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ORIGINAL RESEARCH

Underuse of Cardiovascular Medications in Individuals With Known Lower Extremity Peripheral Artery Disease: HCHS/SOL

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BACKGROUND: Underuse of cardiovascular medications for secondary prevention among individuals with peripheral artery disease (PAD) has been reported. Little is known about PAD treatment status in the Hispanic/Latino population in the United States, who may have limited access to health care and who have worse clinical outcomes than non-Hispanic individuals.

METHODS AND RESULTS: We studied the use of cardiovascular therapies in 1244 Hispanic/Latino individuals recruited from 4 sites in the United States, including 826 individuals who reported diagnosis of PAD by physician and 418 individuals with coronary artery disease alone, in the HCHS/SOL (Hispanic Community Health Study/Study of Latinos). We compared the prevalence of using antiplatelet therapy, lipid-lowering therapy and antihypertensive therapy by PAD and coronary artery disease status. Among those with PAD, we studied factors associated with taking cardiovascular medications, including demographic and socioeconomic factors, acculturation, access to health care and comorbidities, using multivariable regression models. The overall prevalence for individuals with PAD taking antiplatelet therapy, lipid-lowering therapy and, among hypertensive individuals, antihypertensive therapy was 31%, 26% and 57%, respectively. Individuals of Mexican background had the lowest use for all classes of cardiovascular medications. Older age, number of doctor visits and existing hypertension and diabetes mellitus were significantly associated with taking cardiovascular therapies in adjusted models. Compared with those with PAD alone, individuals with PAD and concurrent coronary artery disease were 1.52 (95% CI, 1.20–1.93) and 1.74 (1.30–2.32) times more likely to use antiplatelet agents and statins according to multivariable analysis. No significant difference of antihypertensive medication use was found among PAD patients with or without coronary artery disease.

CONCLUSIONS: Hispanic/Latino individuals with known PAD underuse cardiovascular medications recommended in clinical guidelines. More efforts should be directed to improve treatment in this important group.

Key Words: healthcare disparities ■ Hispanic/Latino ■ medication use ■ peripheral artery disease

Individuals with lower extremity peripheral artery disease (PAD) have progressive deterioration in physical function, and may develop ischemic leg pain, intermittent claudication, and critical limb ischemia.[1,2] PAD is also a risk factor for other cardiovascular disease including coronary artery disease (CAD), stroke, and heart failure.[3–5] To control disease progression and prevent adverse cardiovascular events, current guidelines for PAD treatment include lifestyle modifications and pharmacological interventions.[6,7] For example, American College of Cardiology/ American Heart Association guidelines recommend use of antiplatelet therapy (low dose aspirin or clopidogrel) and statin therapy among all patients with PAD.[6,8,9] Further, recommendations call for patients with concomitant hypertension to be prescribed antihypertensive

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CLINICAL PERSPECTIVE

What Is New?

- In this community-based study of US Hispanic/Latino, an estimated 1 in 4 individuals aware of peripheral artery disease used lipid-lowering medications, 1 in 3 used antiplatelet agents, and 1 in 2 with hypertension used antihypertensive therapy.
- While individuals with peripheral artery disease and concurrent coronary artery disease were at least 1.5 times more likely to use antiplatelet agents and statins than those with peripheral artery disease alone, their use of cardiovascular medications did not differ significantly from those with coronary artery disease alone.

What Are the Clinical Implications?

- Efforts to improve peripheral artery disease treatment in US Hispanic/Latino group are needed, such as improving healthcare use and advocating for guideline-adherent treatment.

Nonstandard Abbreviations and Acronyms

ACEIs	angiotensin-converting enzyme inhibitors
ARBs	angiotensin II receptor blockers
CAD	coronary artery disease
HCHS/SOL	Hispanic Community Health Study/ Study of Latinos
PAD	peripheral artery disease

medications such as angiotensin-converting enzyme inhibitors (ACEIs) or angiotensin II receptor blockers (ARBs).[6,10–13] More recent guidelines also support use of calcium-channel blockers.[14]

It has been estimated that 8.5 million people in the United States have PAD.[15] Several studies have reported underuse of cardiovascular medications among individuals with PAD, with estimated rates of medication use ranging between 20% to 40%.[16–18] National Health and Nutrition Examination Survey estimates show that ≈5 million patients with PAD in the United States do not take statins, ACEIs/ARBs, or aspirin.[17] Pharmacological treatment rates vary markedly by CAD status. PAD patients with concurrent CAD are 2 to 3 times more likely to be prescribed antiplatelet therapy, statins, and ACEI/ARBs, and 4 times more likely to receive smoking cessation counseling compared with patients with PAD alone.[16,18]

PAD treatment among the Hispanic/Latino population remains understudied to date as this diverse ethnic group is underrepresented in large studies. Yet, existing evidence points to important disparities in the treatment and outcomes of PAD among Hispanics/Latinos. For example, whereas cardiovascular intervention rates were lower in Hispanics/Latinos, amputation rates were double the levels reported among non-Hispanic Whites.[19,20] Additionally, among PAD patients, being Hispanic/Latino is a risk factor for higher rates of emergency department use and higher disease severity at hospital admission.[19,20] Thus, understanding the extent to which Hispanic/Latino patients with PAD receive appropriate medications can be helpful for prevention of unfavorable outcomes (eg, amputations) and for improving healthcare efficiency (eg, lowering use of preventable emergency department use). We studied the prevalence of using cardiovascular therapies and related factors in individuals with previous PAD diagnosis by physician in the HCHS/SOL (Hispanic Community Health Study/Study of Latinos).

