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Original Research

Risk factor control across the spectrum of cardiovascular risk: Findings from the Hispanic Community Health Study/Study of Latinos (HCHS/SOL)

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ABSTRACT

Background: Presence of cardiovascular disease (CVD) risk factors (RFs) should prompt patients and their providers to work aggressively towards controlling those that are modifiable. The extent to which a greater CVD RF burden is related to CVD RF control in a contemporary and diverse Hispanic/Latino population is not well-understood.

Methods: Using multicenter community-based data from the Hispanic Community Health Study/Study of Latinos, we assessed the self-reported prevalence of hypertension, hypercholesterolemia, diabetes, and prevalent CVD (ischemic heart disease or stroke). We used contemporaneous guidelines to define RF control. Multivariable logistic regression for complex survey sampling was used to examine whether having more CVD RFs was associated with CVD RF control (adjusting for age, sex, Hispanic background group, education, and health insurance).

Results: Our sample included 8521 participants with at least one CVD RF or prevalent CVD. The mean age in HCHS/SOL target population was 49 (SE 0.3) years and 56% were women. Frequency of one, two, or three self-reported CVD RFs was 57%, 26%, 8%, respectively, and overall 9% of participants had prevalent CVD. After adjusting for sociodemographic factors, compared to those reporting one CVD RF, individuals with three CVD RFs were the least likely to have blood pressure, cholesterol, and glucose optimally controlled (odds ratio [OR]: 0.56; 95% confidence interval [CI]: 0.40–0.80). However, those with prevalent CVD were more likely to have all three risk factors controlled, (OR: 1.43; 95% CI: 1.01–2.01).

Conclusion: Hispanic/Latino adults with three major CVD RFs represent a group with poor overall CVD RF control. Secondary CVD prevention fares better. The potential contributors to inadequate CVD RF control in this highly vulnerable group warrants further investigation.

1. Background

Hispanics/Latinos are currently the largest minority group in the U.S. and face a disproportionate burden of cardiovascular disease (CVD) risk factors (RFs) [1]. Control of prevalent CVD RFs remains a public health priority as uncontrolled CVD RFs are associated with higher costs and adverse clinical outcomes [2–5]. Several primary prevention clinical practice guidelines provide recommendations for control of CVD RFs including hypercholesterolemia, hypertension, and diabetes [6–9]. Control of these and other traditional risk factors may

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Table 1
Characteristics of the HCHS/SOL target population by cardiovascular risk factor burden.

		CV Risk Factor Burden (n = 8521)				p-value
		1 RF	2 RFs	3RFs	Prevalent CVD[a]	
N (%)		4456 (57%)	2473 (26%)	852 (8%)	740 (9%)	
Age, mean (S.E.)		44 (0.3)	52 (0.4)	58 (0.6)	55 (0.9)	<0.001
Female		2785 (56%)	1656 (59%)	580 (61%)	365 (40%)	<0.001
Hispanic/Latino Background Group						<0.001
Dominican		394 (10%)	265 (12%)	99 (12%)	73 (11%)	
Central American		440 (7%)	230 (6%)	64 (5%)	58 (4%)	
Cuban		676 (22%)	366 (24%)	124 (26%)	129 (27%)	
Mexican		1792 (37%)	921 (32%)	295 (30%)	196 (23%)	
Puerto Rican		738 (17%)	494 (19%)	219 (22%)	231 (27%)	
South American		293 (5%)	138 (4%)	34 (3%)	33 (4%)	
Others		115 (4%)	51 (3%)	17 (2%)	18 (4%)	
Education						<0.001
Less than high school		1672 (33%)	1050 (39%)	434 (49%)	352 (44%)	
High school or Equivalent		1064 (27%)	563 (23%)	167 (19%)	144 (20%)	
Greater than HS		1630 (40%)	810 (38%)	226 (32%)	231 (36%)	
Annual Income						<0.001
<$20,000		1937 (46%)	1173 (54%)	447 (57%)	430 (62%)	
$20,001–40,000		1412 (32%)	703 (30%)	211 (27%)	165 (28%)	
$40,001–75,00		558 (15%)	273 (11%)	93 (12%)	45 (5%)	
>$75,000		194 (7%)	75 (5%)	23 (4%)	27 (5%)	
Foreign-Born		3799 (80%)	2215 (89%)	753 (90%)	638 (82%)	<0.001
Years Living in the US		21 (0.5)	24 (0.6)	28 (0.9)	30 (1.0)	<0.001
Spanish Language Preference		3669 (76%)	2127 (84%)	716 (84%)	597 (80%)	<0.001
Immigrant Generation						<0.001
1st		3717 (78%)	2178 (86%)	740 (88%)	623 (80%)	
2nd		732 (21%)	284 (13%)	111 (12%)	114 (20%)	
Health Insurance (yes)		2263 (52%)	1497 (64%)	602 (72%)	543 (78%)	<0.001
Doctor Visits in Past Year, mean (SE)		2.6 (0.03)	3.1 (0.04)	3.4 (0.06)	3.3 (0.10)	<0.001
Field center	Bronx	1093 (29%)	701 (32%)	283 (32%)	257 (38%)	0.001
	Chicago	1105 (14%)	604 (14%)	202 (14%)	175 (13%)	
	Miami	1106 (30%)	566 (31%)	170 (31%)	184 (33%)	
	San Diego	1152 (27%)	602 (24%)	197 (23%)	124 (16%)	

