ORIGINAL ARTICLE

Prevalence and Incident Prehypertension and Hypertension in Postmenopausal Hispanic Women: Results from the Women's Health Initiative

Ruth E. Zambrana,[1–3] Lenny López,[4–7] Gniesha Y. Dinwiddie,[8,9] Roberta M. Ray,[10] Lawrence S. Phillips,[11,12] Maurizio Trevisan,[13] and Sylvia Wassertheil-Smoller[14]

BACKGROUND
There is a paucity of research on prehypertension and incident hypertension among postmenopausal Hispanic women. The overall objective is to determine the multiple risk factors associated with the prevalence of hypertension status at baseline and incident hypertension at year 3 in postmenopausal Hispanic women.

METHODS
For the analyses in this paper, we included a total of 4,680 Hispanic women who participated in the Women's Health Initiative (WHI), a randomized clinical trial and observational study, at baseline (1994–1998) and at third-year follow-up and for whom blood pressure was measured at year 3 (n = 3,848). Multivariable logistic regression models were used to estimate odds ratios (ORs) and 95% confidence intervals (CIs) of hypertension status, defined as systolic blood pressure ≥140 mm Hg and/or diastolic blood pressure ≥90 mm Hg, to assess the odds of incident hypertension at year 3 of follow-up in association with the factors included in the baseline models.

RESULTS
At year 3 of follow-up, 27.3% of Hispanic women who were normotensive at baseline had progressed to prehypertension, and 9.0% had become hypertensive. Among the prehypertensive participants at baseline, 30.4% had progressed to hypertension. Compared with normotensive Hispanic women, hypertensive participants had a higher number of cardiovascular risk factors: body mass index ≥30 kg/m^2 (OR = 3.76; 95% CI = 3.01–4.71), a family history of diabetes, stroke, and/or myocardial infarction (OR = 1.12; 95% CI 1.03–1.23), treated hypercholesterolemia (OR = 1.57; 95% CI = 1.23–1.99), treated diabetes (OR = 2.04; 95% CI = 1.40–2.97), and a history of cardiovascular disease (OR = 2.04; 95% CI = 1.58–2.64).

CONCLUSIONS
Hispanic women seem to experience an increased risk of incident hypertension in later adulthood. On a practical level, recommendations for preventive care and population-wide adoption of health behaviors, such as community-focused campaigns to engage in physical activity, may contribute to reductions in hypertension risk factors.

CLINICAL TRIALS REGISTRATION
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Although there are 30.1 million Hispanic adults in the United States and 14.4 million (48%) of them are women,[1] Hispanic women have been understudied with respect to hypertension and other important risk factors for cardiovascular disease (CVD).[2] Hypertension, an important risk factor for CVDs and stroke, is more common in women than men.[3] Although age-adjusted prevalence of hypertension is reported to be lower among Hispanic women, black and Hispanic (predominantly Mexican American) women, compared with non-Hispanic white women, represent the largest groups with multiple risk factors for high blood pressure.[4,5] Studies show that menopause doubles the risk of hypertension even after adjusting for factors such as age and body mass index (BMI).[6] Further, it has been observed that Hispanics lack hypertension awareness and effective blood pressure control, experience higher incidence of hypertension-related comorbidities compared with non-Hispanic populations,[7] and have rates of uncontrolled hypertension

Correspondence: Ruth E. Zambrana (rzambran@umd.edu).

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[1]Department of Women's Studies, University of Maryland, College Park, Maryland; [2]Consortium on Race, Gender and Ethnicity, University of Maryland, College Park, Maryland; [3]Family Medicine, School of Medicine, University of Maryland, Baltimore, Maryland; [4]Harvard Medical School, Boston, Massachusetts; [5]Disparities Solution Center, Massachusetts General Hospital, Boston, Massachusetts; [6]Mongan Institute for Health Policy, Massachusetts General Hospital, Boston, Massachusetts; [7]Brigham and Women's Hospital, Boston, Massachusetts; [8]African American Studies Department, University of Maryland, College Park, Maryland; [9]Maryland Population Research Center, University of Maryland, College Park, Maryland; [10]Fred Hutchinson Cancer Research Center, Seattle, Washington; [11]Atlanta VA Medical Center, Decatur, Georgia; [12]Division of Endocrinology and Metabolism, Emory University School of Medicine, Atlanta, Georgia; [13]Community Health and Social Medicine, School of Biomedical Education, City College of New York, New York; [14]Department of Epidemiology and Population Health, Division of Epidemiology, Albert Einstein College of Medicine, Bronx, New York.

