Three measurements were taken at 1-minute intervals in the sitting position after the participant had been sitting for five minutes. The mean of the last two readings was used for the analysis (26). Hypertension was defined as self-reported current use of hypertensive medication or mean systolic blood pressure (SBP) 140 mmHg or diastolic blood pressure (DBP) 90 mmHg. Anthropometric measurements were made without shoes and wearing only light clothing. Waist circumference was measured at the smallest horizontal circumference between the ribs and the iliac crest, and hip circumference at the point of maximal extension of the buttocks. All measurements were obtained by trained personnel using standardized procedures (26). Venous blood was collected for fasting and 2-hour post challenge plasma glucose measurements. Total cholesterol, triglycerides and high density lipoprotein cholesterol (HDL) were also measured on the fasting sample.

Presence of the metabolic syndrome was defined using the IDF and AHA/NHLBI criteria. Both criteria used five components namely central obesity, elevated fasting glucose (≥ 5.6 mmol/l), raised triglyceride levels (> 1.7 mmol/l), reduced HDL cholesterol (< 1.03 in men, < 1.29 in women) and elevated blood pressure (≥ 130/85 mmHg). The IDF designated central obesity as a required component and chose ethnic specific cut-points. The cut-points for persons of European descent (94cm for males and 80cm for females) were used for our analyses as recommended by the IDF (7). The presence of central obesity plus any two of the other components was required for diagnosis. The AHA criteria do not designate any component as required thus the diagnosis can be made with the presence of any three of the 5 criteria. The AHA/NHLBI used a cut-point for central obesity of > 102 cm in men and > 88 cm in women.

Socio-economic status was assessed using data obtained from the questionnaire. Data were collected on the highest level of education obtained and participants were grouped into three categories: primary or lower, secondary and post-secondary or tertiary. Total monthly household income was collected in categories using Jamaican dollars and grouped into four categories: J$ 1000 or less, J$ 1001 – J$ 6000, > J$ 6000; persons who did not provide income data were placed in a separate category termed “not reported”.

Statistical Analysis

Statistical analyses were performed using Stata 9.2 (29). Prevalence estimates for the metabolic syndrome by the IDF and AHA/NHLBI criteria and each of the components of the syndrome were calculated for each age group and both genders. Data analysis also yielded prevalence estimates for the various metabolic syndrome components within socio-economic status (SES) groups determined using education and income. Differences in proportions for categorical variables were compared using chi-squared tests. Multivariate logistic regression was used to quantify the relative odds of metabolic syndrome due to given SES as well as determine evidence of interaction between gender and SES on the outcome variable. Odds ratios and the 95% CI for the presence of the metabolic syndrome and each of its individual components were obtained separately for each of the two socio-economic status indicators adjusting for age-group and gender. Gender specific OR were presented because analyses revealed significant interaction by gender for the relationship between SES and the metabolic syndrome.

RESULTS

Of a total of 2654 participants, data from 1870 participants (717 males and 1153 females) who had complete data on the metabolic syndrome and SES variables of interest were analysed. There were no differences in the mean values of the basic characteristics of those excluded from the analysis compared to those included, except for a lower mean waist circumference in those excluded (81.9cm and 83.7cm, p = 0.001).

Summary statistics for the participants are shown in Table 1. The mean age of the sample was 46.6 ± 13.6 years.