Cardiovascular risk factors included diabetes, hypertension, and hypercholesterolemia.
N's presented are unweighted counts of total participants in the HCHS/SOL; percentages are weighted row percentages.
[a] Includes participants who self-identified as having coronary heart disease or stroke.

prevent up to 90% of the global burden of acute myocardial infarctions, for example [10]. For patients with established CVD, control of these RFs remains of critical importance in preventing subsequent events [11,12].

Reasons for poor control of CVD RFs are linked to patient, disease, and system factors [3,13,14]. Few studies have specifically explored how RF control varies across the spectrum of CVD RFs in diverse vulnerable populations and in primary prevention settings. In patients with existing CVD, control of multiple risk factors is challenging [15] and suboptimal even in controlled clinical trial settings [16]. As a person transitions from presence of only a single RF to those with multiple CVD RFs to eventual overt CVD, control of RFs may improve due to increased health awareness or alternatively, may worsen in the setting of increased comorbid status. Understanding the patterns and correlates of RF control across the spectrum of CVD risk may help identify opportunities to augment both primary and secondary prevention efforts. However, the extent to which CVD RF control varies between individuals with more or less CVD risk burden has not been extensively studied in Hispanic/Latino populations.

Our study objective was to analyze the prevalence of RF control across the spectrum of CVD risk burden (from a single CVD RF to prevalent CVD) in a heterogeneous sample of Hispanic/Latino participants from the Hispanic Community Health Study/Study of Latinos (HCHS/SOL). We hypothesized that RF control, defined by contemporaneous primary and secondary prevention CVD guidelines, will vary across the spectrum of CVD risk and that this variation will be associated with sociodemographic and clinical characteristics including age, sex, Hispanic background group, and access to healthcare.

2. Methods

2.1. Study population

HCHS/SOL is a population-based cohort study of the prevalence of multiple health conditions and their RFs among Hispanic/Latinos residing in the United States (US). The sample design and cohort selection have been previously described [17,18]. Briefly, 16,415 participants were recruited from randomly selected households using two-stage area probability sampling of households near four field centers (Bronx, NY; Chicago, IL; Miami, FL; and San Diego, CA). The participants were between 18 and 74 years of age and self-identified Hispanics/Latinos further categorized as Cuban, Central American, Dominican, Mexican, Puerto Rican, South American, or other Hispanic/Latino heritage. We included all eligible men and women who participated in the HCHS/SOL baseline examination from March 2008 to June 2011 with at least one CVD RF or prevalent CVD. All participants provided informed consent, and approval was received from the IRBs of all participating institutions.

