

American College of Cardiology/American Heart Association (ACC/AHA) Class I Guidelines for the Treatment of Cholesterol to Reduce Atherosclerotic Cardiovascular Risk: Implications for US Hispanics/Latinos Based on Findings From the Hispanic Community Health Study/Study of Latinos (HCHS/SOL)

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Background—The prevalence estimates of statin eligibility among Hispanic/Latinos living in the United States under the new 2013 American College of Cardiology/American Heart Association (ACC/AHA) cholesterol treatment guidelines are not known.

Methods and Results—We estimated prevalence of statin eligibility under 2013 ACC/AHA and 3rd National Cholesterol Education Program Adult Treatment Panel (NCEP/ATP III) guidelines among Hispanic Community Health Study/Study of Latinos (n=16 415; mean age 41 years, 40% males) by using sampling weights calibrated to the 2010 US census. We examined the characteristics of Hispanic/Latinos treated and not treated with statins under both guidelines. We also redetermined the statin-therapy eligibility by using black risk estimates for Dominicans, Cubans, Puerto Ricans, and Central Americans. Compared with NCEP/ATP III guidelines, statin eligibility increased from 15.9% (95% CI 15.0–16.7%) to 26.9% (95% CI 25.7–28.0%) under the 2013 ACC/AHA guidelines. This was mainly driven by the $\geq 7.5\%$ atherosclerotic cardiovascular disease risk criteria (prevalence 13.9% [95% CI 13.0–14.7%]). Of the participants eligible for statin eligibility under NCEP/ATP III and ACC/AHA guidelines, only 28.2% (95% CI 26.3–30.0%) and 20.6% (95% CI 19.4–21.9%) were taking statins, respectively. Statin-eligible participants who were not taking statins had a higher prevalence of cardiovascular risk factors compared with statin-eligible participants who were taking statins. There was no significant increase in statin eligibility when atherosclerotic cardiovascular disease risk was calculated by using black estimates instead of recommended white estimates (increase by 1.4%, $P=0.12$) for Hispanic/Latinos.

Conclusions—The eligibility of statin therapy increased consistently across all Hispanic/Latinos subgroups under the 2013 ACC/AHA guidelines and therefore will potentially increase the number of undertreated Hispanic/Latinos in the United States. (*J Am Heart Assoc.* 2017;6:e005045. DOI: 10.1161/JAHA.116.005045.)

Key Words: ACC/AHA cholesterol treatment • disparities • epidemiology • guideline • Hispanics/Latinos • statin therapy

In 2013, American College of Cardiology/American Heart Association (ACC/AHA) cholesterol treatment guidelines based on high-quality evidence were published.¹ These guidelines replaced the previous cholesterol treatment

guidelines: the third report of the national cholesterol education program/adult cholesterol treatment panel III (NCEP/ATP III).² Applying data from the National Health and Nutrition Examination Surveys, researchers suggested that

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Accompanying Tables S1 through S3 and Figure S1 are available at <http://jaha.ahajournals.org/content/6/5/e005045/DC1/embed/inline-supplementary-material-1.pdf>

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the new 2013 ACC/AHA guidelines for the management of cholesterol could potentially increase the number of statin-therapy eligible US adults by 12.8 million.³ However, this study did not include several of the Hispanic/Latino subpopulations and only included Mexican Hispanics. In addition, current cholesterol treatment guidelines were based on either non-Hispanic white and/or black populations and did not take into account Hispanics/Latinos.

Hispanics/Latinos currently constitute 18% of the US population, making them the largest ethnic minority. It is important to study the statin eligibility to direct healthcare needs for primary prevention of cardiovascular disease in this ethnic group. The current guidelines provided an atherosclerotic cardiovascular disease (ASCVD) calculator to estimate 10-year ASCVD risk. This calculator uses the same estimates for Hispanics/Latinos as that of whites. However, several of the Hispanics/Latinos share their ancestry with African ancestry, particularly Caribbean-Hispanics (Cubans, Dominican, and Puerto Rican descent) and Central Americans.^{4–7} It is likely that not recognizing the African ancestry in certain Hispanic groups could underestimate ASCVD risk. It is important to address these knowledge gaps as it would potentially provide data of public health importance that could be utilized to address the current disparities in primary prevention of ASCVD. Therefore, we determined the prevalence estimates from the Hispanic Community Health Study/Study of Latinos eligible for cholesterol treatment under the new 2013 ACC/AHA guidelines and previous NCEP/ATP III guidelines. We further examined the prevalence of US Hispanics/Latinos who are eligible for statin therapy but are currently not on statin therapy.

Methods

Study Design and Population

The Hispanic community health study/study of Latinos (HCHS/SOL) is a community-based study of 16 415 Hispanic/Latino adults aged 18 to 74 years at recruitment, recruited from 4 US metropolitan areas (Bronx, NY; Chicago, IL; Miami, FL; and San Diego, CA).⁸ Participants were recruited by using a 2-stage probability sample design, as described previously.⁹ A comprehensive battery of interviews relating to personal and family characteristics, health status and behaviors, and a clinical assessment with blood draws were conducted at an in-person baseline clinic visit during 2008 to 2011. The study was approved by the institutional review boards at all participating institutions, and all participants gave written informed consent.

Risk Factor Assessment

Participants were asked to fast and refrain from smoking on the morning before the HCHS/SOL baseline clinic visit.

Following a 5-minute rest period, 3 seated blood pressure measurements were obtained with an automatic sphygmomanometer, which were averaged. Total cholesterol, high-density lipoprotein cholesterol, low-density lipoprotein cholesterol, triglycerides, and fasting glucose were measured using standardized methods described previously.^{10,11} Height, waist circumference, and hip circumference were measured to the nearest centimeter and weight to the nearest 0.1 kg. BMI was calculated as weight in kilograms divided by height in meters squared. Interviewer-administered questionnaires were used to collect information on age, sex, annual household income, educational attainment, Hispanic/Latino background, employment status, health insurance status, and history of smoking. Diabetes mellitus was defined as fasting glucose ≥ 126 mg/dL, 2-hour-postload plasma glucose ≥ 200 mg/dL, hemoglobin A1c $\geq 6.5\%$, use of diabetes medications, or self-reported history of diabetes mellitus. Participants were instructed to bring all prescription and nonprescription medications taken in the past 4 weeks; medication preparations, concentrations, and units were coded for analysis. We defined statin medication use as the use of at least 1 statin (3-hydroxy-3-methylglutaryl coenzyme A reductase inhibitors) medication.