METHODS

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Study Population

The HCHS/SOL is an ongoing community-based prospective cohort study to estimate the burden of cardiovascular disease and other chronic diseases and identify the associated risk factors among the US Hispanic/Latino population of 6 backgrounds, including Dominican, Cuban, Central American, Mexican, Puerto Rican, and South American. From 2008 to 2011, HCHS/SOL recruited 16 415 Hispanic/Latino participants aged between 18 and 74 years for a baseline examination at 4 field centers (Bronx, NY, Chicago, IL, Miami, FL, and San Diego, CA) using a 2-stage area household sampling design. Detailed study design and sampling methods were previously published.[21] Briefly, at the first stage of sample selection, census block groups were selected using stratified simple random sampling accounting for socioeconomic status. At the second stage, household addresses were sampled from each census block group and screened for eligibility, which is defined as having at least 1 self-identified Hispanic/Latino household member aged 18 to 74 years. The study collected comprehensive data including sociodemographic and socioeconomic information, medical history, medication use, health-related behaviors, anthropometry, and blood specimens, etc. Institutional review boards at each HCHS/SOL participating field center and institution approved the study. All participants provided written informed consent.

In this study, we included 849 individuals from the baseline visit who reported PAD diagnosis by physician in the medical history form. Specifically, the question was formed in English and Spanish as "Has a doctor ever said that you have peripheral arterial disease (problems with circulation, blocked arteries to the legs)?". Of these, we excluded 23 participants who reported taking medications but did not bring their medications, per instruction, to the study visit, leaving 826 participants. For internal comparison within the HCHS/SOL cohort, we also included 418 participants who reported CAD diagnosis by physician, including myocardial infarction or coronary revascularization, but who were free of PAD and completed the medication use inventory.

Cardiovascular Medications

At the baseline examination, participants brought all medications taken over the past 4 weeks. Site interviewers scanned the Universal Product Code of the participants' medications, when available, into the study database enabling automation of medical therapeutic classification. Centralized manual coding of medications, if needed, was performed at the data coordinating center (University of North Carolina, Chapel Hill). We evaluated medications according to 2005 American College of Cardiology/American Heart Association guideline class I recommendations. This includes use of antiplatelet therapy (aspirin, platelet aggregation inhibitors-clopidogrel), lipid-lowering therapy for all study participants with PAD, consistent with the universal recommendation for use of these drugs in all patients with PAD. We also examined antihypertensive therapy and, particularly, ACEIs and ARBs for participants previously diagnosed with hypertension by a doctor. We included combination drugs. Since aspirin can be used for indications other than cardiovascular prevention, we cross-referenced the aspirin Universal Product Code with drug name, strength (75–325 mg), as well as the participants' response to the question about the purpose for taking aspirin (avoid heart attack or stroke) to reduce misclassifications.

Factors Associated With Use of Cardiovascular Medications and Covariates

Demographic characteristics (age, sex and self-identified Hispanic/Latino background), acculturation variables (place of birth and preferred language), socioeconomic status (education level, annual household income, and employment status), health insurance coverage, and number of doctor visits during the past year were obtained via face-to-face interview using questionnaires. We defined US birth based on whether participants were born in the 50 states or the District of Columbia. We also collected information on smoking behavior, medical history, history of surgical procedures for treatment of PAD, including balloon angioplasty, stenting and amputation, and parental history of PAD. We used the brief version of the San Diego Claudication questionnaire to assess exertional leg pain related to PAD and intermittent claudication.[22] If participants reported that they got pain or discomfort in either leg on walking, they were considered to have exertional leg pain. If participants additionally reported that the pain relieved or lessened when stood still, they were considered to have intermittent claudication. Known hypertension and diabetes mellitus were defined using self-reported diagnosis by a physician in the past or use of antihypertensive or glucose-lowering medications, respectively. The questions were formed in English and Spanish as "Has a doctor ever said that you have high blood pressure or hypertension" and "Has a doctor ever said that you have diabetes (high sugar in blood or urine)?". We defined dyslipidemia as total cholesterol ≥240 mg/dL or low-density lipoprotein cholesterol ≥160 mg/dL or high-density lipoprotein cholesterol <40 mg/dL or by use of lipid-lowering medications. History of stroke, transient ischemic attack, and heart failure were based on self-report of past physician diagnosis in the medical history form. Standing height was measured to the nearest centimeter, and body weight was measured using the Tanita scale to the nearest 0.1 kg. Body mass index was calculated as weight (kg) divided by height squared (m^2) and we defined obesity as body mass index ≥30 kg/m^2.

Statistical Analysis

For all analyses, we applied complex survey methodology and used sampling weights to account for sampling probability and non-response. Sampling weights were calibrated to the US 2010 Census population within the study target areas. Weighted means and proportions were shown for continuous and categorical participant characteristics, respectively. We described the prevalence of taking different classes of cardiovascular medications using survey proportions. We compared the prevalence of these medications using predicted marginals obtained from age-adjusted survey Poisson regression with robust variance among individuals with PAD alone, PAD and CAD, and those with CAD alone. We then further included participant characteristics one at a