2.2. Risk factors ascertainment

All questionnaires were administered by trained staff to collect information pertaining to demographic characteristics and medical history. Participants were asked to respond to questions such as: "Has a doctor ever said that you have high blood pressure or hypertension?"; "Has a doctor ever said that you have high blood cholesterol?"; "Has a doctor ever said that you have diabetes (high sugar in blood or urine)?" to assess awareness of their own risk factors. Participants who provided affirmative responses to these questions were noted to have the specific risk

Table 2
Clinical characteristics by risk factor burden.

	Risk Factor Burden				p-value
	1 RF	2 RFs	3 RFs	Prevalent CVD	
Systolic Blood Pressure (mmHg)	122 (0.5)	130 (0.6)	134 (1.1)	129 (1.2)	<0.001
Diastolic Blood Pressure (mmHg)	75 (0.3)	77 (0.3)	76 (0.6)	74 (0.7)	<0.001
Body Mass Index (kg/m^2)	30 (0.2)	31 (0.2)	32 (0.3)	31 (0.3)	<0.001
Total Cholesterol (mg/dL)	207 (1.1)	214 (1.6)	201 (2.3)	192 (2.0)	<0.001
Triglycerides (mg/dL)	143 (2.4)	169 (3.8)	186 (13.2)	160 (7.6)	<0.001
High-density lipoprotein cholesterol (mg/dL)	48 (0.3)	48 (0.4)	47 (0.5)	47 (0.7)	0.006
Low-density lipoprotein cholesterol (mg/dL)	131 (1.0)	133 (1.4)	120 (2.1)	115 (2.1)	<0.001
Hemoglobin A1c (%)	5.8 (0.02)	6.4 (0.06)	7.6 (0.08)	6.5 (0.09)	<0.001
Medication Use					
Antihypertensives	627 (13%)	996 (40%)	560 (67%)	377 (48%)	<0.001
Antiplatelets	16 (0.3%)	27 (1.6%)	24 (3.8%)	127 (20%)	<0.001
Aspirin	887 (18%)	835 (34%)	412 (49%)	395 (48%)	<0.001
Antidiabetics	240 (5%)	606 (23%)	691 (83%)	245 (32%)	<0.001
Lipid-lowering therapies	380 (7%)	720 (29%)	496 (58%)	335 (43%)	<0.001

Antihypertensives: Angiotensin-converting enzyme inhibitors, Calcium Channel Blocker, Thiazide/Thiazide-Like Diuretic, Beta Blockers and Angiotensin II Receptor Antagonists.
Antiplatelets: Platelet Aggregation Inhibitors such as Clopidogrel.
Lipid-Lowering drugs/Antihyperlipidemic including statins.
Antidiabetics including insulin.
All values are mean (.S.E.) or unweighted counts (weighted percentage), N (%) unless otherwise specified.

factors they indicated. For our primary analyses, CVD RFs were self-reported hypertension, hyperlipidemia and diabetes. Prevalent CVD was defined as self-report of a heart attack, coronary artery bypass surgery, stent placement in coronary arteries, balloon angioplasty, or cerebrovascular disease. In HCHS/SOL, self-reported CVD was assessed with the following questions: "Has a doctor ever said that you had a heart attack?"; "Have you had a balloon angioplasty, a stent, or bypass surgery to the arteries in your heart to improve the blood flow to your heart?"; and "Has a doctor ever said that you had a stroke?"