Table 1: Characteristics of study participants with and across sex groups

	Total N = 1870	**Male N = 717**	**Female N = 1153**	
	Mean ± SD			P-value
Age	46.6 ± 13.6	47.2 ± 14.2	46.1 ±13.2	0.092
WC	83.7 ± 12.7	82.5 ± 12.2	84.4 ± 12.9	0.001
SBP	120.5 ± 20.8	122.2 ± 20.6	119.5 ± 21.0	0.007
DBP	69.4 ± 13.8	70.2 ± 14.4	68.9 ± 13.5	0.048
FBS	5.54 ± 2.29	5.44 ± 2.03	5.61 ± 2.44	0.106
TG	0.99 ± 0.61	1.02 ± 0.70	0.97 ± 0.57	0.043
HDL	1.26 ± 0.43	1.23 ± 0.34	1.29 ± 0.48	< 0.001
Education		**Percentage** ± SE		
Primary or Lower	60.7 ± 1.1	61.2 ± 1.8	60.4 ± 1.4	
Secondary	24.3 ± 1.0	24.1 ± 1.6	24.5 ± 1.3	NS
Tertiary	19.9 ± 0.8	14.6 ± 1.3	15.1 ± 1.1	
Income		**Percentage** ± SE		
J$ 1000 or less	21.0 ± 0.9	14.6 ± 1.3	24.9 ± 1.3	
J$ 1001–6000	34.7 ± 1.1	30.1 ± 1.7	37.5 ± 1.4	< 0.001
J$ > 6000	20.0 ± 0.9	32.8 ± 1.7	12.1 ± 0.9	
Not Reported	24.3 ± 1.0	22.5 ± 1.6	25.6 ± 1.3	

SD = standard deviation, SE = standard error, WC = waist circumference, SBP = systolic blood pressure, DBP = diastolic blood pressure, FBS = fasting blood sugar, TG = triglycerides, HDL = high density lipoprotein cholesterol

Men had higher mean systolic blood pressure, diastolic blood pressure and triglycerides, while women had higher mean waist circumference and high density lipoprotein cholesterol (HDL). There were no significant gender differences in mean fasting glucose. Twenty per cent of participants had completed tertiary education, 24% had completed secondary education and 61% completed only primary education. There were no gender differences in the distribution of educational attainment. Twenty-four per cent of participants did not report their income. Overall more men were more likely to have high or middle income than women.

Table 2 shows the prevalence estimates for the metabolic syndrome and its individual components using the IDF and AHA/NHLBI criteria for males, females and the combined groups. The overall prevalence of the metabolic syndrome was 21.1% (95% CI 19.2%, 22.9%) using IDF criteria and 18.4% (95% CI 16.6%, 20.2%) using the AHA/NHLBI criteria. The prevalence was higher among females compared to males using both criteria. Using the IDF criteria, prevalence among females was 27.6% compared to 10.6% among males, $p < 0.001$. A similar pattern was seen with the AHA/NHLBI criteria 23.0% among females, 11.0% among males, $p < 0.001$. For the individual components, the most common abnormalities were central obesity (45.8% using IDF criteria) and low HDL (45.7%). Approximately 33% had elevated blood pressure, 26% had elevated fasting glucose and 9% had high triglycerides. Females had significantly higher prevalence of central obesity and low HDL when compared to males. Using the IDF criteria, 61.8% of females were centrally obese compared to 20.2% of males, $p < 0.001$ while 58.6% of females had low HDL compared to 24.8% of males, $p < 0.001$. Males had higher prevalence of elevated triglycerides, 11.1%, compared to 8.0% among females, $p = 0.025$. There were no significant gender differences in the prevalence of elevated glucose and elevated blood pressure.

Table 2: Prevalence estimates (in percentages, with 95% CI below) of the metabolic syndrome and its components within and across sex groups in Jamaican adults

Variable	Prevalence Estimates (95% CI)			P value (male: female difference)
	Total	Male	Female	
Overall Metabolic Syndrome				
Metabolic Syndrome (IDF)	21.1 (19.2 – 22.9)	10.6 (8.3 – 12.9)	27.6 (25.0 – 30.2)	< 0.001
Metabolic Syndrome (AHA)	18.4 (16.6 – 20.2)	11.0 (8.7 – 13.3)	23.0 (20.6 – 25.4)	< 0.001
Metabolic Syndrome Components				
WC – IDF	45.8 (43.6 – 48.1)	20.2 (17.3 – 23.2)	61.8 (58.9 – 64.6)	< 0.001
WC – AHA	26.1 (24.2 – 28.1)	7.1 (5.2 – 9.0)	38.0 (35.2 – 40.8)	< 0.001
Low HDL	45.7 (43.4 – 47.9)	24.8 (21.7 – 61.5)	58.6 (55.9 – 61.5)	< 0.001
High BP	32.9 (30.8 – 35.0)	32.3 (28.9 – 35.8)	33.2 (30.5 – 35.9)	0.700
High FBS	25.5 (23.5 – 27.5)	24.4 (21.3 – 27.6)	26.2 (23.7 – 28.7)	0.389
High TG	9.3 (7.9 – 10.6)	11.1 (8.9 – 13.5)	8.0 (6.5 – 9.6)	0.025