Table 1. Characteristics of Individuals With Medical History of PAD and CAD

	All With PAD	PAD Alone	PAD+CAD	CAD Alone
No.	826	723	103	418
Age, y	53.4 (0.8)	53.0 (0.8)	56.3 (3.6)	55.6 (1.1)
Sex (women)	574 (59%)	523 (63%)	51 (35%)	202 (42%)
Education less than high school	414 (48%)	349 (45%)	65 (67%)	193 (42%)
Income <$15K	340 (38%)	294 (39%)	46 (32%)	192 (45%)
Employed	240 (30%)	225 (31%)	15 (28%)	124 (30%)
Hispanic background				
Dominican	119 (15%)	104 (15%)	15 (10%)	36 (9%)
Central American	63 (6%)	58 (6%)	5 (2%)	29 (4%)
Cuban	121 (22%)	104 (22%)	17 (22%)	74 (30%)
Mexican	241 (28%)	221 (28%)	20 (30%)	124 (20%)
Puerto Rican	204 (22%)	165 (20%)	39 (28%)	126 (27%)
South American	50 (5%)	47 (5%)	3 (4%)	20 (5%)
Mixed/other	25 (3%)	21 (3%)	4 (3%)	9 (4%)
Born in mainland United States	100 (11%)	88 (11%)	12 (9%)	50 (16%)
Language preference (English)	125 (15%)	112 (16%)	13 (9%)	78 (21%)
Health insurance coverage				
None	295 (37%)	280 (40%)	15 (15%)	105 (23%)
Private	190 (23%)	165 (23%)	25 (25%)	102 (26%)
Public (Medicaid or Medicare or military)	292 (37%)	237 (35%)	55 (56%)	182 (47%)
Other	24 (3%)	20 (3%)	4 (4%)	14 (4%)
Received health care from physician in the past 12 mo				
None	96 (17%)	94 (17%)	2 (18%)	46 (12%)
Once	80 (9%)	76 (10%)	4 (4%)	26 (6%)
2–3 times	163 (20%)	143 (20%)	20 (20%)	80 (21%)
4+ times	463 (54%)	389 (54%)	74 (59%)	255 (61%)
Use any medication	721 (82%)	622 (83%)	99 (81%)	376 (85%)
Total number of medications	6.3 (0.3)	6.0 (0.3)	8.7 (0.6)	6.9 (0.3)
Current smoking	168 (27%)	141 (24%)	27 (40%)	98 (26%)
Obesity	449 (54%)	389 (53%)	60 (57%)	214 (49%)
Dyslipidemia	435 (51%)	355 (48%)	80 (70%)	291 (68%)
History of hypertension	521 (60%)	427 (57%)	94 (75%)	315 (73%)
History of diabetes mellitus	276 (34%)	226 (32%)	50 (42%)	159 (37%)
History of stroke/TIA	73 (9%)	51 (8%)	22 (17%)	68 (18%)
History of heart failure	66 (9%)	28 (4%)	38 (35%)	91 (22%)
Parental history of PAD	197 (22%)	176 (22%)	21 (16%)	48 (11%)
Exertional leg pain	526 (77%)	450 (77%)	76 (73%)	213 (55%)
Intermittent claudication	309 (47%)	257 (45%)	52 (56%)	131 (36%)
Surgical procedure for PAD	54 (7%)	35 (5%)	19 (18%)	…

Data are survey weighted mean (SE) or n (survey weighted proportion). Hypertension and diabetes mellitus were based on medical history and scanned medications. Hypercholesterolemia was defined as total cholesterol ≥240 mg/dL or low-density lipoprotein ≥160 mg/dL or 0< high-density lipoprotein <40 mg/dL or lipid-lowering medication use. Obesity is defined as body mass index ≥30 kg/m^2. CAD indicates coronary artery disease; PAD, peripheral artery disease; and TIA, transient ischemic attack.

time in addition to age in the survey Poisson models to evaluate the prevalence of using cardiovascular medication by participant characteristic such as sex, Hispanic/Latino background, education, income, employment, nativity, language preference, health insurance coverage, number of doctor visits in the previous year, cardiovascular risk factors (current smoking, hypertension, diabetes mellitus, dyslipidemia, and obesity), PAD symptoms, and history of prior surgical procedures for PAD. Based on a-priori knowledge as well as statistical significance in age-adjusted model of each factor of interest ($P \le 0.10$), age (18–54, 55–64 and 65+ years), sex, Hispanic/Latino background, education level (less than high school, high school degree or equivalent, and above high school), nativity, health insurance coverage, number of doctor visits last year, cardiovascular risk factors (hypertension, diabetes mellitus, dyslipidemia, and obesity) and concurrent CAD status were included in the models for antiplatelet use, statin use, and antihypertensive medication use. Surgical procedures for PAD were added to the models of antiplatelet use and statin use. We also conducted sensitivity analyses excluding patients with surgical procedures and by leg pain symptom. Analyses were conducted using SAS version 9.4 (SAS Institute, Cary, NC) and SUDAAN version 11.0 (RTI International, Research Triangle Park, NC). Two-sided $P<0.05$ were considered statistically significant.

RESULTS

Study participants included 826 individuals with PAD (723 individuals without concurrent CAD and 103 participants with concurrent CAD) as well as 418 who reported CAD but were free of PAD. The weighted mean age for all those with PAD and all those with CAD was 53 and 56 years, respectively. Almost half of the individuals diagnosed with PAD did not have a high school degree and 70% had annual household income <$30 000 US dollars. More than 60% had ≥2 cardiovascular risk factors (including obesity, hypertension, dyslipidemia, and diabetes mellitus) and 27% were current smokers. As compared with individuals with PAD alone, those with both PAD and CAD were older, more likely to be men, retired, have less than a high school education, have health insurance coverage (especially Medicaid or Medicare), and take more medications. They also had worse cardiovascular risk factors, more comorbidities such as diabetes mellitus, stroke, and heart failure and more intermittent claudication. Participants with CAD alone resembled those with concurrent PAD and CAD on age, health insurance coverage, healthcare use, and cardiovascular risk factors (Table 1).

Prevalence of Using Cardiovascular Medications and Discrepancy by CAD

The overall prevalence for use of antiplatelet therapy and lipid-lowering therapy among individuals with PAD was 31% and 26%, respectively. There were 521 participants with PAD who had a history of hypertension and 57% of them were taking antihypertensive medications. After adjusting for age, individuals with both PAD and CAD had more than 20% higher prevalence of taking antiplatelet medications and statins as compared with those with PAD alone ($P\leq0.001$, Table 2). There was no significant difference among groups in use of ACEIs or ARBs when stratified by CAD. We found no difference in most cardiovascular medication use between those with PAD and CAD and those with CAD alone (Table 2). After adjusting for demographic, socioeconomic status, access to health care, and cardiovascular risk factors, prevalence ratio estimates suggested that individuals with PAD and CAD were 1.52 (95% CI, 1.20–1.93) and 1.74 (1.30–2.32) times more likely to use antiplatelet medications and statins, respectively, compared with individuals with PAD alone (Tables 3 and 4).

