Prevalence of Cardiometabolic Risk Factors in Hispanics Living with HIV

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Objective: Human immunodeficiency virus (HIV) infection and antiretroviral treatment are associated with metabolic and cardiovascular complications that resemble metabolic syndrome (MetS) and potentially increase the risk of diabetes and cardiovascular disease in this population. The purpose of this study was to determine the prevalence of MetS and its individual components among Hispanics living with HIV in Puerto Rico.

Methods: Data from 909 clinical records were extracted and the prevalence of MetS determined using the NCEP-ATPIII criteria. Fisher's exact test was used to detect sex differences, and logistic regression to examine the effect of age, sex, smoking, years of HIV infection, antiretroviral therapy, and Hepatitis C co-infection.

Results: The prevalence of MetS in our study group (35.4%) was higher than previously reported in the United States, but not higher than in the general population in Puerto Rico. Females had a higher prevalence of MetS (44.2%) than males (30.5%); mostly explained by high body mass index and waist circumference. Age and sex were associated with the presence of MetS.

Conclusion: Understanding ethnic and sex differences in the prevalence of metabolic risk factors is essential for the implementation of specific targeted interventions to prevent subsequent vascular morbidity and mortality in this population. (*Ethn Dis.* 2010;20:423–428)

Key Words: HIV, Metabolic Syndrome, Hispanics

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INTRODUCTION

The availability of highly active antiretroviral therapy (HAART) has significantly improved life expectancy for people living with human immunodeficiency virus (HIV) infection. This clinical advance in therapy is associated with an increased risk of metabolic and cardiovascular complications such as visceral fat accumulation, dyslipidemia (ie, high triglycerides, low HDL), insulin resistance, and elevated blood pressure,[1,2] all important components of metabolic syndrome (MetS). However, the potential synergy of metabolic complications in HIV infection, therapy, and race/ethnicity has not been evaluated.

Hispanics are disproportionately affected with diseases linked to MetS such as overweight/obesity, diabetes, and hypertension,[3,4] and the age-adjusted prevalence of MetS among Hispanics in the United States (40.6%) is higher when compared with non-Hispanic Blacks (38.8%) and Whites (31.5%).[5] Moreover, the age-adjusted prevalence of MetS among Hispanics in Puerto Rico (38.1%)[6] is similar to non-Hispanic Blacks in the US,[7] and higher than Hispanics in different Latin American countries.[8] The prevalence of MetS and cardiometabolic risk factors among Hispanics living with HIV in Puerto Rico is unknown, and little is known about the prevalence of these complications among Hispanics living with HIV in general. Therefore, the purpose of our study was to determine the prevalence of MetS and the individual cardiometabolic risk factors in Hispanic adults living with HIV in Puerto Rico.

The prevalence of MetS and cardiometabolic risk factors among Hispanics living with HIV in Puerto Rico is unknown, and little is known about the prevalence of these complications among Hispanics living with HIV in general.

METHODS

Study Design

This cross-sectional study included all adult patients attending two HIV clinics and one HIV community-based alternative medicine program in San Juan between 2003 and 2007. These sites provide healthcare services to approximately 20% of the HIV/AIDS population living in Puerto Rico.[9] Clinical records were reviewed and data extraction without personal identifiers completed by authorized personnel at each site. The consistency of data extraction and entry was checked by randomly selecting extraction forms, re-entering data, and comparing with the original file. Discrepancies were corrected after consultation with authorized personnel who verified the information with the original record in each site. Extraction forms excluded were those missing age, sex, height, weight, and two or more of the following: resting blood pressure, fasting glucose, triglyceride and HDL. The study was ap-

proved by the institutional review board of the University of Puerto Rico, Universidad Central del Caribe, and the Mayo Clinic in Rochester, Minnesota.