2.3. Risk factor control

Trained and certified clinic staff obtained blood samples and blood pressure measurements from all HCHS-SOL participants during the baseline visit. After a 5-min rest, blood pressure was measured three times at 1-min intervals using an automated oscillometric device with the participant in a seated position with the back and arm supported. The average of the second and third blood pressure measurements was used for this analysis. Blood lipids and lipoproteins were measured from samples obtained after an overnight fast. Total cholesterol was measured using a cholesterol oxidase enzymatic method and high-density lipoprotein cholesterol with a direct magnesium/dextran sulfate method. Triglyceride levels were measured in EDTA plasma with the use of TG GB reagent (Roche Diagnostics) on a centrifugal analyzer. Low-density lipoprotein cholesterol (LDL-C) was calculated using the Friedewald equation. Plasma glucose were also measured using samples collected after an overnight fast. Measurements of glycosylated hemoglobin (A1c) were captured using a Tosoh G7 automated high-performance liquid chromatography analyzer (Tosoh Bioscience Inc., San Francisco, CA). Risk factor control was defined by guidelines contemporaneous with HCHS/SOL Visit 1 [8,9,11,19]. Blood pressure control was defined as a blood pressure of <140/90 mm Hg or <130/80 mm Hg if diabetes or prevalent CVD was self-reported. Cholesterol control was defined as LDL <130 mg/dL and/or total cholesterol <240 mg/dL [20]. For patients with prevalent CVD or diabetes, cholesterol control was defined as LDL<100 mg/dL. If diabetes was not reported, a fasting glucose under 100 mg/dL or A1c < 6.5% was defined as glucose control. If a participant had prevalent diabetes, glycemic control was defined as an A1c <7%, as has been done in prior HCHS/SOL studies [21]. Data relating to medication use were self-reported at the time of the baseline examination survey. Additionally, participants were instructed to bring all medications and supplements used during the last 4 weeks, which were subsequently reviewed and coded by the clinic staff.

2.4. Sociodemographic variables

Sociodemographic variables obtained included age, sex, education level (less than high school, high school or equivalent, or beyond high school), and income level. Acculturation was measured by four metrics: Spanish language preference, years of residence in the US, nativity status (foreign vs. US-born) and immigrant generation (first generation is defined as foreign born with foreign born parents; 2nd generation includes individuals who are US born or those who are foreign born but have at least one US-born parent). Insurance status and number of healthcare visits in the past year were also obtained through surveys and interviews.

2.5. Statistical analyses

Survey methods using sampling weights were used to obtain weighted frequencies of descriptive variables and population estimates. All weights were calibrated to the age, sex, and Hispanic/Latino background distributions from the 2000 US Census for the four study field centers. Sociodemographic and clinical characteristics of the target population by prevalent risk factor burden were presented with weighted means ± SE for continuous measures and frequencies (percentage) for categorical measures. Statistical significance was assessed using survey regression weighted least squares for continuous variables and Rao-Scott Chi-Square test for categorical variables. Weighted logistic regression models were used to assess the association of complete RF control for all 3 RFs by risk group. Multivariable models were adjusted for age, sex, Hispanic/Latino background group, education, income, field center, and insurance status. Odds ratios (ORs) were calculated to estimate the associations of risk factor burden and sociodemographic factors with risk factor control. Age-sex adjusted interaction analyses were performed to determine whether the association between CVD RF burden and RF control was dependent on an individual's education level and/or insurance status. All analyses were performed using survey procedures in SAS version 9.4 (SAS Institute, Cary, NC). A two-sided p-value of <0.05 was considered statistically significant.

3. Results

Our analysis included 8521 participants with at least one self-reported CVD RF or prevalent CVD. The sociodemographic characteristics of HCHS/SOL target population by the number of CVD RFs are shown in Table 1. The mean age of the target population was 49 (SE 0.3) years and more than half were women (56%). Frequency of one, two, or three self-reported CVD RFs was 57%, 26%, 8%, respectively, and 9% reported established CVD. Individuals with a greater CVD RF burden were more likely to be women and were older; however, those with prevalent CVD were younger and more likely to be male. Hispanic/Latinos of Puerto Rican and Cuban descent were more likely to have higher RF burden as

Table 3
Participant characteristics by risk factor control.