Cholesterol Treatment Guidelines and Statin Eligibility

Statin eligibility was defined by using the following NCEP/ATP III updated guidelines¹² and ACC/AHA guidelines. As per 2004 NCEP/ATP III guidelines, statin-eligible participants included participants with (1) prevalent coronary heart disease, defined as myocardial infarction, coronary bypass surgery, balloon angioplasty, or stent placement in coronary arteries, and low-density lipoprotein (LDL) cholesterol of 100 or higher; (2) LDL cholesterol of 190 mg/dL or higher; (3) diabetes mellitus and LDL cholesterol of 100 or higher; (4) combination of calculated 10-year coronary heart disease Risk (using the Framingham risk calculator) and LDL cholesterol levels: (1) risk of 20% or greater and LDL cholesterol of 100 mg/dL or higher; (2) risk of 10% to 20% and LDL cholesterol of 130 mg/dL or higher with 2 or more risk factors (smoking, hypertension, high-density lipoprotein cholesterol less than 40 mg/dL, myocardial infarction or angina in first-degree relative before age 50, and age [45 years or older for men, 55 years or older for women]); (3) risk of less than 10% and LDL cholesterol of 160 mg or higher with 2 or more risk factors.

By 2013 ACC/AHA class I guidelines,¹³ statin-eligible participants included the following: (1) prevalent cardiovascular disease, defined as coronary heart disease, angina, or stroke; (2) LDL cholesterol of 190 mg/dL or higher; (3) diabetes mellitus and LDL cholesterol of 70 mg/dL or

higher; and (4) 10-year cardiovascular disease risk of 7.5% or greater, based on the pooled cohort equations and LDL cholesterol of 70 or higher.¹⁴

Statistical Analysis

We chose a probability sampling strategy with face-to-face recruitment. Geographic clusters were stratified by the proportion of the population found to be Hispanic/Latino in the 2000 decennial census, and clusters in the “high concentration” stratum were selected at a higher rate than clusters in the “low concentration” stratum at the first stage of sample selection. An optimal delineation point between high and low concentration was determined for each field center using Cochran’s cumulative \sqrt{f} rule.¹⁵ Furthermore, we also used Hispanic/Latino surnames to identify home addresses in these geographic areas and were oversamples compared to the home addresses without Hispanic/Latino surnames. We used SAS SURVEY command to calculate the prevalence estimates by using sampling weights, which took into account nonresponse and oversampling of specific population subgroups to provide weighted frequencies of descriptive variables and population estimates of statin-therapy eligibility. Weights were calibrated to 2010 US census characteristics by age, sex, and Hispanic/Latino background in each field center’s target population, in accordance with the procedures commonly used in population-based studies.⁹ Continuous variables were compared using regression analysis and categorical variables were compared using Rao–Scott χ^2 test. We also classified prevalence that were statin-therapy eligible under previous versus newer guidelines. Under the new guidelines, statin eligibility falls into 3 criteria: (1) individuals with history of clinical cardiovascular disease; (2) those with LDL-C ≥ 190 mg/dL; (3) those without known ASCVD with LDL-C between 70 and 189 mg/dL but with $\geq 7.5\%$ 10-year ASCVD risk; and (4) those with diabetes mellitus and LDL-C ≥ 70 mg/dL. The new Pooled Cohort Risk Assessment calculator was used to assess ASCVD risk using white estimates for Hispanics.¹⁴

We then identified individuals who were not treated (undertreatment) by statin therapy but were classified as eligible for statin therapy. We defined statin-therapy undertreatment as the prevalence eligible for statin therapy under cholesterol treatment guideline but were not on statin. We then examined prevalence of various subgroups that were statin eligible under current and previous guidelines to show disparities and characteristics of these individuals. Race factors into ASCVD risk prediction in the new ACC/AHA guidelines, with recommendations to assume white risk estimates in all Hispanics. Since certain Hispanic groups have more African ancestry, the current guidelines fail to

consider the complexity of the Hispanic/Latino population. Thus, race was treated separately in sensitivity analysis. All analyses were weighted to adjust for sampling probability and nonresponse, to make the estimates applicable to the target population from which the HCHS/SOL sample was drawn in accordance with guidelines suggested by the HCHS/SOL Steering and Data Analysis Committee. A *P* value of <0.05 was considered significant. All analyses were performed using SAS v. 9.3 (Cary, NC).

Results

Participant Characteristics

Descriptive characteristics are shown in Table 1. Hispanics/Latinos statin-therapy eligible by ACC/AHA guidelines were more often older, more males, and had higher systolic blood pressure and total cholesterol than participants eligible by NCEP/ATP III guidelines. On the other hand, the prevalence of obesity and antihypertensive medication use was lower for statin-eligible participants by ACC/AHA guidelines than NCEP/ATP III guidelines.

Application of 2013 ACC/AHA Cholesterol Treatment Guidelines to the Cohort

Figure shows the breakdown of study participants by cholesterol treatment guidelines. Out of 16 415 participants, 4160 (26.9%; 95% CI 25.7–28.0%) were statin eligible under the 2013 ACC/AHA guidelines while 2609 (15.9%; 95% CI 15.0–16.7%) were statin eligible under the NCEP/ATP III guidelines. This eligibility was based on prior history of ASCVD in 771 (4.7%; 95% CI 4.2–5.2%), LDL ≥ 190 mg/dL in 640 (3.9%; 95% CI 3.5–5.3%), history of diabetes mellitus in 2101 (12.8%; 95% CI 12.0–13.5%), and LDL ≥ 70 mg/dL with 10-year ASCVD risk of $\geq 7.5\%$ in 2281 (13.9%; 95% CI 13.0–14.7%) (Table 2). The overall most common indication for statin eligibility among all Hispanics/Latinos subgroups was having ASCVD risk of $\geq 7.5\%$. When stratified by age and sex, Puerto Rican females aged 18 to 64 years had the highest prevalence of statin-eligible participants by 10-year ASCVD risk of $\geq 7.5\%$ criteria (χ^2 statistic <0.05) than other subgroups (Table S1).