Study Outcomes

The most recent data available in each clinical record were used for analyses. Primary variables included: waist circumference, body mass index (BMI[kg/m^2]), fasting glucose, triglycerides and HDL, use of antihypertensive and lipid control medications, resting systolic and diastolic blood pressures, and diagnosis of diabetes. Waist circumference was used as an index of visceral fat and BMI as an index of obesity, both were collapsed into one criterion called body shape. Other variables included: sex, date of birth, date and age at HIV diagnosis, viral load, CD4 count, education, alcohol consumption, hepatitis C co-infection, smoking, and history of antiretroviral medications.

The National Cholesterol Education Program – Adult Treatment Panel III (NCEP-ATPIII) criteria were used to determine the proportion of participants having one or more of the cardiometabolic risk factors,[10,11] and the proportion having MetS.

Data Management and Statistical Analyses

To include all participants and avoid biases, missing values were imputed using the Markov Chain Monte Carlo multiple-imputation method. Then, a sensitivity analysis was conducted including 280 patients with complete datasets. Descriptive statistics were performed for socio-demographic and research variables (ie, means, standard deviations, and proportions). Fisher's exact test was used to identify sex differences in the prevalence of MetS, visceral fat/obesity, dyslipidemia, high fasting glucose, and hypertension; and differences between our study group and the general population in Puerto Rico using published data.[6] The effect of age, sex, hepatitis C, and type of
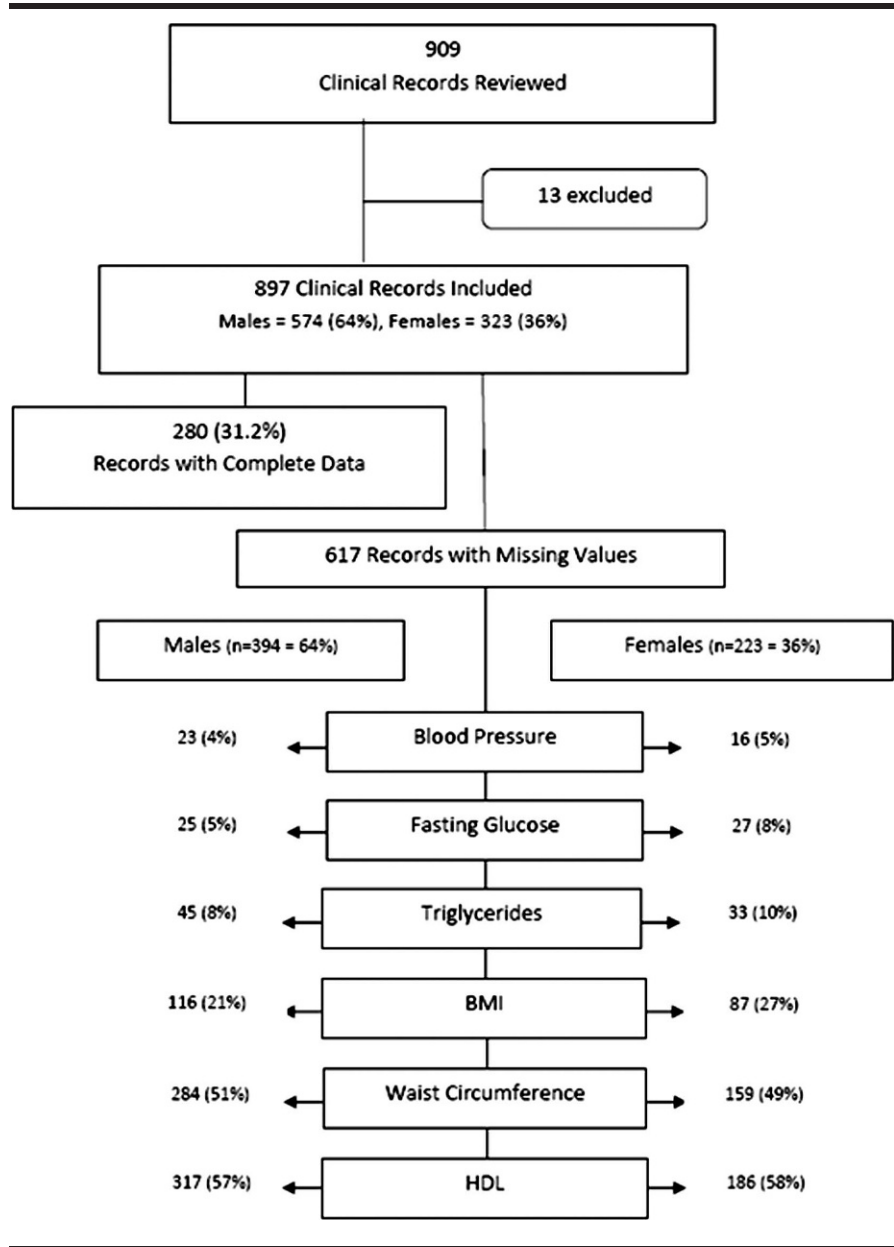
Fig 1. Algorithm of clinical records reviewed and number of missing values for each cardiometabolic risk factor