IDF = International Diabetes Federation, AHA = American Heart Association, CI = Confidence interval

As shown in Fig. 1, the prevalence of the metabolic syndrome increased with age for both males and females using both criteria, p(trend) < 0.001 in all tests. Among males, prevalence ranged from 1.8% among persons 25–34 years old to 19.0% among persons 55–64 years old using the IDF criteria, while among females prevalence ranged from 11.0% among those 25–34 years old to 48.9% among those 55–64 years old. Similar patterns were seen when the AHA/NHLBI criteria were used.

Fig. 2 (panels A–D) shows the association between the prevalence of the metabolic syndrome and levels of income and education for males and females separately. Among males, there was a higher prevalence of the metabolic syndrome among those with higher education but the association was not statistically significant. For income, however, prevalence of the metabolic syndrome was 4.8% among those with low income compared to 18.8% among those with high income ($p < 0.001$) using IDF criteria. A statistically significant association ($p = 0.024$) was also seen when AHA/NHLBI criteria were used. Among females, prevalence of the metabolic syndrome was highest among those with primary education and lowest among those with secondary education with evidence of a statistically significant association using both criteria ($p < 0.001$). For income, prevalence of the metabolic syndrome was highest among those who did not report income and lowest among those with middle income ($p < 0.001$). The findings were similar for both the IDF and AHA/NHLBI criteria.

The association between the individual components of the metabolic syndrome and levels of income and education among males are shown in Table 3A. There were significant associations between educational level and elevated blood pressure and glucose. Both elevated blood pressure and elevated glucose were highest among men with primary education only and lowest among those with secondary education. Central obesity (high waist circumference) was significantly associated with income but not education although prevalence of central obesity was noticeably higher among those with post-secondary education relative to the other (education) categories. Using the IDF criteria, prevalence of central obesity was 9.5% among those in the low income category compared to 32.8% among the high income category ($p < 0.001$). When the AHA/NHLBI criteria were used prevalence of central obesity was 6.7% among the low income