Factors Associated With Using Cardiovascular Medication

The prevalence of using cardiovascular medications was, on average, 11% to 18% higher among people

Table 2. The Prevalence and Corresponding 95% CIs of Cardiovascular Medications Among Individuals With Medical History of PAD and CAD

	All PAD (n=826)	PAD Alone* (n=723)	PAD+CAD* (n=103)	CAD Alone* (n=418)	*P* Value* (PAD Alone vs PAD+CAD)	*P* Value* (CAD Alone vs PAD+CAD)
Any antiplatelet therapy	31 (26–35)	28 (23–33)	53 (43–66)	47 (42–54)	<0.001	0.32
Aspirin	27 (22–31)	25 (20–30)	42 (32–56)	42 (37–49)	0.002	0.96
Clopidogrel	7 (5–9)	4 (2–6)	25 (17–35)	17 (13–22)	<0.001	0.08
Both aspirin and clopidogrel	4 (3–6)	2 (1–3)	18 (11–29)	12 (8–17)	<0.001	0.17
Platelet aggregation inhibitors	8 (6–11)	4 (3–7)	29 (21–40)	17 (13–23)	<0.001	0.02
Lipid-lowering therapy	26 (22–30)	23 (19–28)	48 (38–61)	42 (36–48)	<0.001	0.27
Statins	23 (20–27)	20 (17–24)	46 (36–59)	39 (34–45)	<0.001	0.21
Antihypertensive therapy in hypertensive individuals†	57 (50–62)	54 (48–61)	66 (56–79)	68 (61–75)	0.051	0.85
ACEIs	38 (33–44)	36 (30–43)	48 (36–62)	46 (39–53)	0.09	0.77
ARBs	17 (13–23)	17 (13–24)	17 (10–29)	20 (15–26)	0.99	0.68

ACEI indicates angiotensin-converting enzyme inhibitor; ARB, angiotensin II receptor blocker; CAD, coronary artery disease; and PAD, peripheral artery disease.

*Adjusted for age.

†Hypertension is defined as history of hypertension or antihypertensive medication use.

Table 3. Multivariable Survey Poisson Regression of Factors Associated With Prevalence of Antiplatelet Use in Individuals With Medical History of PAD

	Age-Adjusted*	Model 1	Model 2
	PR (95% CI)	PR (95% CI)	PR (95% CI)
Age			
55–64 vs <55 y	2.86 (2.00–4.08)	2.69 (1.87–3.86)	1.42 (1.05–1.92)
65+ vs <55 y	3.85 (2.67–5.56)	3.61 (2.44–5.35)	1.67 (1.20–2.31)
Sex (women vs men)	0.78 (0.59–1.02)	0.86 (0.66–1.14)	0.97 (0.78–1.21)
Hispanic background			
Dominican vs Mexican	1.72 (1.04–2.86)	1.70 (1.03–2.79)	1.63 (1.10–2.41)
Central American vs Mexican	0.97 (0.48–1.94)	0.96 (0.47–1.97)	1.08 (0.67–1.73)
Cuban vs Mexican	1.68 (1.05–2.69)	1.71 (1.07–2.74)	1.60 (1.14–2.23)
Puerto Rican vs Mexican	1.55 (0.99–2.42)	1.48 (0.94–2.31)	1.22 (0.87–1.72)
South American vs Mexican	1.12 (0.57–2.23)	1.26 (0.62–2.55)	1.57 (0.93–2.64)
Mixed/other vs Mexican	1.09 (0.40–2.99)	1.15 (0.43–3.05)	0.95 (0.36–2.52)
Education			
High school graduates vs below high school	0.86 (0.60–1.25)	0.85 (0.61–1.18)	1.11 (0.85–1.45)
Above high school vs below high school	0.80 (0.60–1.09)	0.80 (0.59–1.08)	0.91 (0.70–1.18)
Nativity (US born vs foreign born)	1.16 (0.72–1.85)	1.13 (0.69–1.86)	1.14 (0.76–1.72)
Health insurance (yes vs no)	1.47 (1.06–2.03)		0.93 (0.71–1.21)
Number of doctor visits in the past 12 mo (2+ times vs 0–1 time)	2.25 (1.41–3.59)		1.43 (0.93–2.20)
Concurrent CAD (yes vs no)	2.00 (1.57–2.55)		1.52 (1.20–1.93)
Obesity (yes vs no)	1.29 (1.00–1.66)		1.02 (0.83–1.25)
Hypertension (yes vs no)	6.55 (4.07–10.54)		4.27 (2.58–7.05)
Dyslipidemia (yes vs no)	1.83 (1.33–2.52)		1.15 (0.88–1.49)
Diabetes mellitus (yes vs no)	2.78 (2.10–3.69)		2.12 (1.69–2.66)
Surgical procedure for PAD (yes vs no)	1.45 (1.05–2.00)		1.28 (1.00–1.64)

N=795 after excluding missing covariates.

*Age-adjusted model only included age and 1 factor. Age, sex, Hispanic background, education, and nativity were included in Model 1. Health insurance coverage, number of doctor visits in the past year, concurrent coronary artery disease, obesity, hypertension, dyslipidemia, and diabetes mellitus, and surgical procedure for peripheral artery disease were further included in Model 2. Grey area indicated that these variables were not included in Model 1. CAD indicates coronary artery disease; PAD, peripheral artery disease; and PR, prevalence ratio.

with health insurance coverage than those without and did not differ between public-funded or private health insurance (Table S1). The use of these medications varied greatly among Hispanic/Latino groups. The Mexican group had the lowest prevalence of using cardiovascular medications (Figure). Individuals with >80% health insurance coverage, such as those of Puerto Rican background (90%), were more likely to use antiplatelet and statins, as compared with those of Mexican background, who had 42% coverage rate (P<0.05, Figure, Table S2). However, the cardiovascular medication use in the Cuban group, which had 55% insurance coverage, was close to that in the Dominican group, which had 83% insurance coverage (Figure, Table S2). Health insurance coverage was associated with using statins (prevalence ratio, 2.08; 95% CI, 1.24–3.49, P=0.006) and antihypertensive medications (prevalence ratio, 1.40; 95% CI, 1.08–1.81, P=0.012) adjusting for demographic and socioeconomic variables. However, after adjusting for the number of doctor visits in the last year, the associations of health insurance coverage and cardiovascular medication use were non-significant.