Increase in Eligibility for Statin Therapy

There was an increase in eligibility for statin therapy under the ACC/AHA guidelines across all Hispanic/Latino subgroups as shown in Table 3. The increase in eligibility was mainly driven by ASCVD risk score. There was an absolute increase by 11.0% (69.1% relative increase). Particularly, the subgroups aged >65 years and males had the highest increase in statin

Table 1. Prevalence Estimates and 95% CI by Category of ATP III and ACC/AHA Cholesterol Guidelines for Participants in the HCHS/SOL

Characteristic	All Cohort	Statin Eligible by ATP III Guidelines	Statin Eligible by ACC/AHA Guidelines	Newly Eligible for Statin by ACC/AHA Guidelines
Age, y	41.0 (0.3)	52.9 (0.4)	54.3 (0.4)	55.3 (0.5)
Male	47.9 (46.8, 48.9)	45.1 (42.6, 47.7)	52.8 (50.8, 54.8)	61.7 (58.7, 64.7)
Females	54.4 (51.1, 53.2)	54.8 (52.3, 57.4)	47.2 (45.2, 49.2)	38.3 (35.3, 41.4)
Hypertension	21.8 (20.6, 22.9)	51.7 (49.0, 54.2)	50.9 (48.6, 53.3)	48.7 (45.4, 52.0)
Smoking status				
Never	61.3 (60.0, 62.5)	56.2 (52.6, 58.7)	49.2 (47.1, 51.3)	40.9 (37.6, 44.1)
Former	17.4 (16.5, 18.2)	24.8 (22.6, 26.9)	24.5 (22.7, 26.2)	24.1 (21.3, 26.9)
Current	21.4 (20.3, 22.5)	19.1 (16.9, 21.3)	26.3 (24.2, 28.4)	35.0 (31.9, 38.2)
Health insurance	50.5 (48.7, 52.4)	59.4 (56.7, 62.2)	59.9 (57.6, 62.2)	59.6 (56.2, 63.0)
Education				
Lower than high school	32.5 (31.1, 33.9)	43.5 (40.9, 46.0)	42.6 (40.4, 44.7)	40.8 (37.7, 43.9)
High school or equivalent	28.4 (27.3, 29.5)	23.9 (21.6, 26.3)	23.0 (21.2, 24.8)	22.0 (19.4, 24.6)
Higher than high school	39.1 (37.5, 40.7)	32.6 (30.0, 35.1)	34.4 (32.2, 36.7)	37.2 (34.0, 40.4)
Income \geq \$40 000/y	20.4 (18.5, 22.4)	15.7 (13.3, 18.0)	16.2 (14.3, 18.2)	16.8 (14.0, 19.7)
Mod/high physical activity	44.5 (43.2, 45.8)	32.5 (29.7, 35.3)	35.3 (33.0, 37.6)	38.9 (35.4, 42.2)
Antihypertensive use	12.8 (12.0, 13.7)	39.4 (36.9, 42.0)	33.1 (31.0, 35.2)	25.8 (23.2, 28.4)
Systolic blood pressure, mm Hg	119.9 (0.2)	128.0 (0.5)	130.9 (0.4)	133.0 (0.6)
Obese (BMI \geq 30 kg/m ²)	39.6 (38.2, 40.9)	55.1 (52.7, 57.6)	48.1 (46.1, 50.2)	39.8 (36.6, 43.1)
Total cholesterol, mg/dL	194.3 (0.6)	210.6 (1.4)	214.6 (1.1)	218.3 (1.6)
High-density lipoprotein, mg/dL	48.5 (0.2)	46.6 (0.3)	47.2 (0.3)	47.4 (0.4)
Hispanic subgroups				
Dominican	10.4 (8.9, 11.8)	14.4 (12.8, 16.0)	23.3 (21.1, 25.5)	11.9 (9.8, 12.2)
Central American	7.7 (6.6, 8.8)	14.6 (13.2, 16.0)	23.5 (21.5, 25.6)	10.8 (9.6, 12.1)
Cuban	20.9 (17.5, 24.3)	17.1 (15.1, 19.2)	36.6 (32.7, 40.5)	21.8 (19.5, 24.1)
Mexican	39.0 (35.6, 42.3)	15.2 (14.2, 16.2)	22.3 (20.9, 23.7)	9.7 (8.8, 10.5)
Puerto Rican	16.9 (15.2, 18.5)	18.8 (17.5, 20.1)	31.6 (29.7, 33.5)	15.3 (14.0, 16.5)
South American	5.2 (4.5, 5.8)	10.6 (9.3, 11.9)	21.5 (19.5, 23.5)	12.2 (10.8, 13.6)

Continuous variables are expressed as mean (standard error) and categorical as numbers (percentage). ACC/AHA indicates American College of Cardiology/American Heart Association; ATP III, 3rd National Cholesterol Education Program Adult Treatment Panel; HCHS/SOL, Hispanic Community Health Study/Study of Latinos.

eligibility under the ACC/AHA guidelines: an absolute increase by 45.6% (114.9% relative increase) and 14.7% (98.6% relative increase), respectively. Among the Hispanic/Latino subgroups, in unadjusted analysis, Cubans and South Americans had the highest increase in statin eligibility (Table 3). The increase in eligibility was more pronounced in >65-year-old individuals and males ($P<0.05$). The age- and sex-stratified analyses shown in Table S2 also demonstrated a consistent pattern of increase in prevalence of statin therapy among statin-eligible participants. In age- and sex-adjusted analyses, the South American subgroup had the least prevalence of statin-eligible participants by both NCEP/ATP III guidelines and ACC/AHA guidelines, while the Puerto Rican

subgroup had the highest prevalence of statin-eligible participants by both guidelines (Table S3).

Statin Treatment Rates of Hispanics/Latinos Under 2013 ACC/AHA and 2004 NCEP/ATP III Guidelines

Among Hispanics/Latinos, prevalence of statin use was 7.9% (95% CI 7.2–8.6%). Of the participants who were statin eligible, only about one third and one fifth of the participants were taking statins under NCEP/ATP III guidelines (28.2% [95% CI 26.3–30.0%]) and ACC/AHA guidelines (20.6% [95% CI 19.4–21.9%]), respectively (P for difference <0.0001).