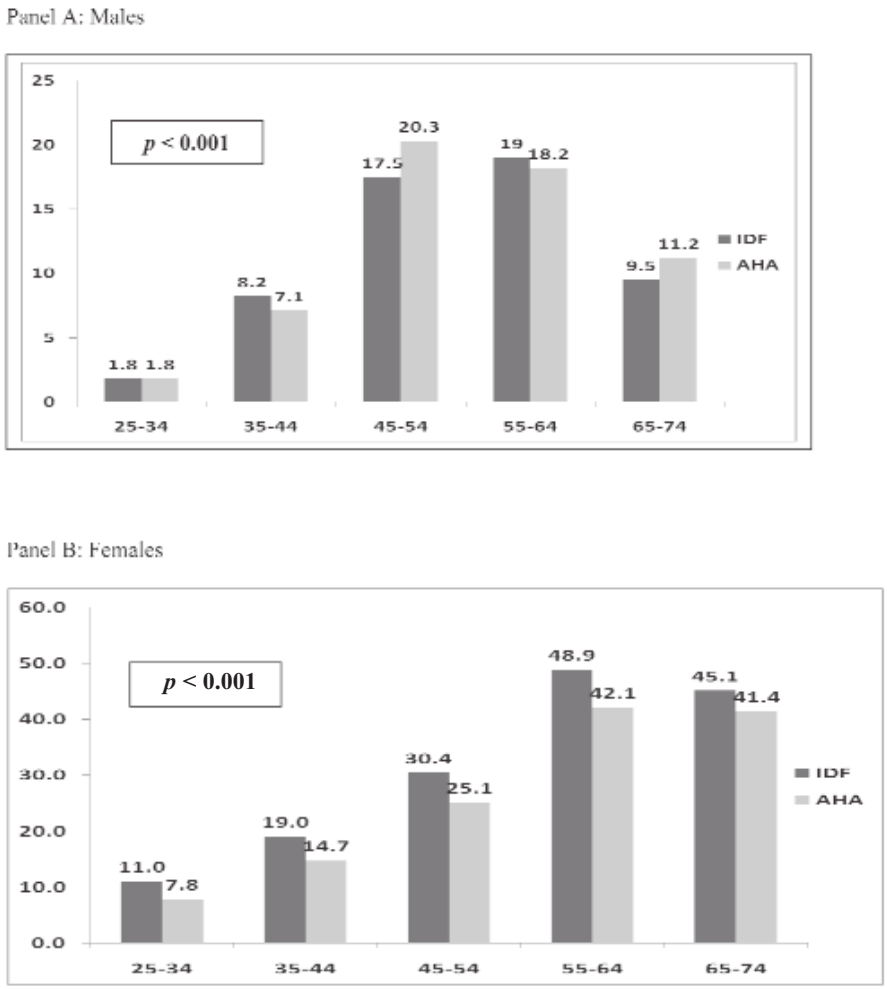

Fig. 1: Prevalence estimates for the metabolic syndrome by age group and gender among Jamaican adults

AHA = American Heart Association
IDF = International Diabetes Federation

group, 4.2% in the middle income group and 12.4% in the high income group ($p = 0.002$).

Table 3b shows the associations between individual components of the metabolic syndrome and levels of income and education for women. As seen with the men, there were significant associations between education level and elevated blood pressure and glucose. Again the prevalence of elevated blood pressure and glucose was highest among those with primary education only and lowest among those with secondary education ($p < 0.001$). When income was used as the measure of SES, similar patterns were seen. For central obesity, however, prevalence was highest among those with high income or who did not report their income but this did not reach statistical significance.

In Tables 4 and 5, crude and adjusted odds ratios (OR) derived from logistic regression models for the association between the overall metabolic syndrome prevalence and levels of income and education are presented. Gender significantly modified the effect of SES on the odds of metabolic syndrome so we report gender-specific odds ratios adjusted for 10-year age groups. Separate models were used for metabolic syndrome as defined by the IDF and AHA/NHLBI criteria and for education and income. Primary education and low income were used as reference categories. Among males, the crude odds ratio for secondary and post-secondary education was 1.1 and 1.7, respectively (Table 4). After adjustment for age group, the odds of having the metabolic syndrome was significantly higher among those with both secondary (OR = 3.12, $p = 0.002$) and post secondary (OR = 2.61, $p = 0.005$) education. High income was associated with a six-fold increase in the odds of the metabolic syndrome (OR=6.0, $p < 0.001$); however, the OR for the middle income