We found that people who visited doctors ≥2 times in the past year, compared with those who visited doctors less often, were 3.02 (1.34–6.84) times more likely to use statins, adjusting for other factors (Table 4). A similar pattern was observed for antiplatelets and antihypertensive medications (Tables 3 and 5). Apart from concurrent CAD, individuals with hypertension and diabetes mellitus were more likely to use cardiovascular medications, adjusting for other factors (Tables 3 through 5). Individuals with high school degree as the highest education were less likely to use statins as compared with those with lower education levels (Table 4). Individuals born in the mainland United States were more likely to use antihypertensive medication than those foreign born (Table 5).

A small proportion (7%) of patients with PAD reported that they had surgical procedures for the disease. They

Table 4. Multivariable Survey Poisson Regression of Factors Associated With Prevalence of Statins Use in Individuals With Medical History of PAD

	Age-Adjusted*	Model 1	Model 2
	PR (95% CI)	PR (95% CI)	PR (95% CI)
Age			
55–64 vs <55 y	2.85 (1.90–4.28)	2.69 (1.76–4.11)	1.43 (0.97–2.13)
65–76 vs <55 y	3.04 (1.95–4.75)	2.90 (1.84–4.58)	1.36 (0.84–2.22)
Sex (women vs men)	0.72 (0.52–0.99)	0.79 (0.58–1.09)	0.87 (0.64–1.18)
Hispanic background			
Dominican vs Mexican	1.31 (0.78–2.20)	1.32 (0.79–2.22)	1.19 (0.71–2.01)
Central American vs Mexican	0.98 (0.45–2.10)	0.97 (0.46–2.04)	1.34 (0.62–2.87)
Cuban vs Mexican	1.24 (0.74–2.07)	1.23 (0.73–2.07)	1.18 (0.71–1.97)
Puerto Rican vs Mexican	1.90 (1.21–2.97)	1.78 (1.14–2.78)	1.29 (0.82–2.03)
South American vs Mexican	0.62 (0.27–1.44)	0.65 (0.27–1.54)	0.83 (0.34–2.07)
Mixed/other vs Mexican	0.13 (0.02–0.97)	0.11 (0.01–0.89)	0.09 (0.01–0.78)
Education			
High school graduates vs below high school	0.50 (0.31–0.80)	0.52 (0.33–0.83)	0.68 (0.43–1.07)
Above high school vs below high school	0.92 (0.64–1.33)	1.05 (0.73–1.51)	1.17 (0.84–1.61)
Nativity (US born vs foreign born)	1.50 (0.91–2.46)	1.27 (0.74–2.18)	1.25 (0.80–1.95)
Health insurance (yes vs no)	2.43 (1.47–4.03)		1.36 (0.87–2.14)
Number of doctor visits in the past 12 mo (2+ times vs 0–1 time)	5.66 (2.59–12.36)		3.02 (1.34–6.84)
Concurrent CAD (yes vs no)	2.45 (1.86–3.23)		1.74 (1.30–2.32)
Obesity (yes vs no)	1.32 (0.95–1.83)		1.15 (0.84–1.58)
Hypertension (yes vs no)	4.28 (2.11–8.65)		2.48 (1.28–4.78)
Diabetes mellitus (yes vs no)	2.63 (1.77–3.92)		1.90 (1.35–2.67)
Surgical procedure for PAD (yes vs no)	1.66 (1.11–2.49)		1.21 (0.80–1.84)

N=792 after excluding missing covariates.

*Age-adjusted model only included age and 1 factor. Age, sex, Hispanic background, education, and nativity were included in Model 1. Health insurance coverage, number of doctor visits in the past year, concurrent coronary artery disease, obesity, hypertension and diabetes mellitus, and surgical procedure for peripheral artery disease were further included in Model 2. Grey area indicated that these variables were not included in Model 1. CAD indicates coronary artery disease; PAD, peripheral artery disease; and PR, prevalence ratio.

had, on average, 15% higher use of antiplatelets (44%) and statins (37%) than those without any operations (Table S1). We repeated the analyses among people without surgical procedures for PAD and the results were largely similar (data not shown). The majority (77%) of people with history of PAD reported leg symptoms during walking. However, the prevalence of using cardiovascular medications among patients with PAD with leg symptoms were comparable with those without (Table S1).

DISCUSSION

In this Hispanic/Latino community-based study, we report substantial underuse of American College of Cardiology/ American Heart Association guideline-suggested cardiovascular therapies among individuals aware of PAD. Prevalence of use varied by treatment class, ranging from 1 in 4 individuals for lipid-lowering medications, to 1 in 3 for antiplatelet agents and 1 in 2 for antihypertensive therapy. The underuse in antiplatelet medications, statins, and ACEIs/ARBs has been reported in US ambulatory data from 2005 to 2012 and National Health and Nutrition Examination Survey data from 1999 to 2004, which included a mostly non-Hispanic White population.[16,17] The prevalence of using antiplatelet medications and statins among the Hispanic/Latinos in 2008 to 2012 remained low as reported several years ago. This may suggest an underappreciated lack of secondary prevention among this race-ethnic minority group, given the increasing use of these cardiovascular medications in general through the years in the first decade of the 21st century.[23] The underuse of antiplatelet medications and statins was found even among individuals with PAD who underwent surgical

Table 5. Multivariable Survey Poisson Regression of Factors Associated With Prevalence of Antihypertensive Medications in Individuals With Medical History of PAD and Hypertension