		Total = 8446				p-value
		0 RF Controlled	1 RF Controlled	2 RF Controlled	3 RF Controlled	
N (%)		176 (2%)	1451 (16%)	4068 (47%)	2751 (35%)	
Age, mean (S.E.)		56 (1.4)	55 (0.5)	49 (0.4)	44 (0.5)	<0.001
Female		108 (51%)	887 (55%)	2559 (55%)	1787 (58%)	0.376
Hispanic/Latino Background group						<0.001
Dominican		13 (7%)	157 (11%)	376 (10%)	275 (12%)	
Central American		20 (7%)	159 (8%)	378 (7%)	230 (5%)	
Cuban		25 (20%)	285 (30%)	660 (24%)	318 (18%)	
Mexican		60 (34%)	462 (29%)	1541 (33%)	1127 (38%)	
Puerto Rican		43 (20%)	300 (18%)	743 (18%)	570 (19%)	
South American		9 (5%)	55 (3%)	266 (5%)	160 (4%)	
Others		6 (7%)	30 (2%)	97 (3%)	64 (3%)	
Education						<0.001
Less than high school		84 (48%)	661 (42%)	1581 (34%)	1148 (37%)	
High school or Equivalent		36 (20%)	295 (22%)	948 (24%)	644 (28%)	
Greater than HS		51 (32%)	467 (37%)	1458 (41%)	898 (35%)	
Income						0.122
<$20,000		92 (55%)	708 (54%)	1849 (49%)	1300 (51%)	
$20,001–40,000		49 (33%)	403 (31%)	1220 (31%)	800 (31%)	
$40,001–75,00		15 (11%)	140 (11%)	481 (14%)	327 (12%)	
>$75,000		2 (1%)	39 (4%)	168 (6%)	109 (6%)	
Foreign-Born		161 (89%)	1313 (88%)	3580 (86%)	2293 (78%)	<0.001
Years living in US, mean (S.E.)		26 (1.6)	24 (0.7)	23 (0.6)	23 (0.5)	0.101
Spanish Language Preference		152 (84%)	1257 (85%)	3449 (81%)	2198 (75%)	<0.001
Immigrant Generation						<0.001
1st		158 (86%)	1294 (87%)	3500 (84%)	2250 (76%)	
2nd		17 (13%)	155 (13%)	558 (16%)	493 (23%)	
Health Insurance (Yes)		98 (64%)	788 (57%)	2279 (57%)	1700 (63%)	0.004
# Doctor Visits in Past Year, mean (S.E)		3.1 (0.1)	2.9 (0.1)	2.8 (0.0)	2.9 (0.0)	0.110
Field center	Bronx	56 (28%)	407 (28%)	1056 (29%)	769 (34%)	<0.001
	Chicago	32 (12%)	288 (10%)	961 (14%)	796 (16%)	
	Miami	48 (34%)	440 (39%)	1019 (32%)	507 (24%)	
	San Diego	40 (26%)	316 (23%)	1032 (25%)	679 (26%)	

RF = Risk factor.

compared with those of Mexican descent. Individuals with higher CVD RF burden were more likely to have a higher acculturation (as measured by years in the US but no other acculturation metrics) and utilize healthcare more frequently. Lower household income, less educational attainment, and having health insurance were associated with a higher number of CVD RFs.

Table 2 illustrates the clinical characteristics, stratified by the number of CVD RFs or prevalent CVD. With higher number of CVD RFs, systolic blood pressure, and glycemic control worsened despite greater medication use. Individuals with three CVD RFs had the highest mean values of systolic blood pressure, BMI, and A1C. However, those with prevalent CVD had lower cholesterol values and lower diastolic blood pressure compared with CVD RF groups. Of note, only 48%, 43%, and 48% of individuals with prevalent CVD were on aspirin, lipid-lowering therapy and antihypertensives, respectively. A higher proportion of individuals with three CVD RFs were on antihypertensives as compared to those with prevalent CVD (67% vs. 48%) and on lipid-lowering therapies as compared to those with prevalent CVD (58% vs. 43%).

The baseline characteristics stratified by the number of CVD RF controlled are shown in Table 3. There was a lower proportion of individuals with all three CVD RFs controlled than with two CVD RFs controlled. Those with higher number of CVD RF controlled tended to be younger and female, and were more likely to prefer English to Spanish.

Table 4 shows the weighted, adjusted ORs of complete RF control for all three RFs by RF burden and sociodemographic indicators. Compared to individuals with one CVD RF, those with two RFs had 37% lower odds of having their blood pressure, cholesterol, and glucose controlled; whereas those with three RFs had 44% lower odds of having their risk factors controlled. Furthermore, as compared with those who were uninsured, participants with health insurance had 25% higher odds of having CVD RFs controlled. The interaction analyses revealed that insurance status influences the relationship between RF burden and RF control up to two CVD RFs ($p < 0.01$); with three CVD RFs and/or prevalent CVD, insurance status had no effect ($p > 0.05$). Levels of educational status did not modify the association between CVD RF burden with CVD RF control on interaction analyses ($p > 0.05$).