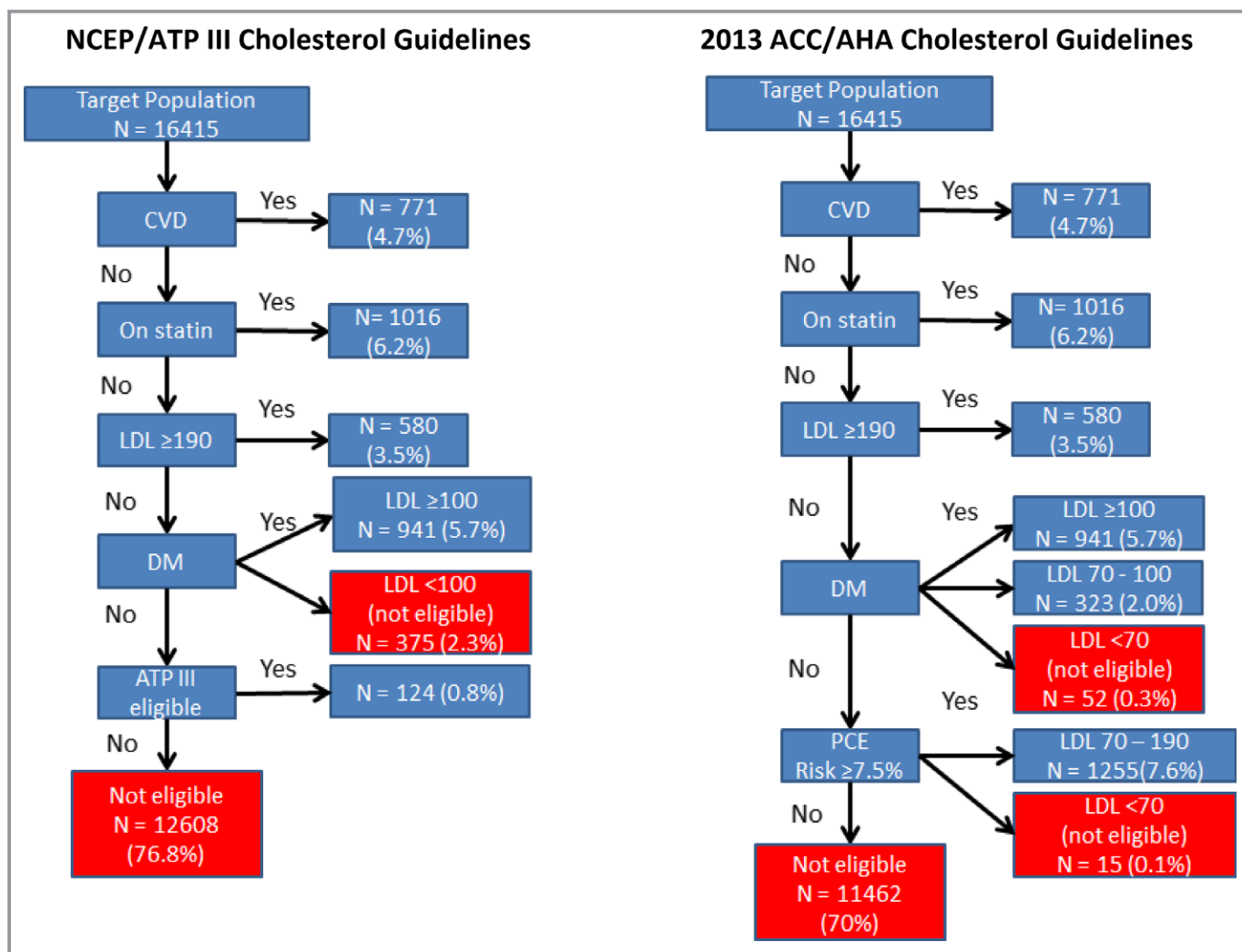


Figure. Eligibility for statin therapy. ACC/AHA indicates American College of Cardiology/American Heart Association; CVD, cardiovascular disease; DM, diabetes mellitus; LDL, low-density lipoprotein; NCEP/ATP III, 3rd National Cholesterol Education Program Adult Treatment Panel; PCE, pooled cohort equation.

Figure S1 shows prevalence of statin therapy for age, sex, and Hispanic/Latino subgroups under both treatment guidelines. This figure shows that younger participants, males, and all Hispanic/Latino subgroups except Puerto Ricans were undertreated by statins. We observed that among those who were statin eligible under the ACC/AHA guidelines, those not on statin therapy were significantly younger and more likely to be males, smokers, and hypertensives. They were also more likely to have no medical insurance and be lower income (Table 4).

Accounting for African Ancestry of Dominicans, Puerto Ricans, Dominicans, and Central Americans for Calculation of 10-Year ASCVD Risk

When we used the white coefficient to calculate 10-year ASCVD risk for all Hispanics/Latinos subgroups, about one

fourth of the participants were statin eligible (26.9% [95% CI 25.8–28.0%]) under ACC/AHA guidelines. When we used black coefficient to estimate ASCVD risk for Dominicans, Puerto Ricans, and Central Americans, 28.2% (95% CI 27.0–29.4%) were statin eligible, which was a 1.3% absolute increase in statin eligibility while 0.40% (95% CI 0.29–0.53%) became ineligible.

Discussion

In this large population-based sample of Hispanics/Latinos living in the United States, we observed that a higher number of Hispanics/Latinos will be eligible for statin therapy under the new 2013 ACC/AHA guidelines. The increase in eligibility was found across several demographic subgroups but was particularly higher among males, middle aged (45–64 years) individuals, and among certain Hispanic

Table 2. Prevalence Estimates and 95% CI for Statin Therapy by 2013 ACC/AHA Cholesterol Treatment Class I Guideline-Based Categories

	History of ASCVD	P Value	LDL ≥190 mg/dL	P Value	Diabetes Mellitus	P Value	≥7.5% of ASCVD Risk and LDL ≥70 mg/dL	P Value
All	4.7 (4.2, 5.2)		3.9 (3.5, 4.3)		12.8 (12.0, 13.5)		13.9 (13.0, 14.7)	
Age 18 to 44, y	2.4 (2.1, 2.7)	<0.0001	2.2 (2.0, 2.5)	<0.0001	5.0 (4.7, 5.4)	<0.0001	1.5 (1.3, 1.7)	<0.0001
Age 45 to 64, y	7.0 (6.4, 7.6)		6.7 (6.1, 7.3)		20.7 (19.6, 21.7)		21.8 (20.6, 23.0)	
Age >65, y	12.6 (11.2, 14.1)		5.2 (4.4, 6.1)		37.4 (34.5, 40.4)		71.0 (66.3, 75.7)	
Female	2.0 (1.6, 2.3)	0.0001	2.0 (1.7, 2.2)	0.48	7.2 (6.6, 7.8)	0.008	5.6 (5.1, 6.1)	<0.0001
Male	2.8 (2.3, 3.2)		1.9 (1.6, 2.2)		5.6 (5.1, 6.0)		8.3 (7.6, 8.9)	
Dominican	4.2 (3.6, 4.9)	<0.0001	3.8 (3.2, 4.4)		11.4 (10.1, 12.8)	<0.0001	10.4 (9.0, 11.7)	<0.0001
Central American	3.4 (2.7, 4.0)		4.0 (3.4, 4.7)		11.6 (10.5, 12.8)		11.5 (10.4, 12.7)	
Cuban	5.3 (4.6, 6.1)		5.7 (5.0, 6.5)		13.9 (12.2, 15.6)		23.6 (21.2, 26.1)	
Mexican	3.4 (3.0, 3.9)		3.4 (3.0, 3.9)		11.9 (11.1, 12.7)		9.7 (8.9, 10.4)	
Puerto Rican	7.5 (6.7, 8.3)		3.1 (2.6, 3.6)		15.8 (14.7, 16.9)		16.9 (15.5, 18.2)	
South American	3.5 (2.8, 4.2)		4.2 (3.4, 4.9)		8.3 (7.2, 9.4)		12.3 (10.8, 13.7)	