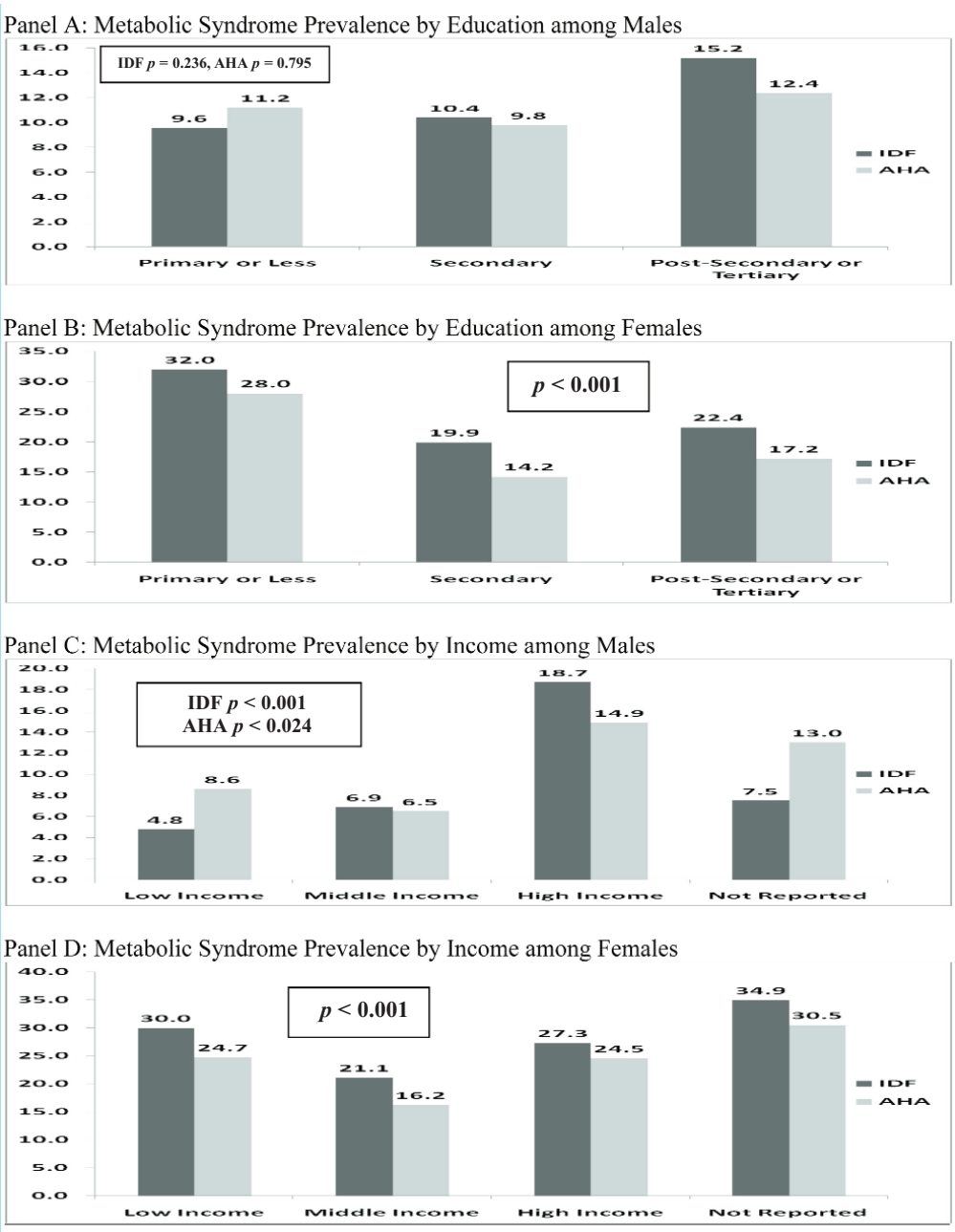

Fig. 2: Unadjusted prevalence of metabolic syndrome by socio-economic status groups

AHA = American Heart Association, IDF = International Diabetes Federation

category did not reach statistical significance (Table 5). Among females, odds for the metabolic syndrome was lower among those with higher income and education in the crude analyses but these associations were reversed and no longer significant after adjustment for age-group.

DISCUSSION

In this study, we report prevalence estimates of the metabolic syndrome in Jamaican adults for the first time. The metabolic syndrome was found to be relatively common with overall prevalence of 21% using IDF criteria and 18% using the AHA/NHLBI criteria. The prevalence of central obesity and low HDL were very high, particularly among females (62% and 59%, respectively). Females had a greater burden of both the metabolic syndrome and its individual components, except for high triglycerides. Prevalence of the metabolic syndrome was associated with markers of SES among men, being more likely among men with secondary or post-secondary education and among men in the higher income categories.