that exceed those of blacks and whites.[8] Mounting evidence underscores the importance of sociodemographic factors, health insurance coverage, health behaviors, and other comorbid conditions in increasing risk for hypertension and related CVD conditions among adult Hispanic women.[9]

Although studies are available on contributing factors to hypertension among Hispanics, most of these are of a cross-sectional design[10] or based on self-report.[11,12] In addition, a paucity of research on rates of prehypertension and rates of incident hypertension among Hispanic postmenopausal women is evident. An understanding of the complex factors that may be associated with incident hypertension is especially important because empirical data show that Mexican Americans compared with whites[13] and other Hispanic subgroups[14,15] experience a greater number of multiple risk factors. In this study, we explored sociodemographic, health insurance coverage, and clinical risk factors associated with the prevalence of hypertension at baseline and incidence of prehypertension and hypertension at year 3 of follow-up to improve the cardiovascular health of postmenopausal Hispanic women.[4,16]

METHODS

The Women's Health Initiative (WHI) study is a large, multiethnic, 40-center, National Heart, Lung, and Blood Institute–funded health study focused on strategies for preventing heart disease, breast and colorectal cancer, and osteoporotic fractures in postmenopausal women. The total study sample includes 161,808 women aged 50–79 years. The race/ethnic distribution as self-reported is 82.5% non-Hispanic white; 9.0% black or African American; 4.0% Hispanic, predominantly Mexican American; 2.6% Asian or Pacific Islander; 0.4% American Indian or Alaska Native; and 1.1% other. For the analyses in this paper, we include a total of 4,680 Hispanic women who participated in the WHI observational and clinical trial studies at baseline (1994–1998) and at the third-year follow-up and for whom blood pressure was measured at year 3. The third year for each woman corresponded to her third year of enrollment. Because we were looking at changes between baseline and year 3, all women in the analysis had blood pressure follow-up data at year 3.

Multivariable data were limited to Hispanic women with complete data on all variables (n = 3,848). We combined the clinical trial and observational study cohorts because prior analyses showed that study component did not confound the associations between the main outcomes and the covariables of interest. Data were collected during a baseline screening visit and during a third year visit; the data included physical measurements and questionnaires related to medical history, family history, lifestyle/behavioral factors, and quality of life. A full description of the WHI study is presented elsewhere.[16,17]

The dependent variable is hypertension status. Blood pressure was measured by certified staff with the use of standardized procedures and instruments described elsewhere.[17] Based upon data on lifetime risk of hypertension and increased risk of cardiovascular complications associated with previously considered normal blood pressures, the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC7) defined prehypertension for those with blood pressures ranging from 120 to139 mm Hg systolic and/or 80 to 89 mm Hg diastolic.[18] Participants with hypertension were defined as those who reported they were told by a doctor they had high blood pressure, and/or those who were currently taking medications for hypertension, and/or those whose systolic blood pressure was ≥140 mm Hg, and/or those whose diastolic blood pressure was ≥90 mm Hg.[4]

The independent variables assessed were demographic (level of education, age at WHI enrollment); BMI (kg/m^2); first-degree family history of adult diabetes, stroke, or heart attack/myocardial infarction; and personal medical history of cholesterol levels requiring pills, treated diabetes, and CVD (yes/no). BMI was defined as normal weight (<25 kg/m^2), overweight (25 to <30 kg/m^2) and obese (≥30 kg/m^2). Family history of diabetes, stroke, and myocardial infarction were summed with scores of 0–3, with higher scores indicating higher number of family history conditions. Access to health care was recoded as follows: yes = any health insurance coverage; no = no health insurance coverage. Health behaviors included smoking status (never smoked/past smoker; current smoker); physical activity, assessed as total energy expenditure in MET (metabolic equivalent task)-hours per week (0 to <3; 3.0 to <11.75; ≥11.75); and alcohol intake (nondrinker/past drinker; <7 drinks per week; and ≥7 drinks per week).