The percentages are related to the total number of individuals eligible for statin therapy by ACC/AHA class I guidelines in each subgroup. ACC/AHA indicates American College of Cardiology/American Heart Association; ASCVD, atherosclerotic cardiovascular disease; LDL, low-density lipoprotein.

background groups (Dominicans, Puerto Ricans, and Central Americans). We also found that only one third and one fifth of statin-eligible Hispanics/Latinos under NCEP/ATP III guidelines and 2013 ACC/AHA guidelines, respectively, were taking statins. In addition, we found that changing the estimates for 10-year ASCVD risk for the Hispanic/Latino subgroups for Dominicans, Puerto Ricans, and Central Americans did not significantly increase statin eligibility.

To our knowledge, this is the first population-based study of Hispanics/Latinos living in the United States that has provided prevalence estimates of statin eligibility under 2013 ACC/AHA cholesterol and 2004 NCEP/ATP III cholesterol treatment guidelines. The findings of this study are consistent with other studies showing increase in statin eligibility among whites,¹⁶ Europeans,¹⁷ and Koreans, Mexican majority Hispanics, and Chileans.^{18–21} The newer guidelines have expanded the

Table 3. Prevalence Estimates and 95% CI of Statin-Therapy Eligible Under Both Guidelines

	2004 ATP III/NCEP	2013 ACC/AHA	Newly Eligible	P Value	Absolute Increase*	Relative Increase†
	Prevalence Estimates (95% CI)					
All	15.9 (15.0, 16.7)	26.9 (25.7, 28.0)	13.2 (12.4, 14.1)		11.0%	69.1%
Age 18 to 44, y	7.0 (6.7, 7.2)	10.0 (9.4, 10.5)	4.3 (3.9, 4.6)	<0.0001	3.0%	42.8%
Age 45 to 64, y	25.4 (24.5, 26.3)	42.0 (39.8, 44.1)	20.4 (19.1, 21.7)		16.6%	65.3%
Age >65, y	43.4 (38.8, 47.9)	89.0 (83.5, 94.5)	49.9 (46.3, 53.4)		45.6%	114.9%
Female	16.8 (15.9, 17.7)	24.4 (23.3, 25.6)	9.7 (9.1, 10.3)	<0.0001	7.6%	45.2%
Male	14.9 (14.1, 15.7)	29.6 (28.1, 31.1)	17.8 (16.7, 18.8)		14.7%	98.6%
Dominican	14.4 (12.8, 16.0)	23.4 (21.2, 25.5)	11.0 (9.8, 12.2)	<0.0001	9.0%	62.5%
Central American	14.6 (6.9, 22.4)	23.6 (21.5, 25.6)	10.8 (9.6, 12.1)		9.0%	61.6%
Cuban	17.1 (15.1, 19.2)	36.6 (32.7, 40.5)	21.8 (19.5, 24.1)		19.5%	114.0%
Mexican	15.2 (14.2, 16.2)	22.3 (20.9, 23.7)	9.7 (8.8, 10.5)		7.1%	46.7%
Puerto Rican	18.8 (17.5, 20.1)	31.6 (29.7, 33.5)	15.3 (14.0, 16.5)		12.8%	68.1%
South American	10.6 (9.3, 11.9)	21.5 (19.5, 23.5)	12.2 (10.8, 13.6)		10.9%	102.8%

ACC/AHA indicates American College of Cardiology/American Heart Association; ATP III/NCEP, 3rd National Cholesterol Education Program Adult Treatment Panel.

*Absolute increase in eligibility in a subgroup=([Eligible by ACC/AHA–Eligible by ATP III/NCEP]/total number at risk in that subgroup)×100%.

†Relative increase in eligibility in a subgroup=([Eligible by ACC/AHA–Eligible by ATP III/NCEP]/Eligible by ATP III/NCEP)×100%.

Table 4. Prevalence Estimates (%) and 95% CI for Statin Eligible on Statins and Not on Statins Under Both Guidelines