Table 3a: Prevalence (percentage) of metabolic syndrome components with income and education categories in Jamaican males

	EDUCATION			
	Primary or less	Secondary	Post-secondary	P-value Association
	N = 439	N = 173	N = 105	
WC – IDF	18.5	21.4	25.7	0.227
WC – AHA	6.8	6.9	8.6	0.820
High – BP	36.7	20.8	33.3	0.001
High Glucose	28.0	17.3	21.0	0.015
High – TG	9.1	13.3	16.2	0.069
Low – HDL	21.0	27.2	28.6	0.354

	INCOME				
	Low Income	Middle Income	High Income	Not Reported	P-value Association
	N = 105	N = 216	N = 235	N = 161	
WC – IDF	9.5	14.8	32.8	16.2	< 0.001
WC – AHA	6.7	4.2	12.4	3.7	0.002
High – BP	38.1	27.8	33.2	33.5	0.281
High Glucose	22.9	22.2	27.7	23.6	0.552
High – TG	6.7	8.3	14.0	13.7	0.076
Low – HDL	24.8	21.8	28.9	23.0	0.320

WC = waist circumference, BP = blood pressure, TG = triglycerides, HDL = high density lipoprotein cholesterol

Table 3b: Prevalence (percentage) of metabolic syndrome components with income and education categories in Jamaican females

	EDUCATION			
	Primary	Secondary	Post-secondary	P-value Association
	N = 697	N = 282	N = 174	
WC – IDF	62.6	62.1	58.1	0.545
WC – AHA	39.9	34.0	36.8	0.219
High – BP	41.9	16.3	25.9	< 0.001
High Glucose	31.3	17.0	20.7	< 0.001
High – TG	8.8	5.3	9.8	0.136
Low – HDL	56.5	63.1	59.8	0.157

	INCOME				
	Low Income	Middle Income	High Income	Not Reported	P-value Association
	N = 287	N = 432	N = 139	N = 295	
WC – IDF	57.1	60.4	64.8	66.8	0.086
WC – AHA	34.8	35.4	42.4	42.7	0.094
High – BP	41.1	26.6	32.3	35.6	0.001
High Glucose	31.0	20.1	23.0	31.9	0.001
High – TG	7.0	4.6	9.4	13.6	< 0.001
Low – HDL	56.1	56.7	61.9	62.4	0.293

WC = waist circumference, BP = blood pressure, TG = triglycerides, HDL = high density lipoprotein cholesterol

Table 4: Odds ratios for association of metabolic syndrome (IDF) with education category among male and female study participants

	MALES (N = 717)		
	Crude OR (95% CI)	Adjusted OR* (95% CI)	P-value (Adjusted OR)
Primary	1.0	1.0	
Secondary	1.10 (0.61 – 1.97)	3.12 (1.54 – 6.34)	0.002
Post-Secondary	1.70 (0.91–3.15)	2.61 (1.33–5.11)	0.005

	FEMALES (N = 1153)		
	Crude OR (95% CI)	Adjusted OR* (95% CI)	P-value (Adjusted OR)
Primary	1.0	1.0	
Secondary	0.53 (0.38–0.73)	1.32 (0.88–1.97)	0.182
Post-Secondary	0.61 (0.42–0.91)	1.10 (0.72–1.71)	0.654

OR = odds ratio, CI = confidence interval * Estimates adjusted for 10-year age groups.

Table 5: Odds ratios for association of metabolic syndrome (IDF) with income category for males and females

	MALES (N = 717)		
	Crude OR (95% CI)	Adjusted OR* (95% CI)	P-value (Adjusted OR)
Low Income	1.0	1.0	
Middle Income	1.49 (0.53–4.22)	1.85 (0.64–5.37)	0.259
High Income	4.61 (1.77–11.99)	6.0 (2.22–16.19)	<0.001
Not Reported	1.61 (0.55–4.71)	2.0 (0.67–6.04)	0.214

	FEMALES (N = 1153)		
	Crude OR (95% CI)	Adjusted OR* (95% CI)	P-value (Adjusted OR)
Low Income	1.0	1.0	
Middle Income	0.62 (0.44–0.87)	0.79 (0.55–1.13)	0.198
High Income	0.88 (0.56–1.38)	1.21 (0.75–1.97)	0.422
Not Reported	1.25 (0.89–1.77)	1.41 (0.98–2.05)	0.064

OR = odds ratio, CI = confidence interval * Estimates adjusted for 10-year age groups.