Fig. 1 shows the proportions with RFs controlled according to self-reported CVD RF burden combinations. Individuals with only one CVD RF of hypertension, hypercholesterolemia, or diabetes had low rates of the corresponding CVD RF control. For example, only 36% individuals with just hypercholesterolemia had this CVD RF controlled, compared with 58% of individuals who reported having all three CVD RFs. Those with prevalent CVD were more likely to have higher proportions of individual RF control but only 40% had all CVD RFs controlled.

4. Discussion

4.1. Summary of findings

In this large sample of diverse Hispanic/Latino adults in the US, we found significant variation in the prevalence of risk factor burden and control across the spectrum of CVD. In general, individuals with a higher self-reported burden of CVD RFs were less likely to have all 3 RFs controlled. Those with prevalent CVD were more likely to have RFs controlled. We also found significant heterogeneity in risk factor control by sociodemographic factors including Hispanic/Latino background groups, education, and acculturation.

4.2. Potential explanations

Our findings that a higher self-reported RF burden was associated with lower RF control (despite more frequent healthcare utilization and greater use of medications) is noteworthy and highlights an opportunity to improve primary prevention efforts. Interestingly, individuals with

Table 4
Association of risk factor burden with risk-factor control[a].

		Multivariable-Adjusted Models		
		OR (95% CI)	P value	
			Overall	Pairwise
Age (per year)		0.97 (0.96, 0.98)	<0.001	–
Sex	Male	Referent	0.101	–
	Female	1.17 (0.97, 1.41)		–
Hispanic/Latino Background Subgroup	Mexican	Referent	0.178	–
	Dominican	0.72 (0.43, 1.21)		
	Central American	0.64 (0.40, 1.02)		–
	Cuban	0.92 (0.53, 1.60)		–
	Puerto Rican	0.82 (0.51, 1.31)		–
	South American	0.93 (0.57, 1.51)		–
	Others	0.62 (0.32, 1.20)		–
Education Level	Less than HS	Referent	0.035	–
	Greater than HS	0.79 (0.64, 0.97)		0.026
	HS or equivalent	1.03 (0.82, 1.29)		0.785
Years living in US		1.00 (0.99, 1.01)	0.892	–
Language	Spanish	Referent	0.229	–
	English	1.22 (0.88, 1.70)		–
Foreign Born	US born	Referent	0.530	–
	Not US born	0.75 (0.30, 1.85)		–
Generational status	1st	Referent	0.561	–
	2nd	0.70 (0.29, 1.68)		–
Insurance status	Uninsured	Referent	0.049	–
	Insured	1.25 (1.00, 1.55)		0.049
CV Risk Factor Burden	1 RF	referent	<0.001	–
	2 RF	0.63 (0.50, 0.78)		<0.001
	3 RF	0.56 (0.40, 0.80)		0.001
	Prevalent CVD	1.50 (1.08, 2.08)		0.016
# Doctor Visits in Past Year		1.17 (1.07, 1.28)	0.001	–
Field center	Bronx	Referent	0.176	–
	Chicago	1.03 (0.71, 1.49)		–
	Miami	0.74 (0.49, 1.14)		–
	San Diego	0.81 (0.49, 1.33)		–

[a] Defined as having all 3 CVD RFs controlled (hypertension, diabetes, and hypercholesterolemia).