Variables	Statin Eligible by ATP III Guidelines on Statins	Statin Eligible by ATP III Guidelines Not on Statins	P Value	Statin Eligible by ACC/AHA Guidelines on Statins	Statin Eligible by ACC/AHA Guidelines Not on Statins	P Value
All	28.2 (26.3, 30.0)	71.8 (68.4, 75.3)		20.6 (19.4, 21.9)	79.4 (75.6, 83.1)	
Age, y	59.8 (0.5)	50.5 (0.5)	<0.001	61.0 (0.4)	52.7 (0.4)	<0.001
Male	43.4 (38.3, 48.4)	45.2 (42.1, 48.3)	0.29	46.9 (42.3, 51.4)	54.0 (51.6, 56.2)	0.007
Female	56.6 (51.5, 61.6)	54.9 (51.8, 58.0)		53.1 (48.6, 57.7)	46.0 (43.7, 48.3)	
Hypertension	77.9 (74.1, 81.7)	42.8 (39.7, 45.9)	<0.001	75.7 (71.9, 79.4)	45.6 (42.8, 48.4)	<0.001
Smoking status			0.03			<0.001
Never	55.9 (51.5, 60.4)	56.4 (53.2, 59.6)		53.2 (49.2, 57.3)	48.5 (46.0, 50.9)	
Former	28.8 (24.7, 32.8)	23.6 (21.1, 26.0)		30.1 (26.3, 33.9)	23.1 (21.1, 25.1)	
Current	15.3 (11.8, 18.9)	20.0 (17.5, 22.5)		16.7 (13.3, 20.1)	28.4 (26.1, 30.8)	
Health insurance	82.3 (78.4, 86.2)	50.9 (47.9, 53.8)	<0.001	85.6 (82.6, 88.6)	53.4 (50.9, 56.0)	<0.001
Education			0.007			0.004
Lower than high school	14.4 (12.7, 16.1)	29.6 (27.1, 32.1)		49.6 (45.4, 53.7)	41.1 (38.6, 43.5)	
High school or equivalent	5.4 (4.0, 6.8)	17.6 (15.5, 19.7)		18.4 (14.8, 21.9)	23.6 (21.5, 25.8)	
Higher than high school	8.4 (6.9, 10.0)	24.4 (22.2, 26.7)		32.0 (27.4, 36.7)	35.3 (32.8, 37.7)	
Income ≥\$40 000/y	15.8 (11.6, 20.1)	15.1 (12.6, 17.5)	0.02	18.2 (14.0, 22.4)	15.7 (13.7, 17.8)	0.09
Moderate/high physical activity	27.9 (22.4, 33.5)	33.6 (30.2, 36.8)	0.10	26.8 (22.1, 31.6)	63.0 (60.2, 65.8)	0.001
Antihypertensive use	70.5 (66.4, 74.6)	27.3 (24.7, 29.8)	<0.001	65.7 (61.6, 69.8)	24.6 (22.5, 26.7)	<0.001
Systolic blood pressure, mm Hg	131.2 (0.8)	126.7 (0.6)	<0.001	133.1 (0.7)	130.4 (0.5)	<0.001
Obese (BMI ≥30 kg/m ²)	16.4 (14.3, 18.5)	39.2 (36.7, 41.6)	0.14	10.6 (9.2, 12.1)	37.6 (35.6, 39.7)	0.10
Total cholesterol, mg/dL	185.0 (2.1)	220.3 (1.6)	<0.001	193.5 (1.9)	220.3 (1.2)	<0.001
High-density lipoprotein, mg/dL	47.6 (0.6)	46.3 (0.4)	<0.001	48.5 (0.6)	46.8 (0.3)	<0.001
Hispanic subgroups			<0.001			
Dominican	10.5 (7.6, 13.3)	9.2 (7.0, 11.3)		9.8 (7.3, 12.3)	8.7 (7.0, 10.3)	
Central American	5.7 (3.7, 7.8)	7.8 (6.4, 9.3)		4.9 (3.3, 6.6)	7.2 (6.0, 8.5)	
Cuban	23.8 (18.4, 29.1)	22.3 (18.0, 26.7)		26.2 (21.6, 30.7)	29.2 (24.6, 33.7)	
Mexican	29.4 (24.5, 34.2)	40.7 (36.3, 45.0)		28.0 (23.7, 32.3)	33.2 (29.3, 37.2)	
Puerto Rican	27.3 (23.3, 31.3)	27.3 (23.3, 31.3)		27.6 (23.9, 31.2)	17.3 (15.0, 19.7)	
South American	3.3 (2.1, 4.5)	3.7 (2.7, 4.7)		3.6 (2.4, 4.7)	4.4 (3.5, 5.2)	

ACC/AHA indicates American College of Cardiology/American Heart Association; ATP III/NCEP, 3rd National Cholesterol Education Program Adult Treatment Panel. Continuous variables are expressed as mean (SE) and categorical as numbers (percentage). Continuous variables were compared using survey regression method and categorical variables were compared using Rao-Scott χ^2 method.

indications for statin therapy by including ASCVD risk score and have shown almost doubling of the statin eligibility.^{16–18,22} Our study confirms a prior study where the majority of the Hispanics were of Mexican origin. However, the study did not provide prevalence estimates and did not represent all the subgroups of Hispanic/Latino origin.²² An important aspect of our analysis that sets it apart from other analyses is inclusion of younger (<45-year-old) individuals who are included in the guidelines but have not been studied in the European cohort. Approximately one tenth of these individuals were eligible for statins under the new guidelines and had significant differences among the

various Hispanic subgroups, with the Puerto Rican female subgroup having the highest prevalence of individuals who qualified for statin therapy. The prevalence of statin therapy eligibility among 6 Hispanics/Latinos subgroups that this study has provided has not been previously studied. In addition, there was a concern that using white estimates for Hispanics/Latinos under the newer guidelines might not be appropriate for Hispanic subgroups with predominance of African ancestry. However, we did not detect a significant difference in increase in prevalence when white estimates were used for Dominicans, Puerto Ricans, Central Americans, and Cubans.

Furthermore, the ASCVD risk estimator under the current guidelines may not hold for Hispanics the same way as they do for other ethnicities. The current guidelines rely on cardiovascular risk factors to assign particular 10-year ASCVD risk. Hispanics are known to have a higher burden of cardiovascular risk factors and thus are likely to have higher estimates for ASCVD risk based on current guidelines; however, there is a documented notion that despite high cardiovascular risk factor burden, Hispanics suffer from much lower overall and cardiovascular mortality than other race-ethnic groups such as non-Hispanic whites and black Americans, a phenomenon known as “Hispanic paradox” in scientific literature.^{23,24} The Hispanic paradox may or may not be applicable across all Hispanic background groups,^{25,26} and future prospective data from the HCHS/SOL will help elucidate cardiovascular risk for Hispanics. This becomes important in the light of a recent “real-world” study that showed that ASCVD risk by AHA/ACC guidelines might lead to overestimation of ASCVD risk.²⁷ Among 18 745 (6.1%) Hispanics included in this study, the risk score overestimated the risk of ASCVD events. Thus, our study further emphasizes the critical need to have race/ethnic-based calibrated scores.²⁸

There are several implications of this study. First, this study demonstrates and confirms findings similar to other cohort studies in Hispanics. Secondly, it showed important differences across several subgroups of Hispanics/Latinos. Thirdly, the study showed gross undertreatment of US-based Hispanics/Latinos in regard to primary prevention of cardiovascular disease. This level of undertreatment is likely to increase when the indications for statin therapy are going to increase eligible participants under the newer ACC/AHA cholesterol treatment guidelines. We also observed gross differences in demographics of participants already on statin therapy compared with those not on statin therapy but who were eligible under the new and old guidelines. These differences will potentially inform public health policy makers to target certain subgroups of Hispanics/Latinos to improve primary prevention of ASCVD. Lastly, the study did not show a significant increase in statin eligibility when black ASCVD risk estimates were used to identify participants with greater than 7.5% 10-year risk of ASCVD, suggesting that it may be appropriate to use any of the estimates; however, having in mind the Hispanic paradox, the white and black estimates might erroneously increase the statin eligibility in Hispanics/Latinos. Hispanics/Latinos constitute the largest ethnic minority in the United States and already suffer from disparities in cholesterol treatment that could potentially be increased by inaccurately estimating their ASCVD risk. However, this does not disregard the need for clinician-patient risk discussion. We also identified 2% to 3% of Hispanics who became ineligible by ACC/AHA guidelines who

were eligible under NCEP/ATP III guidelines. This is an important group to focus on, as they might still be at high risk of cardiovascular disease and would benefit from clinician-patient risk discussion.