antiretroviral therapy was tested using logistic regression analysis. An alpha ≤.05 was used for statistical significance using SPSS Statistical Software (Release 18, SPSS Inc., Chicago, Ill).

RESULTS

Study Participants

A total of 909 data extraction forms were received from the collaborating sites, and 13 did not meet the inclusion criteria (Figure 1). From the remaining 897 records, 574 (64%) were males (a sex distribution closely resembling that of the HIV/AIDS epidemic in Puerto Rico), with a mean age of 44.7 ± 10.1 years. All participants were aged ≥21 years, non pregnant, with no history of illicit drug use/abuse, and without current AIDS diagnosis. An algorithm including the number of records reviewed, extraction forms ex-

Table 1. General characteristics of study participants

Variable	All (*n*=897)	Females (*n*=323)	Males (*n*=574)	*P*
Age, yrs	44.7 (10.1)	45.2 (10.1)	44.4 (10.1)	.19
Age at HIV, yrs	37.9 (10.7)	38.2 (10.9)	37.7 (10.5)	.70
CD4, cells/µL	473 (322)	486 (326)	467 (320)	.55
<200	19%	16%	20%	.22
201–500	41%	44%	40%	
>500	40%	40%	40%	
HIV RNA, copies/mL				
Non detectable	51%	48%	52%	.27
<1,000	13%	14%	12%	
1,000–30,000	21%	23%	19%	
>30,000	16%	14%	17%	
Education ≥high school, %	56	48	60	<.001
Smokers, %	50	44	53	.01
Alcohol abuse, %	39	27	45	<.001
Hepatitis C, %	21	17	23	.06
HAART-Naïve, %	10	10	9	.75
PI Only, %	3	2	3	.82
NRTI/NNRTI Only, %	34	38	32	.07
HAART, %	45	42	46	.31

Data are given as mean (SD) except where noted.
HAART, highly active antiretroviral therapy.
PI, protease inhibitors.
NRTI/NNRTI, nucleoside and non-nucleoside reverse transcriptase inhibitors.

cluded, and number of missing values for each cardiometabolic risk factor by gender is presented in Figure 1.

Cardiometabolic Variables

Sociodemographic and clinical characteristics organized by sex are presented in Table 1. No sex differences were observed for age, age at HIV infection, CD4, viral load, proportion with hepatitis C co-infection, and proportion using antiretroviral therapy. There were significant differences in the females reporting less formal education and males having a higher prevalence of smoking and alcohol abuse.

The prevalence of cardiometabolic variables organized by sex is presented in Table 2. Females had higher waist circumference, BMI, and HDL; and lower triglycerides and systolic blood pressure than males. Mean fasting glucose, and systolic and diastolic blood pressures were within normal values for both males and females. However, mean triglyceride, BMI and waist circumferences were higher than normal values in both males and females.

High fasting glucose (≥100 mg/dL) was observed in 24% of participants, 35% were overweight (BMI = 25–29.9 kg/m²), 20% were obese (BMI ≥30 kg/m²), 50% had high triglycerides (≥150 mg/dL), 74% had low HDL levels (≤50 mg/dL), and 58% had blood pressure levels considered in the pre-hypertensive/hypertensive category (>120/80 mm Hg). No sex differences were observed in the proportion of patients diagnosed with diabetes or hypertension, conditions that developed after HIV diagnosis.