prevalent CVD (i.e. secondary prevention) were more likely to have CVD risk factors controlled than those without prevalent disease. In recent years, the American Heart Association and other groups have shifted to focus on emphasizing primary prevention of CVD. For example, Life's Simple 7 emphasizes optimization of CV health with the presence of seven metrics: not smoking, having a healthy diet, adequate physical activity, healthy body weight, healthy blood pressure, and cholesterol, and glucose [22]. However, almost no US adults meet all ideal CV health metrics, with more pronounced disparities in CV health attainment among Black and Hispanics/Latino individuals [23]. Controlling multiple cardiovascular risk factors is challenging and, as seen in our study, failure to control one RF may be associated with worse control of other risk factors [24]. With an increasing medication burden, it is possible that participants in our study were less likely to be adherent to their medications and that the quality of the patient-provider interaction deteriorated. These patients may benefit from nurse or pharmacist-led intensive interventions that improve medication adherence, patient-provider interaction, clinical inertia and as a regular check on risk factor control. Furthermore, our work suggests that individuals with one CV risk factor should be monitored and counseled extensively on preventing additional risk factors.

Following a diagnosis of CVD, it is likely that individuals may be more likely to adhere to medical therapy resulting in better RF control. Individuals with CVD likely perceive their health risk at higher risk than simply having one or multiple RFs and may be more motivated to engage in appropriate secondary prevention strategies. Prior studies in predominantly non-Hispanic/Latino populations support these hypotheses and note that RF control in those with established CVD may be improved through higher medication adherence [25,26]. Similarly, hospitalizations for acute myocardial infarction, heart failure, or stroke may prompt increased medication adherence since these provide "teachable moments" to motivate behavioral change.

4.3. *In context to prior literature*

Complementary to other studies, we also found significant differences in CVD RF burden by Hispanic/Latino background group and four acculturation metrics. Hispanics/Latinos with Puerto Rican and Cuban background had a greater burden of CVD RF and worse RF control as compared with those of Mexican descent. This association may be mediated by other factors since Hispanic/Latino background group was not independently associated with RF control in multivariable analysis. This finding highlights the importance of disaggregating Hispanics/Latinos into subpopulations since health risks, behaviors, and outcomes differ substantially and primary prevention efforts need to be tailored accordingly [27,28]. Longer length of stay in the US was associated with a higher CVD RF burden. Higher acculturation has generally been linked to greater risk of CVD [29,30], although results are mixed and vary depending on the acculturation metric studied [31,32]. We found that Spanish language preference and foreign-born status – both measure of lower acculturation – predicted poorer RF control. These findings underscore the importance of disaggregating Hispanic/Latino CVD data by background and varied acculturation metrics.

Inadequate RF control among Hispanics/Latinos with a high burden of CVD risk factors may also be attributable to health care system factors such as access to care or provider treatment inertia. This disconnect may be a contributing factor to provider treatment or a patient's lack of adherence to medical therapy. We found less than half of the Hispanic/Latino population with prevalent CVD were on aspirin, antihypertensives and lipid-lowering therapy. Hispanic/Latino patients may be particularly vulnerable to inadequate shared decision making due to language barriers and other cultural differences. In fact, we found that Spanish language preference was associated with lower RF control and more frequent doctor's visits (a metric for interactions with the healthcare system) along having health insurance resulted in improved CVD RF control.

Interestingly, having a sole CVD RF was associated with low levels of control of that specific CVD RF. It is possible that individuals with more comorbidities were more adherent to lifestyle and pharmacotherapy that led to improved individual CVD RF control. Other studies have also documented this counter-intuitive finding that increasing number of medications is positively associated with adherence and improved CVD RF control [25,33,34]. Sicker patients may be more attune to their health and be more likely to regularly comply with their drug therapies. We extend this finding to a diverse cohort of Hispanic/Latino adults. However, individuals with three self-reported CVD RF represented a group that was particularly vulnerable to poor CVD RF control. This highlights a population that may require additional attention and resources to ensure initiation and adherence to preventive therapies.