There are several limitations of this analysis. First, this is a cross-sectional analysis and does not take into account the longitudinal changes in the risk factors that determine the eligibility of statin use nor the pretreatment LDL cholesterol levels among individuals who were using statins at enrollment. Therefore, it is likely that some individuals might be misclassified. Second, much of the data were self-reported, which can be a source of recall bias. However, the risk scores were calculated based on objective data. Third, we did not account for treatment adherence, which in several series has been reported to be low for statins.^{29–32}

Currently, more than one third of the US community-dwelling Hispanics/Latinos eligible under the new as well as old treatment guidelines are not on statin therapy. There is a need for Hispanics/Latinos-specific ethnic estimates for estimating 10-year ASCVD risk. The study indicates the need for additional resources for improving cardiovascular health for Hispanics/Latinos.

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Disclosures

None.

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SUPPLEMENTAL MATERIAL

Table S1. Age and Sex Stratified Prevalence estimates and 95% confidence intervals for statin therapy by 2013 ACC/AHA cholesterol treatment class I guideline based categories

Age categories	Sex Categories	Ethnic Subgroups	History of ASCVD	LDL ≥ 190 mg/dl	Diabetes mellitus	$\geq 7.5\%$ of ASCVD risk and LDL ≥ 70 mg/dl
18 – 44	Females	Dominican	2.2 (1.2, 3.1)	1.9 (1.1, 2.7)	4.7 (3.1, 6.2)	1.3 (0.7, 1.9)
		Central American	1.3 (0.8, 1.88)	2.1 (1.3, 2.8)	5.4 (4.2, 6.5)	1.8 (0.9, 2.8)
		Cuban	1.0 (0.5, 1.6)	2.0 (1.1, 2.9)	3.0 (2.1, 3.9)	2.0 (1.3, 2.8)
		Mexican	1.6 (1.2, 2.1)	0.5 (0.4, 0.7)	5.9 (5.1, 6.7)	1.4 (0.9, 1.9)
		Puerto-Rican	3.9 (2.6, 5.1)	1.5 (0.8, 2.2)	7.1 (5.6, 8.5)	5.5 (4.1, 6.8)
		South American	1.1 (0.3, 2.0)	1.1 (0.1, 2.1)	1.0 (0.4, 1.5)	0.5 (0.0, 1.0)
		P	0.09	0.08	0.02	0.0002
18 – 44	Males	Dominican	1.6 (0.7, 2.5)	1.8 (1.0, 2.6)	5.3 (3.5, 7.2)	0.3 (0.0, 0.5)
		Central American	2.0 (1.2, 2.8)	3.0 (2.1, 4.0)	2.2 (1.4, 3.0)	0.5 (0.2, 0.9)
		Cuban	2.1 (1.1, 3.0)	4.2 (2.9, 5.6)	2.4 (1.6, 3.3)	1.7 (1.0, 2.4)
		Mexican	2.7 (1.8, 3.6)	4.0 (3.0, 4.9)	6.4 (5.4, 7.4)	1.0 (0.7, 1.3)
		Puerto-Rican	4.8 (3.4, 6.3)	2.8 (1.6, 3.9)	4.6 (3.4, 5.7)	0.8 (0.4, 1.3)
		South American	1.3 (0.5, 2.1)	2.2 (1.2, 3.1)	1.8 (0.8, 2.7)	0.6 (0.0, 1.1)
		P	0.19	0.73	0.004	0.36
45 – 64	Females	Dominican	5.5 (4.3, 6.8)	8.7 (6.6, 10.7)	18.8 (16.0, 21.5)	7.0 (5.6, 8.3)
		Central American	2.4 (1.8, 3.1)	6.6 (5.0, 8.2)	20.3 (17.5, 23.2)	11.0 (8.8, 13.2)
		Cuban	3.8 (2.8, 4.7)	10.0 (8.3, 11.7)	17.8 (15.3, 20.4)	13.4 (11.5, 15.4)
		Mexican	3.7 (2.9, 4.4)	7.1 (5.7, 8.5)	22.7 (20.6, 24.9)	6.0 (5.2, 6.8)
		Puerto-Rican	9.7 (8.1, 11.3)	4.4 (3.5, 5.2)	25.2 (23.1, 27.3)	13.3 (11.9, 14.8)
		South American	5.8 (3.9, 7.6)	6.4 (4.5, 8.2)	13.5 (11.3, 15.7)	7.0 (5.3, 8.6)
		P	<0.0001	0.01	0.003	<0.0001
45 – 64	Males	Dominican	9.2 (7.2, 11.2)	4.2 (3.1, 5.4)	18.3 (15.1, 21.4)	31.6 (27.4, 35.8)
		Central American	8.9 (6.8, 11.1)	4.5 (3.0, 5.9)	26.0 (22.0, 30.1)	37.0 (31.8, 42.2)
		Cuban	8.4 (6.8, 10.0)	7.4 (5.9, 8.9)	16.9 (14.5, 19.3)	41.7 (36.6, 46.8)
		Mexican	7.3 (6.2, 8.3)	4.0 (3.0, 5.0)	20.8 (18.6, 23.1)	34.7 (30.9, 38.5)
		Puerto-Rican	11.3 (9.8, 12.9)	4.2 (3.2, 5.2)	21.5 (19.1, 23.8)	33.6 (30.5, 36.7)
		South American	5.2 (3.1, 7.2)	7.3 (5.3, 9.3)	13.2 (9.7, 16.6)	31.2 (26.4, 36.0)
		P	0.15	0.37	0.04	0.04
≥ 65	Females	Dominican	11.2 (7.3, 15.1)	5.7 (3.6, 7.8)	43.1 (29.7, 56.5)	72.2 (54.8, 89.6)