	Age-Adjusted*	Model 1	Model 2
	PR (95% CI)	PR (95% CI)	PR (95% CI)
Age			
55–64 vs <55 y	1.42 (1.08–1.86)	1.46 (1.11–1.92)	1.36 (1.05–1.77)
65–76 vs <55 y	1.49 (1.13–1.97)	1.55 (1.18–2.04)	1.37 (1.05–1.79)
Sex (women vs men)	1.02 (0.83–1.25)	1.05 (0.85–1.29)	1.07 (0.89–1.30)
Hispanic background			
Dominican vs Mexican	1.19 (0.84–1.69)	1.22 (0.86–1.73)	1.27 (0.92–1.75)
Central American vs Mexican	1.64 (1.22–2.21)	1.63 (1.21–2.18)	1.87 (1.32–2.64)
Cuban vs Mexican	1.17 (0.82–1.66)	1.22 (0.85–1.75)	1.24 (0.91–1.69)
Puerto Rican vs Mexican	1.23 (0.90–1.69)	1.19 (0.86–1.63)	1.10 (0.84–1.45)
South American vs Mexican	0.60 (0.26–1.39)	0.63 (0.28–1.42)	0.62 (0.32–1.21)
Mixed/other vs Mexican	0.41 (0.12–1.39)	0.39 (0.12–1.27)	0.36 (0.11–1.18)
Education			
High school graduates vs below high school	0.96 (0.76–1.22)	0.97 (0.76–1.22)	1.09 (0.85–1.40)
Above high school vs below high school	0.82 (0.63–1.07)	0.85 (0.66–1.11)	0.89 (0.71–1.11)
Nativity (US born vs foreign born)	1.31 (0.93–1.85)	1.45 (1.03–2.04)	1.37 (1.02–1.83)
Health insurance (yes vs no)	1.35 (1.05–1.72)		1.21 (0.94–1.56)
Number of doctor visits in the past 12 mo (2+ times vs 0–1 time)	1.87 (1.23–2.82)		1.50 (0.99–2.27)
Concurrent CAD (yes vs no)	1.22 (0.99–1.51)		1.17 (0.97–1.42)
Obesity (yes vs no)	1.81 (1.39–2.35)		1.24 (1.02–1.50)
Dyslipidemia (yes vs no)	2.10 (1.57–2.81)		1.30 (1.03–1.65)
Diabetes mellitus (yes vs no)	2.41 (1.87–3.12)		1.50 (1.23–1.82)

N=500 individuals who had hypertension with no missing covariates.

*Age-adjusted model only included age and 1 factor. Age, sex, Hispanic background, education, and nativity were included in Model 1. Health insurance coverage, number of doctor visits in the past year, concurrent coronary artery disease, obesity, dyslipidemia, and diabetes mellitus were further included in Model 2. Grey area indicated that these variables were not included in Model 1. CAD indicates coronary artery disease; and PR, prevalence ratio.

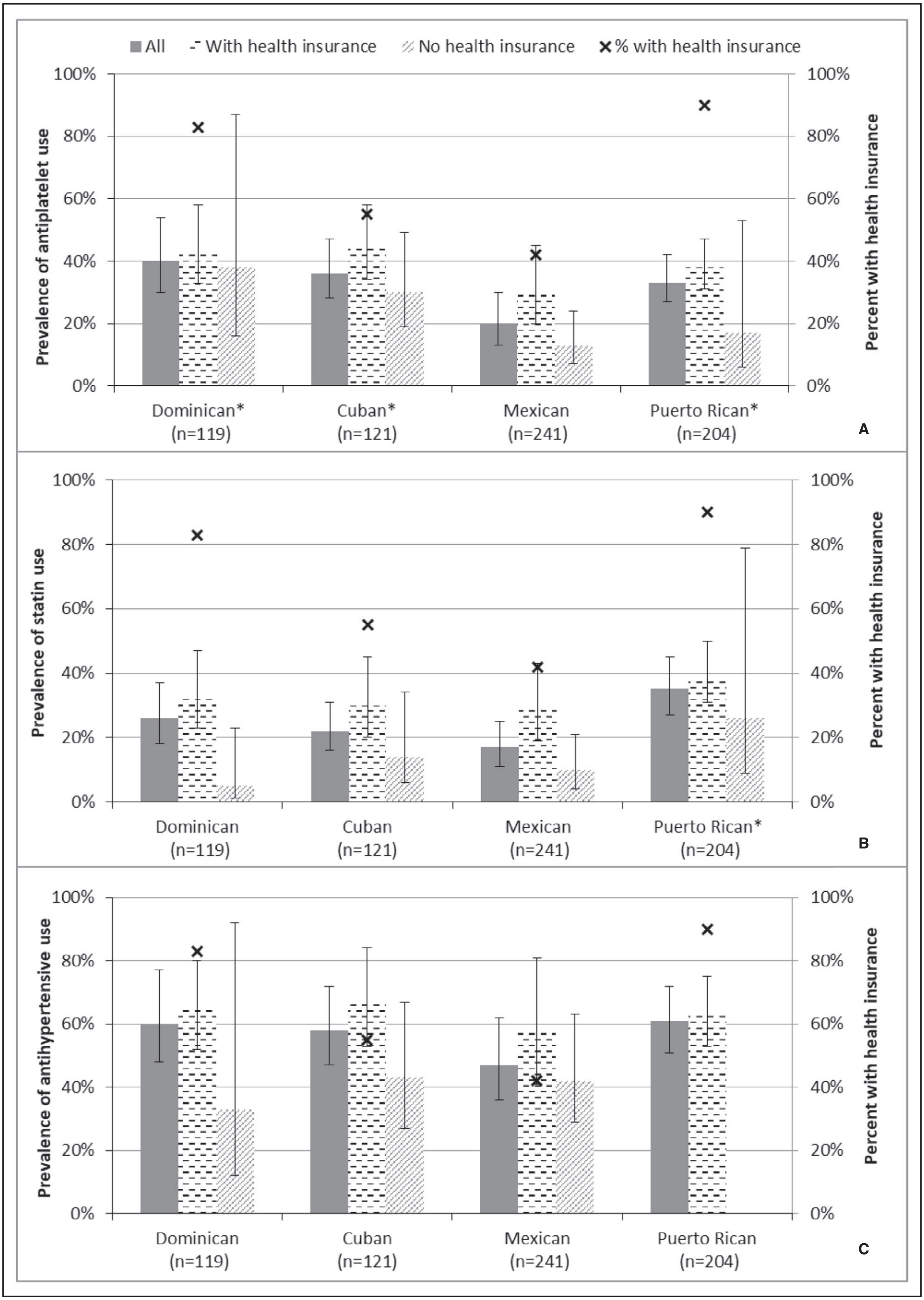
procedures in our study. Evidence of underuse in this high clinical need group has been reported previously in other populations.[24,25]