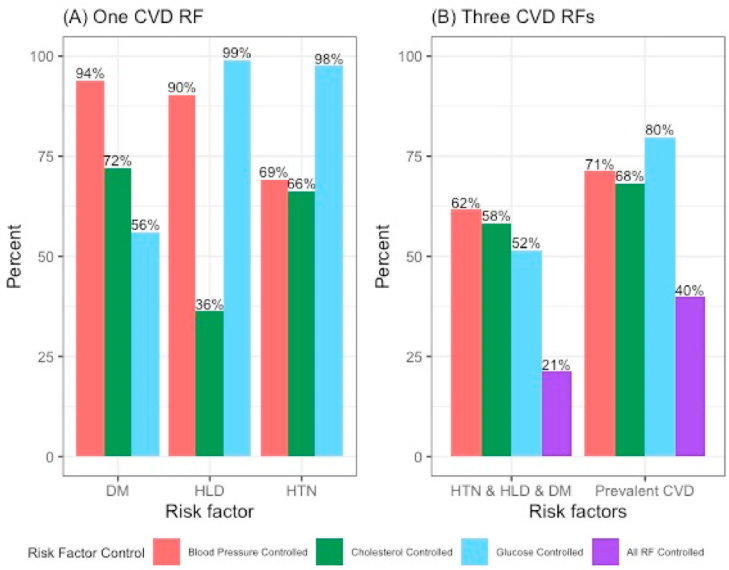

Fig. 1. Risk Factor Control in Individuals with One or Three CVD RFs or Prevalent CVD. Control of blood pressure, cholesterol, and glucose by number of self-reported risk factors (RF). Panel A shows control in patients with a single CVD RF and panel B shows participants with three CVD RFs or prevalent CVD. Blood pressure control was defined as a systolic blood pressure of less than 140 mmHg and a diastolic blood pressure of less than 90 mmHg, cholesterol control was defined as a LDL-C of less than 130 mg/dL and/or TC < 240 mg/dL, and glycemic control was defined as a Hemoglobin A1C of less than 7.0% for those with self-reported diabetes, while an A1C of 6.5% or a fasting plasma glucose of below 100 mg/dL was used to define control for individuals who did not self-report having diabetes.

DM = diabetes mellitus; HLD = hyperlipidemia; HTN = hypertension; CVD = cardiovascular disease; RF = risk factor

4.4. Limitations

Our study should be interpreted in light of several limitations. First, our study design was cross-sectional and limits our ability to infer causality or longitudinal associations of RF burden and control over time. HCHS/SOL was designed to be the largest epidemiologic study of community-dwelling US Hispanics/Latinos but was not designed to be nationally representative; but it is the most generalizable cohort of US Hispanics/Latinos to date. We focused only on self-reported CVD RFs and it is likely that a proportion of participants are unaware of their risk factors, as reported in other HCHS/SOL publications [20,21,35]. We focused on only three CVD RFs and their control (blood pressure, cholesterol, and glucose) and recognize that other lifestyle factors such as physical activity and a healthy diet are important contributors to optimal CVD health. Prior work in HCHS/SOL documented an overall low achievement of optimal cardiovascular health including physical activity in Hispanic/Latino populations, with significant heterogeneity by ethnic background and sociocultural factors [36]. Furthermore, CVD RF identification and subsequent management may differ across the geographic regions that HCHS/SOL was sampled from which could affect participant's awareness and control of self-reported CVD RFs.

4.5. Clinical implications

Because Hispanics/Latinos are the largest minority population in the US, understanding CVD RF control across the CVD risk spectrum is essential for the development of targeted interventions. Our work suggests that patients with multiple CV risk factors may be particularly vulnerable to poor risk factor control and should be the focus of intensive clinical interventions. Future studies should further disentangle the role of risk factor awareness, health care system factors (access to care, provider inertia) and medication non-adherence in CVD RF control.

5. Conclusion

In a large sample of diverse Hispanic/Latino adults, we found that individuals with 3 self-identified major CVD RFs – but not yet overt CVD – appear to represent a group especially prone to poor overall CVD RF control. Those with prevalent CVD had improved CVD RF control as compared to those with less CVD RF burden. These findings identify and underscore a potential missed opportunity for CVD prevention focused interventions in a particularly vulnerable subset of the population at large.

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DM = diabetes mellitus; HLD = hyperlipidemia; HTN = hypertension; CVD = cardiovascular disease; RF = risk factor.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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All authors were involved in the conception and design of the study, had access to the data, and participated in the writing of the manuscript.

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