The estimated prevalence of the metabolic syndrome found in this study is somewhat lower than the reported prevalence of about 25% in the Americas, Europe and India (30). The estimated prevalence was also slightly lower than that seen in the African American, 21.6% using NCEP/ATP III criteria (11) compared to 18.4% using the AHA/NHLBI criteria in the present study. The difference was even more marked among men with prevalence in African Americans of 16.4% (11) compared to 11% in this study. The prevalence in the present study was however markedly higher than that reported in Africans in the Cameroon (10). Using the IDF criteria, prevalence of the metabolic syndrome was 1.5% and 1.2% among urban women and men respectively; while among the rural population, prevalence was 0.3% among women and was not found in men. When the NCEP-ATP III criteria were used, the prevalence was 0.2% among urban women and 0.5% among urban men and was not seen in rural men or women (10). The increasing prevalence of the metabolic syndrome as one move westward from Africans in the Cameroon to Afro-Caribbeans in Jamaica to African Americans in the USA suggests the significant role of environmental factors in modifying the risk for the metabolic syndrome. A similar phenomenon has been demonstrated with hypertension and obesity (27, 31), suggesting an important role for gene-environment interaction in cardiovascular disease risk.

The association between socio-economic status and obesity found in the present study is noteworthy. While some studies in developed countries found an inverse association between socio-economic status and metabolic syndrome (20 21), this study found that the metabolic syndrome prevalence was positively associated with higher education and income among men after adjusting for age but was not associated with SES among women. This pattern of different associations with SES according to gender groups has been reported elsewhere. In a study from France, the metabolic syndrome was associated with education, occupation and working status in both men and women, but income was inversely associated with the metabolic syndrome in women only (21). Gender differences have also been reported from Korea, with inverse associations seen in women but not in men (23, 25). Similarly, in the United States of America, the metabolic syndrome showed a significant inverse associated with education and 'poverty income ratio' in women but showed no significant associations in men (24). This finding may also reflect Jamaica's stage in the epidemiological transition where cardiovascular disease is associated with affluence during the phase of increasing mortality but with poverty during the phase of decreasing mortality (17, 18).

This study has a number of strengths. Firstly, the study was population based and the sample was selected to be representative of the urban Jamaican population. This makes the findings generalizable to urban Jamaica. Secondly, measurement procedures were standardized (26), thus minimising the possibility of measurement errors. Thirdly, the prevalence estimates of the metabolic syndrome were made using two established international criteria thus allowing for easy comparison with other studies.

There were also some limitations to the study. Firstly, a number of participants had missing values for some of the variables of interest and thus were excluded from the analysis. However, there were no significant differences in the mean values of the variables studied except for waist circumference which was slightly lower in those with missing data. Although this may introduce a possible overestimate of the metabolic syndrome prevalence, the overall effect is likely to be very small. Secondly, the cross-sectional nature of the analysis prohibits any causal inference regarding the association between the metabolic syndrome prevalence and measures of SES.

This report will provide the first population based estimates of the prevalence of the metabolic syndrome among adults in the English-speaking Caribbean and thus will allow for comparison with other countries at a similar stage of development.

In conclusion, the metabolic syndrome is common in Jamaica. Low HDL cholesterol and central obesity are the most common abnormalities. The inconsistent relationships with markers of SES may be a reflection of the stage of economic development and the epidemiological transition. Clinicians should look for this clustering of CVD risk factors in their patients and take steps to treat abnormalities identified.

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