Statistical analyses

All statistical analyses were performed using SAS System for Windows version 9.3 (SAS Institute, Cary, NC). Descriptive analyses evaluated unadjusted baseline associations for hypertension status and the primary socioeconomic and access to health care factors of interest (education, health insurance status), as well as age, BMI, family history, medical history, and health behaviors known to be associated with hypertension status for Hispanic women. These variables were included as part of our baseline multivariable regression models. Logistic regression models were used to estimate odds ratios (ORs) and 95% confidence intervals (95% CIs) of hypertension status (prehypertensive or hypertensive vs. normotensive) at WHI baseline in relation to each explanatory variable, and adjusted for the effects of all other explanatory variables and potential confounders included in the model. Among women who were normotensive or prehypertensive at baseline, we assessed the odds of developing hypertension by year 3 of follow-up in association with the factors included in the baseline model. We also examined factors associated with hypertension at year 3 among the subset of participants with prehypertension at baseline. Associations were presented as ORs and 95% CIs, including *P* values, adjusted for all explanatory variables and potential confounders. Tests for linear trend were conducted by treating the scored categorical variables as continuous variables in the models. Appropriate multivariable model fit statistics were calculated to assess model calibration and discrimination.

RESULTS

Baseline characteristics of hypertension status

Compared with normotensive and prehypertensive Hispanic women, hypertensive participants were older and had less than a high school education (Table 1). They also had a higher number of cardiovascular risk factors, such as family history of diabetes, stroke, and/or myocardial infarction, treated hypercholesterolemia, treated diabetes, and history of CVD. Hypertensive Hispanic women had a higher BMI ($30.3 \pm 6.0\,kg/m^2$) than prehypertensive ($29.0 \pm 5.4\,kg/m^2$) and normotensive participants ($27.3 \pm 5.4\,kg/m^2$). Finally, hypertensive Hispanic women were not currently smoking, did not engage in moderate to strenuous activity, and were more likely to be a nondrinker/past drinker. An essentially similar pattern of association was found when comparing

Table 1. Characteristics of Hispanic women by hypertension status at baseline (year 1)

	Normotensive		Prehypertensive		Hypertensive	
Characteristic	**No.**	**%**	**No.**	**%**	**No.**	**%**
Education	306	27.0	393	34.7	434	38.3
Less than high school	437	32.8	450	33.8	444	33.4
High school diploma or GED, vocational or training school						
Some college or associate degree	400	35.1	394	34.6	344	30.2
College graduate and above	390	39.1	319	32.0	289	29.0
Age at WHI enrollment	1,293	38.1	1,161	34.2	942	27.7
50–64	271	21.1	420	32.7	593	46.2
65–79						
Body mass index, kg/m^2, baseline	551	47.0	348	29.7	273	23.3
<25	632	34.9	631	34.8	549	30.3
25 to <30						
≥30	368	22.3	592	35.9	691	41.9
Family history of diabetes, stroke, MI, no. of conditions	474	36.9	458	35.6	354	27.5
0	552	33.3	570	34.3	538	32.4
1						
2	375	30.9	390	32.1	449	37.0
3	141	31.4	146	32.5	162	36.1
Taking antihypertensive medication	--	--	--	--	540	100.0
Yes						
History of high cholesterol requiring pills	1,282	34.7	1,262	34.2	1,150	31.1
No						
Yes	150	23.5	198	31.0	290	45.5
Treated diabetes, pills or shots	1,503	34.3	1,501	34.3	1,378	31.4
No						
Yes	59	20.1	80	27.2	155	52.7
History of cardiovascular disease	1,338	34.7	1,340	34.7	1,181	30.6
No						
Yes	125	22.8	147	26.8	276	50.4
Health insurance status	112	22.5	169	33.9	217	43.6
Public only (Medicare/Medicaid)						
Private only	871	37.5	777	33.4	677	29.1
Public/private combination	107	21.7	156	31.6	230	46.7
Military/VA sponsored and/or other	127	36.8	106	30.7	112	32.5
No health insurance	269	34.4	296	37.9	216	27.7
Smoking status	1,408	32.7	1,467	34.1	1,429	33.2

Table 1. *Continued*

Characteristic	Normotensive		Prehypertensive		Hypertensive	
	No.	%	No.	%	No.	%
Never smoked, past smoker						
Current smoker	131	41.7	96	30.6	87	27.7
Total energy expenditure/week, MET-hours	493	31.1	548	34.6	545	34.4
0 to <3.0						
3.0 to <11.75	468	32.7	455	31.8	507	35.5
≥11.75	527	36.3	501	34.6	422	29.1
Alcohol intake	240	27.6	297	34.1	333	38.3
Nondrinker						
Past drinker	329	31.1	351	33.1	379	35.8
<7 drinks per week	893	36.4	826	33.7	735	30.0
≥7 drinks per week	78	34.7	84	37.3	63	28.0

Abbreviations: GED, General Education Development; MET, metabolic equivalent; MI, myocardial infarction; WHI, Women's Health Initiative.

prehypertensive participants with normotensive Hispanic women. At year 3 of follow-up, 27.3% of those who were normotensive at baseline had progressed to prehypertension, and 9.0% had become hypertensive (Table 2). Among participants with prehypertension at baseline, 30.4% had progressed to hypertension.