		Central American	15.5 (4.0, 27.0)	1.6 (0.5, 2.7)	40.8 (30.4, 51.1)	71.7 (58.0, 85.4)
		Cuban	7.6 (5.2, 10.2)	12.2 (9.1, 15.3)	37.5 (30.4, 44.6)	70.9 (62.3, 79.6)
		Mexican	5.8 (4.2, 7.5)	6.2 (3.6, 8.9)	33.9 (27.9, 40.0)	71.0 (62.2, 79.7)
		Puerto-Rican	11.1 (8.8, 13.5)	2.4 (1.3, 3.5)	39.6 (33.2, 45.9)	64.7 (51.6, 77.8)
		South American	12.2 (7.0, 17.4)	5.2 (2.0, 8.4)	32.9 (23.5, 42.2)	63.4 (48.5, 78.3)
		P	0.50	0.002	0.93	0.87
		Dominican	16.7 (8.8, 24.5)	-	36.9 (25.0, 48.8)	73.1 (50.5, 95.7)
		Central American	10.2 (5.1, 15.3)	12.6 (2.2, 22.9)	42.6 (28.4, 56.8)	76.4 (58.6, 94.3)
		Cuban	20.1 (15.8, 24.5)	14.1 (13.4, 14.8)	34.6 (28.5, 40.8)	73.1 (61.3, 84.8)
		Mexican	16.6 (10.7, 22.5)	9.4 (8.0, 10.7)	31.6 (25.0, 38.3)	73.7 (62.1, 85.3)
		Puerto-Rican	16.2 (11.8, 20.6)	3.6 (2.0, 5.2)	44.8 (37.2, 52.5)	76.6 (65.8, 87.3)
		South American	5.5 (0.3, 10.7)	15.8 (10.3, 21.2)	28.5 (15.2, 41.8)	79.3 (60.3, 98.3)
		P	0.71	-	0.58	>0.99
≥65	Males					

ASCVD = atherosclerotic cardiovascular disease; LDL = low density lipoprotein

The percentages are related to the total number of individuals eligible for statin therapy by ACC/AHA class I guidelines in each subgroup

Table S2. Age and Sex Stratified Prevalence estimates and 95% confidence intervals for statin therapy by NCEP/ATP III and 2013 ACC/AHA cholesterol treatment guidelines

Age categories	Sex Categories	Ethnic Subgroups	ATP III	ACC/AHA
18 – 44	Females	Dominican	5.4 (3.8, 6.9)	9.1 (7.2, 11.1)
		Central American	6.9 (5.4, 8.3)	10.4 (8.4, 12.4)
		Cuban	4.8 (3.4, 6.1)	7.1 (5.4, 8.8)
		Mexican	6.9 (6.1, 7.7)	9.0 (8.0, 10.1)
		Puerto-Rican	8.9 (7.1, 10.8)	15.6 (13.3, 18.0)
		South American	2.4 (1.3, 3.6)	3.6 (2.1, 5.0)
		p	0.08	0.0002
18 – 44	Males	Dominican	6.4 (4.5, 8.4)	8.4 (6.3, 10.6)
		Central American	4.3 (3.2, 5.4)	7.3 (5.9, 8.7)
		Cuban	5.2 (3.7, 6.6)	9.1 (7.3, 10.9)
		Mexican	9.6 (8.3, 10.9)	11.9 (10.3, 13.6)
		Puerto-Rican	7.4 (5.3, 9.5)	11.1 (9.0, 13.2)
		South American	3.2 (2.0, 4.5)	5.0 (3.6, 6.5)
		p	0.02	0.09
45 – 64	Females	Dominican	23.3 (20.4, 26.2)	30.7 (27.3, 34.2)
		Central American	26.2 (23.0, 29.5)	30.8 (27.0, 34.6)
		Cuban	23.9 (20.6, 27.3)	33.4 (28.8, 38.0)
		Mexican	28.1 (25.7, 30.6)	30.7 (28.0, 33.4)
		Puerto-Rican	30.7 (28.2, 33.1)	37.8 (35.0, 40.7)
		South American	18.0 (15.2, 20.7)	24.1 (20.8, 27.4)
		p	0.008	0.01
45 – 64	Males	Dominican	26.0 (20.9, 31.1)	51.3 (45.6, 57.0)
		Central American	28.9 (24.8, 33.0)	57.6 (50.9, 64.4)
		Cuban	18.6 (16.0, 21.3)	57.1 (50.0, 64.2)
		Mexican	26.5 (23.9, 29.1)	50.1 (45.2, 55.1)
		Puerto-Rican	23.0 (20.6, 25.4)	50.4 (46.5, 54.3)
		South American	16.4 (12.8, 20.1)	46.2 (40.2, 52.2)
		p	0.006	0.14
≥65	Females	Dominican	52.0 (37.2, 66.8)	87.8 (68.3, 100)
		Central American	52.8 (37.5, 68.1)	88.5 (70.6, 100)
		Cuban	40.9 (33.2, 48.6)	91.4 (80.9, 100)
		Mexican	41.0 (34.6, 47.3)	82.9 (73.0, 92.8)
		Puerto-Rican	41.0 (34.6, 47.3)	78.7 (65.6, 91.9)
		South American	44.4 (38.0, 50.9)	80.6 (64.4, 96.9)
		p	0.63	0.08
≥65	Males	Dominican	45.7 (32.8, 58.6)	89.8 (66.2, 100)
		Central American	43.9 (29.5, 58.2)	99.4 (78.3, 100)
		Cuban	41.0 (34.2, 48.0)	93.9 (80.5, 100)
		Mexican	41.5 (33.1, 50.0)	92.2 (78.6, 100)
		Puerto-Rican	49.9 (41.6, 58.3)	96.1 (84.4, 100)
		South American	37.4 (23.0, 51.7)	90.2 (69.0, 100)
		p	0.87	0.58

ASCVD = atherosclerotic cardiovascular disease; LDL = low density lipoprotein

The percentages are related to the total number of individuals eligible for statin therapy by ACC/AHA class I guidelines in each subgroup

Table S3. Age and Sex Adjusted Prevalence estimates and 95% confidence intervals for statin therapy by NCEP/ATP III and 2013 ACC/AHA cholesterol treatment guidelines

Ethnic Subgroups	ATP III	ACC/AHA
Dominican	11.8 (10.2, 13.7)	18.7 (16.5, 21.2)
Central American	12.1 (10.4, 14.1)	18.9 (16.7, 21.3)
Cuban	9.3 (8.2, 10.5)	19.5 (17.7, 21.4)
Puerto-Rican	13.1 (11.3, 15.0)	20.9 (18.2, 23.9)
South American	7.0 (5.6, 8.8)	12.8 (10.7, 15.2)
Mexican	13.7 (12.4, 15.1)	19.2 (17.5, 21.1)

Figure S1. Prevalence (%) and 95% Confidence interval of eligible Hispanic/Latinos that are treated with statin therapy under each guideline