Metabolic Syndrome

The prevalence of MetS using actual and imputed values were not different (40.0% vs 35.4%, respectively; *P*=.28). The prevalence of each component of the MetS from actual and imputed values were also not different (ie, elevated fasting glucose: 15.9% vs 17.4%; elevated BMI and waist circumference: 36.4% vs 39.7%; elevated triglycerides: 50.2% vs 52.7%; low HDL: 54.0% vs 51.2%; and elevated blood pressure: 49.6% vs 48.3%; *P*>.05 for all). Because of these find-

The 35.4% prevalence of MetS [among Hispanics living with HIV] was high compared to the 24–26% prevalence reported among adults living with HIV in the United States,[12,13] 18% in Australia,[14] and 17% in Spain.[15]

ings, the following results are based on the imputed values.

Sex differences in the prevalence of MetS and its individual components are presented in Figure 2. Females had a higher prevalence of MetS compared to males (44% vs 31%, respectively, *P*=.04), and body shape was the only individual component significantly higher in women compared to men, indicating that women had higher abdominal or general obesity than men. Logistic regression also confirmed that males were less likely to have MetS compared to females (OR: 0.61, 95% CI: 0.42–0.92; *P*=.02).

Older HIV patients (age ≥60 years) were more likely to have MetS than those aged <30 years (OR: 1.04, 95% CI: 1.01–1.08; *P*=.01), and the prevalence was higher in females, particularly in the younger and older age group (Table 3). After adjusting for age and sex, factors such as smoking, alcohol abuse, education level, age at HIV infection, antiretroviral therapy, and co-infection with hepatitis C did not influence the prevalence of MetS.

DISCUSSION

This is the first study to report the prevalence of cardiometabolic risk factors and MetS among Hispanics living

Table 2. Cardiometabolic characteristics of study sample

Variable	All	Females	Males	P
Fasting Glucose, mg/dL	96.1 (28.2) (n=825)	95.0 (29.0) (n=296)	96.7 (27.8) (n=529)	.11
<100	76%	77%	75%	.69
100–124	16%	15%	17%	
>124	8%	9%	8%	
Body shape, BMI; kg/m²	26.3 (5.4) (n=674)	27.2 (6.1) (n=236)	25.9 (4.9) (n=438)	.007
<18.5	4%	5%	4%	.03
18.5–24.9	41%	35%	45%	
25.0–29.9	35%	35%	35%	
>29.9	20%	25%	17%	
Body shape, waist circumference; cm	94.3 (5.6) (n=434)	96.6 (17.8) (n=164)	93.0 (13.9) (n=270)	.03
Triglycerides, mg/dL	193.8 (162.5) (n=799)	163.8 (99.0) (n=290)	210.9 (187.4) (n=509)	.003
<150	50%	57%	46%	.003
150–199	20%	19%	20%	
200–500	26%	22%	28%	
>500	4%	2%	6%	
HDL, mg/dL	43.7 (14.2) (n=374)	48.0 (15.9) (n=137)	41.2 (12.4) (n=237)	<.001
<41	47%	34%	54%	<.001
41–50	27%	25%	27%	
51–60	16%	24%	11%	
>60	10%	17%	7%	
Blood Pressure, mm Hg	(n=838)	(n=307)	(n=531)	
<120/80	43%	49%	39%	.004
120–139/80–89	40%	36%	43%	
140–159/90–99	14%	10%	16%	
>160/100	3%	5%	3%	
Systolic BP, mm Hg	120.5 (16.2)	118.1 (17.1)	121.8 (15.6)	<.001
Diastolic BP, mm Hg	75.5 (10.6)	74.7 (10.9)	75.9 (10.4)	.10
Hypertension, %	18.5 (n=686)	18.0 (n=245)	18.8 (n=441)	.78
Diabetes, %	9.8 (n=519)	11.6 (n=190)	8.8 (n=329)	.31