Multivariable prevalence results at baseline

Compared with normotensive Hispanic women at baseline, fewer risk factors were associated with prehypertension than with hypertension at baseline (Table 3). Level of educational attainment was inversely associated with baseline prehypertension (OR = 0.7; 95% CI = 0.6–0.9) for Hispanic women who were college graduates and above, ($P_{trend} = 0.02$). Hispanic participants with prehypertension at baseline were older at time of enrollment and were less likely to be current smokers (OR = 0.7; 95% CI = 0.5–1.0).

Education was inversely associated with baseline hypertension (OR = 0.6; 95% CI = 0.5–0.8) for women who were college graduates and above ($P_{trend} < 0.001$). Hispanic participants with hypertension were older at time of enrollment (OR = 2.8; 95% CI = 2.3–3.4) and were less likely to be a past drinker (OR = 0.7; 95% CI = 0.5–0.9), to drink <7 drinks per week (OR = 0.7; 95% CI = 0.6–0.9), and to be current smokers (OR = 0.6; 95% CI = 0.5–0.9).

Hypertension was associated with several cardiovascular risk factors: BMI ≥30 kg/m^2 (OR = 3.8; 95% CI = 3.0–4.7), a family history of diabetes, stroke, and/or myocardial infarction (OR = 1.1; 95% CI = 1.0–1.2), treated hypercholesterolemia (OR = 1.6; 95% CI = 1.2–2.0), treated diabetes (OR = 2.0; 95% CI = 1.4–3.0), and a history of CVD (OR = 2.0; 95% CI = 1.6–2.6).

Incident hypertension at year 3

Among Hispanic women who were normotensive or prehypertensive at baseline, the odds of incident hypertension at follow-up were highest among those who were older (OR = 2.0; 95% CI = 1.6–2.5), overweight (OR = 1.6; 95% CI = 1.3–2.1), obese (OR = 2.2; 95% CI = 1.7–2.9), had a family history of diabetes, stroke, and/or myocardial infarction (OR = 1.1; 95% CI = 1.0–1.2), treated hypercholesterolemia (OR = 1.5; 95% CI = 1.1–2.0), treated diabetes (OR = 1.6; 95% CI = 1.2–2.2), or a history of CVD (OR = 1.6; 95% CI = 1.2–2.2) (Table 4). Participants were less likely to develop hypertension if they were current smokers (OR = 0.60; 95% CI = 0.4–0.1). Finally, Hispanic women who developed hypertension were more likely not to have health insurance (OR = 1.4; 95% CI = 1.0–1.8). Associations with education, exercise, and alcohol intake were not significant.

Baseline normotensive Hispanic women were less likely to develop prehypertension (OR = 0.6; 95% CI = 0.4–0.9) and hypertension (OR = 0.3; 95% CI = 0.2–0.7) if they had a college education or higher (Table 5). They were more likely to develop prehypertension and hypertension if at baseline they were aged >65 years and had a BMI ≥25 kg/m^2. Incident hypertension was more likely for those baseline normotensive Hispanic women who had treated diabetes (OR = 2.3; 95% CI = 1.2–4.5) and a history of CVD (OR = 2.0; 95% CI = 1.1–3.5). Incident prehypertension was more likely for those baseline normotensive Hispanic women who had ≥7 drinks per week (OR = 2.2; 95% CI = 1.2–4.1).

Among Hispanic women who were prehypertensive at baseline, the odds of incident hypertension at follow-up were highest among those who had some college (OR = 1.6; 95% CI = 1.1–2.3), were college graduates or higher (OR = 1.7; 95% CI = 1.2–2.5), were older (OR = 1.7; 95% CI = 1.3–2.3), were obese (OR = 1.5; 95% CI = 1.1–2.1), had a family history of diabetes, stroke, and/or myocardial infarction (OR = 1.1; 95% CI = 1.0–1.3), had treated hypercholesterolemia (OR = 1.7; 95% CI = 1.2–2.4), had treated diabetes (OR = 1.4; 95% CI = 0.9–2.0), and had a history of CVD (OR = 1.4; 95% CI = 1.0–2.1) (Table 6). Finally, these Hispanic women were more likely not to have health insurance (OR = 1.3; 95% CI = 0.9–1.8).