Consistent with previously reported discrepancies in the treatment of PAD patients with versus without CAD,[16–18] we found that people with PAD and concurrent CAD were at least 1.5 times more likely to use antiplatelet medications and statins than those with PAD alone adjusting for sociodemographic and socioeconomic factors. A large international study across North America, Latin America, Europe, Asia, and Australia showed that patients with PAD were less likely to achieve optimal cardiovascular risk factors control compared with those with CAD or cerebrovascular disease.[24] These findings may reflect systematic differences in applying recommended guidelines in clinical practice on CAD/stroke versus other forms of vascular disease. Given the beneficial effects of cardiovascular pharmacotherapies, our reported levels of underuse among patients with PAD suggest an imperative to raise awareness among clinicians about treatment of patients with PAD according to the established guidelines to prevent adverse outcomes.[17,25–31]

We found variations in use of cardiovascular therapies according to Hispanic/Latino background. Adults of Mexican background tended to lack health insurance coverage and reported low use of all classes of cardiovascular medications. Differences

Figure 1. Prevalence of using cardiovascular medications among individuals with history of PAD with and without health insurance coverage and percent of health insurance coverage stratified by Hispanic/Latino background (adjusted for age). Error bars indicate 95% CIs.

A, Prevalence of antiplatelet medication use. **B**, Prevalence of statin use. **C**, Prevalence of antihypertensive medication use among people with hypertension. *Indicates prevalence of medication use in comparison with Mexican P<0.05 among people with and without health insurance. Hispanic/Latino group with n<100 were not shown. Puerto Ricans with hypertension and no health insurance were omitted because of n<10.


All
With health insurance
No health insurance
% with health insurance
Prevalence of antiplatelet use
Percent with health insurance
100%
80%
60%
40%
20%
0%
Dominican* (n=119)
Cuban* (n=121)
Mexican (n=241)
Puerto Rican* (n=204)
A
Prevalence of statin use
Dominican (n=119)
Cuban (n=121)
Mexican (n=241)
Puerto Rican* (n=204)
B
Prevalence of antihypertensive use
Dominican (n=119)
Cuban (n=121)
Mexican (n=241)
Puerto Rican (n=204)
C

in cardiovascular medication use among diverse US Hispanic/Latinos with PAD have not been previously reported. Existing estimates (eg, National Health and Nutrition Examination Survey) are derived from Mexican origin samples and miss important variations between Hispanic/Latino groups.[32] The differences may not be fully explained by levels of health insurance coverage. For instance, our results indicate that individuals of Puerto Rican and Dominican background had high levels of coverage with health insurance (80%–90%), yet they did not have proportionally more use of statins or antihypertensive medications compared with other groups. Adjusting for health insurance coverage and healthcare use attenuated the association between Hispanic/Latino background and statins use but the association remained significant for antihypertensive medication use.

The majority of our study population was born outside of the United States, most preferred to speak Spanish, and about 37% did not have health insurance coverage. These factors may be associated with barriers to health services (eg, delayed care) and low use of prescribed medications among Hispanic/Latinos in the United States.[33] Indeed, as compared with other racial/ethnic groups, Hispanic/Latino patients with PAD are more likely to be admitted to emergency departments with higher disease severity,[19] and are less likely to have lower extremity revascularization when hospitalized despite ischemic conditions.[20] There might be more complex reasons behind these findings, such as high burden of comorbid disease with poor glycemic control,[34] lack of access to health services, lack of awareness of the disease, and treatment discrepancies. Our study suggests that PAD patients with more frequent physician visits and with existing cardiovascular risk factors, such as hypertension and diabetes mellitus, were more likely to use cardiovascular medication. This might be explained by more frequent use of health care among people with more severe disease conditions, along with increased opportunities for physician implementation or management of guideline-directed medical therapies. Such a pattern might also be accompanied by greater awareness of the condition and improved adherence to the medication prescription.[35] However, improving access to health services might be insufficient. Preventing delayed treatment and unfavorable outcomes might require educating the patients about the disease and increasing adherence to prescribed cardiovascular medications and lifestyle modification.[26,36–38]

The major strength of our study is that we provided the prevalence of cardiovascular medication use among a large and diverse community-based population of Hispanics/Latinos. In addition, we evaluated a wide range of factors including socioeconomic status, health insurance coverage, healthcare use, and comorbidities. However, there are limitations related to this study. First, we only estimated the prevalence for using guideline-recommended medications during a specific calendar time and lack multiple estimates across years. Second, the prevalence estimates in our study may be subject to misclassification of medications, and we could not distinguish between patients who were not prescribed medications and those who may not have been taking prescribed medications. Third, PAD defined using self-reported physician diagnosis may be subject to information bias such as inclusion of false-positive cases or exclusion of false-negative cases, which would underestimate the prevalence of using cardiovascular medications. Fourth, this study did not have a non-Hispanic group for comparison. Finally, our target population consisted of community-based middle-aged Hispanic/Latinos residing in 4 cities in the United States; thus, our findings cannot be generalized to those living in other areas of the United States or the elderly population.