Data are given as mean (SD) except where noted.
BMI, body mass index.
HDL, high density lipoprotein.
BP, blood pressure.

with HIV in Puerto Rico. The 35.4% prevalence of MetS was high compared to the 24–26% prevalence reported among adults living with HIV in the United States,[12,13] 18% in Australia,[14] and 17% in Spain.[15] However, the crude prevalence of the MetS was not higher in the group of adults living with HIV compared to the general population in Puerto Rico[6] (35.4% vs 43.3%, respectively, P=.155). Also, the prevalence of individual components such as HDL, blood pressure, or obesity and central obesity were not different between our study group and the general population in Puerto Rico[6] (51.2% vs 46.0%, P=.27; 48.3% vs 46.1%, P=.44; 39.7% vs 49.0%, P=.13, respectively). These results are consis-

tent with previous reports,[12,13] and suggest that environmental, sociocultural and/or genetic factors are as influential as HIV infection and its treatment in explaining the risk of cardiometabolic complications among Hispanics living with HIV in Puerto Rico.

According to the CDC,[16] behavioral risk factors linked to cardiometabolic complications, such as poor nutrition and low physical activity, are highly prevalent among Hispanics in Puerto Rico compared to Hispanics and non-Hispanic Whites in the United States (physical inactivity: 49%, 33.2%, 23.8%, respectively; consumption of fruits and vegetables: 14.3%, 20.4%, 23.5%, respectively). Hispanic adults living with HIV in Puerto Rico are

likely to have similar risk behaviors and therefore, similar risk of cardiometabolic dysfunction as the general population in Puerto Rico. However, we observed important differences in the prevalence of individual components of the MetS between our study group and the general population in Puerto Rico.[6] The two most important factors driving the prevalence of MetS in the general population in Puerto Rico[6] were elevated fasting glucose (49.8%) and abdominal obesity (49.0%),[6] while, similar to previous studies,[17] the two most influential factors in our study group were hypertriglyceridemia (52.7%) and low HDL levels (51.2%).

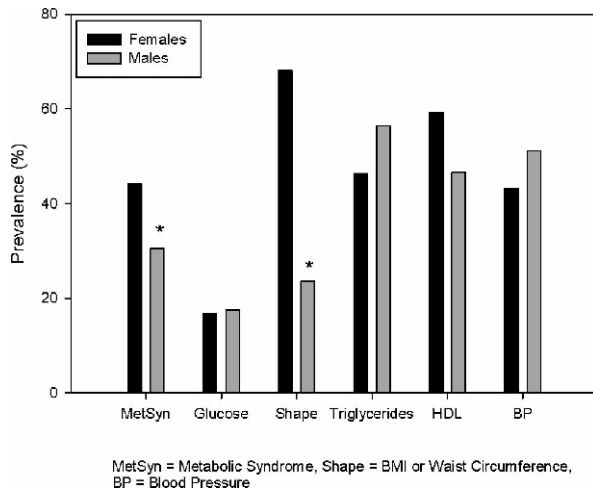A lower prevalence of elevated fasting glucose and a higher prevalence

Fig 2. Prevalence of metabolic syndrome and individual components by sex

creases, particularly in females.[20] In the present study, the prevalence of at least one cardiometabolic disorder was 92% (females=95%, males=91%) compared to 85% in the general population in Puerto Rico;[6] and the prevalence of meeting all five criteria was 2% in our study group compared to 7% in the general population. Elevated triglycerides (53%) and low HDL levels (51%) were the components with the highest prevalence; high fasting glucose the component with the lowest prevalence (17%), and elevated resting blood pressure the third most influential component with a prevalence of 48.3%. This is higher than the prevalence of hypertension (17–21%) previously reported among adults living with HIV in the United States.[21] The presence of all mentioned factors combined with persistent levels of immune activation may explain the high frequency of cardiovascular events observed in this population.