In conclusion, among this Hispanic/Latino community-based sample, we found underuse of guideline-recommended cardiovascular therapies among individuals with known PAD. The underuse varied by Hispanic/Latino background and was worse in people of Mexican background. Our results suggest that improving healthcare use and advocating for guideline-adherent treatment, especially among those with PAD alone, might be key factors to increasing cardiovascular medication use. We believe our findings provide crucial evidence on the treatment status of Hispanic/Latino population with PAD in the United States, identifying a clear area of need in improving cardiovascular outcomes among this important race-ethnic minority group.

ARTICLE INFORMATION

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Disclosures

Dr Kizer reports stock ownership in Bristol-Myers Squibb, Merck, Medtronic, Johnson & Johnson, and Pfizer. The remaining authors have no disclosures to report.

Supplementary Materials

Tables S1–S2

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SUPPLEMENTAL MATERIAL

Table S1. Age-adjusted prevalence of using cardiovascular medications by individual characteristics among those with medical history of PAD.

	Antiplatelets row % (95% CI)	Statins row % (95% CI)	Antihypertensives[‡] row % (95% CI)
Age[†]	***	***	***
18-44	6 (2-13)	3 (1-9)	40 (23-60)
45-54	21 (15-28)	19 (14-27)	42 (31-54)
55-64	41 (34-49)	34 (28-41)	62 (53-70)
65-76	55 (43-66)	37 (27-47)	66 (55-75)
Sex	*	*	
Male	35 (28-43)	27 (22-35)	57 (49-64)
Female	27 (28-43)	20 (17-25)	56 (49-67)
Education		*	*
less than 9 years	33 (27-42)	24 (19-31)	55 (46-65)
9 years-10 years	32 (23-44)	32 (23-47)	75 (63-89)
high school	28 (20-41)	14 (9-21)	55 (44-70)
more than high school	28 (22-37)	25 (18-33)	51 (40-63)
Income			
less than $15K	31 (25-39)	27 (22-34)	58 (49-68)
$15K-30K	32 (24-42)	24 (18-34)	56 (46-70)
$30k or more	28 (20-40)	20 (13-30)	44 (32-61)
missing	29 (20-41)	16 (9-27)	50 (37-69)
Employment			
Retired	35 (28-44)	25 (18-33)	59 (50-70)
Unemployed	30 (24-37)	27 (21-34)	58 (49-68)
Part-time	30 (18-49)	21 (12-36)	48 (29-79)
Full-time	22 (14-35)	15 (8-30)	53 (39-71)
Hispanic background		**	**
Dominican	40 (30-54)	26 (18-37)	60 (48-77)
Central American	22 (13-39)	19 (11-35)	81 (71-93)
Cuban	36 (28-47)	22 (16-31)	58 (47-72)
Mexican	20 (13-30)	17 (11-25)	47 (36-62)
Puerto Rican	33 (27-42)	35 (27-45)	61 (51-72)
South American	32 (19-52)	15 (7-31)	36 (19-69)
Mixed/other	24 (9-70)	2 (0-19)	21 (6-73)
Nativity		*	*
US born	35 (23-54)	34 (22-53)	74 (54-102)
Foreign born	30 (26-35)	23 (19-27)	55 (49-62)
Language preference		*	
English	31 (22-45)	36 (25-53)	69 (51-94)
Spanish	30 (26-36)	22 (18-26)	55 (49-62)
Health insurance	*	**	*

No	25 (18-34)	13 (8-21)	46 (37-58)
Yes	36 (31-41)	31 (26-36)	62 (55-69)
Health insurance type		**	
None	25 (18-34)	13 (8-21)	46 (37-58)
Private	35 (28-45)	27 (20-36)	60 (50-72)
Public (Medicaid or Medicare or military)	37 (31-44)	33 (27-41)	64 (55-74)
Other	22 (10-52)	24 (10-56)	45 (22-89)
Number of doctor visits in the past year	**	**	**
0	14 (7-28)	2 (0-14)	25 (12-52)
1	16 (9-29)	9 (4-20)	37 (21-63)
2-3	34 (26-45)	24 (17-35)	50 (38-66)
4+	35 (30-42)	31 (26-36)	65 (58-73)
Exertional leg pain			
Yes	38 (32-45)	30 (25-36)	62 (52-75)
No	39 (30-50)	29 (22-39)	58 (51-66)
Claudication			
Yes	41 (35-50)	30 (24-38)	57 (49-67)
No	34 (28-42)	28 (23-35)	60 (52-68)
Surgical procedure for PAD	*	*	
Yes	44 (33-61)	37 (25-56)	55 (37-82)
No	29 (25-34)	22 (19-26)	57 (51-63)
Obesity	*		*
Yes	34 (28-40)	26 (21-31)	61 (54-69)
No	27 (22-34)	21 (16-27)	50 (41-60)
Dyslipidemia	**	***	**
Yes	38 (32-45)	42(36-48)	64 (57-71)
No	20 (15-27)	0	43 (34-53)
History of hypertension	***	**	***
Yes	41 (36-47)	31 (26-36)	51 (45-58)
No	7 (4-10)	8 (4-15)	0
History of diabetes	***	***	***
Yes	48 (41-56)	37 (30-45)	71 (63-80)
No	18 (14-23)	14 (10-19)	43 (36-51)
Current smoking			
Yes	30 (20-43)	21 (13-32)	53 (40-69)
No	31 (26-36)	24 (20-29)	57 (51-64)

***<0.0001,**<0.01,*≤0.10. †No adjustment for age. ‡ Among people with known hypertension.

Table S2. Health insurance coverage by Hispanic/Latino background.

	Health insurance coverage % (95% CI)	P-values
Hispanic background		<0.0001
Dominican	83 (74-93)	<0.0001
Central American	36 (24-55)	0.53
Cuban	55 (46-67)	0.11
Mexican	42 (32-56)	reference
Puerto Rican	90 (85-95)	<0.0001
South American	60 (44-82)	0.09
Mixed/other	68 (49-94)	0.03

Adjusted for age.