Although many metabolic abnormalities in adults living with HIV have been attributed to antiretroviral therapy,[12,14,22,23] in the present study, specific antiretroviral classes were not related to MetS after adjusting for age and sex. Compared to adults living with HIV that were naïve or were not taking antiretrovirals for at least two years, the odds of having MetS in those taking HAART was not significant (OR:1.17, 95%CI; .65–2.15, P=.62). This observation differs from Bergersen et al[24] who reported a higher prevalence of MetS in HAART treated compared with HAART-naïve patients, but are in agreement with Sobieszczyk et al[22] who reported no differences in the prevalence between HIV infected women naïve to antiretrovirals with those taking HAART.

Some important limitations in our study need to be addressed. Missing data is a known problem when using data extraction from clinical records, and using imputation methods is not always a valid remedy. However, when we compared the prevalence of MetS and its individual components using impu-

of elevated triglycerides were the most important differences observed between our study group and the general population in Puerto Rico (17.4% vs 49.8%, P<.01; and 52.7% vs 31.3%, P<.01; respectively). Mondy et al[13] reported similar results when they compared adults living with HIV and the general population in the United States, suggesting that different approaches might be necessary for the management and control of cardiometabolic complications in adults living with HIV compared to the general population.

Although obesity was not among the components of the MetS with the highest prevalence in our study group, it has become an important health problem among females and males living with HIV. Before the introduction of HAART, elevated BMI was associated with a slower progression from HIV infection to AIDS; whereas

now, elevated BMI is associated with high cholesterol, triglycerides, glucose, and insulin resistance.[18,19]

Males and females in the general population in Puerto Rico did not differ in their prevalence of MetS;[6] however, females in our study group had a higher prevalence of MetS compared to males. Obesity/waist circumference was the only individual component with a higher prevalence among females compared to males, and similar to Mondy et al,[13] we observed a higher mean BMI and waist circumference, and lower triglyceride levels among females compared to males. These differences suggest that sex-specific approaches might be needed for the prevention and clinical care of cardiometabolic dysfunction in adults living with HIV.

Metabolic syndrome is known to increase the risk of cardiovascular disease, and the risk is higher as the number of individual components in-

Table 3. Proportion of Hispanic adults living with HIV meeting the criteria for metabolic syndrome, % by age group

Age Group (yrs)	All (*n*=897)	Females (*n*=323)	Males (*n*=574)
<30 (*n*=60)	17.2	29.5	11.5
30–39 (*n*=195)	28.5	38.2	23.3
40–49 (*n*=381)	37.1	44.4	33.1
50–59 (*n*=201)	38.4	45.6	34.3
≥60 (*n*=60)	55.3	63.9	47.8

tation and actual values, no significant differences were detected. Another limitation in our data extraction was the lack of information regarding physical activity and nutritional behaviors, and the inconsistency in recording follow-up evaluations and metabolic related variables such as waist circumference, HDL, LDL, lipodystrophy and microalbuminuria. However, this is the largest dataset that has evaluated the prevalence of MetS in a Hispanic HIV- infected population.

In summary, the prevalence of MetS among Hispanic adults living with HIV in Puerto Rico was higher than previously reported in the United States but not different than the general population in Puerto Rico. The two most prevalent components of the MetS in Hispanics with HIV (ie, elevated triglycerides, low HDL) were different from the general population in Puerto Rico (ie, elevated fasting glucose, waist circumference), but elevated resting blood pressure was the third most prevalent component in both populations. We suggest that social and cultural influences might be as strong as the HIV infection itself and antiretroviral therapy in explaining the development of cardiometabolic dysfunction in Hispanics living with HIV in Puerto Rico. Understanding ethnic and sex differences in the prevalence of cardiometabolic risk factors is essential for the implementation of specific targeted interventions to prevent subsequent vascular morbidity and mortality in this population.

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Acquisition of funding: Ramírez-Marrero, Joyner
Administrative: Ramírez-Marrero, De Jesús, Santana-Bagur, Hunter, Frontera, Joyner
Supervision: Ramírez-Marrero, De Jesús, Santana-Bagur, Hunter, Frontera, Joyner