Table 2. Changes in hypertension status of Hispanic women from baseline to year 3 follow-up

	Hypertension status, after 3 years					
	Normotensive		Prehypertensive		Hypertensive	
Hypertension status, baseline	No.	%	No.	%	No.	%
Normotensive	996	63.7	427	27.3	141	9.0
Prehypertensive	0.0	0.0	1,100	69.6	481	30.4

Table 3. Associations of baseline prehypertension and hypertension among Hispanic women

	Prehypertension		Hypertension	
Baseline characteristic	OR (95% CI)	*P* value	OR (95% CI)	*P* value
Education				
Less than high school	1.0 (reference)		1.0 (reference)	
High school diploma or GED, vocational or training school	0.8 (0.7–1.1)	0.17	0.7 (0.6–0.9)	0.01
Some college or associate degree	0.9 (0.7–1.1)	0.26	0.7 (0.5–0.9)	<0.01
College graduate and above	0.7 (0.6–0.9)	0.01	0.6 (0.5–0.8)	<0.001
P_{trend}	0.02		<0.001	
Age at WHI enrollment, y				
50–64	1.0 (reference)		1.0 (reference)	
65–79	1.8 (1.5–2.2)	<0.001	2.8 (2.3–3.4)	<0.001
Body mass index, kg/m^2, baseline				
<25	1.0 (reference)		1.0 (reference)	
25 to <30	1.6 (1.3–1.9)	<0.001	1.8 (1.4–2.2)	<0.001
≥30	2.4 (2.0–3.0)	<0.001	3.8 (3.0–4.7)	<0.001
P_{trend}	<0.001		<0.001	
Family history of diabetes, stroke, MI, no. of conditions, 0–3	1.0 (0.9–1.1)	0.01	1.1 (1.0–1.2)	0.01
History of high cholesterol requiring pills	1.1 (0.9–1.4)	0.44	1.6 (1.2–2.0)	<0.001
Treated diabetes, pills or shots	1.3 (0.9–1.9)	0.20	2.0 (1.4–3.0)	<0.001
History of cardiovascular disease	1.0 (0.8–1.3)	0.92	2.0 (1.6–2.6)	<0.001
No health insurance coverage	1.2 (0.9–1.5)	0.15	0.9 (0.7–1.1)	0.22
Current smoker	0.7 (0.5–1.0)	0.04	0.7 (0.5–0.9)	0.01
Total energy expenditure/week, MET-hours				
<3.0	1.0 (reference)		1.0 (reference)	
3.0 to <11.75	0.9 (0.8–1.1)	0.40	1.1 (0.9–1.3)	0.40
≥11.75	1.0 (0.8–1.2)	0.73	0.8 (0.7–1.0)	0.13
P_{trend}	0.73		0.16	
Alcohol intake				
Nondrinker	1.0 (reference)		1.0 (reference)	
Past drinker	0.8 (0.6–1.0)	0.11	0.7 (0.5–0.9)	<0.01
<7 drinks per week	0.9 (0.7–1.1)	0.19	0.7 (0.6–0.9)	0.01
≥7 drinks per week	1.1 (0.7–1.6)	0.70	0.9 (0.6–1.4)	0.66
Likelihood ratio	505.1 (DF = 34), *P* <0.0001			
Max-rescaled R^2	0.1384			

Abbreviations: CI, confidence interval; GED, General Education Development; MET, metabolic equivalent; MI, myocardial infarction; OR, odds ratio; WHI, Women's Health Initiative.

Table 4. Incident hypertension at year 3 follow-up in Hispanic women who were normotensive or prehypertensive at enrollment

Characteristic	OR (95% CI)	*P* value
Education		
Less than high school	1.0 (reference)	
High school diploma or GED, vocational or training school	1.3 (1.0–1.7)	0.07
Some college or associate degree	1.3 (0.9–1.7)	0.13
College graduate and above	1.1 (0.8–1.5)	0.65
P_{trend}	0.90	
Age at WHI enrollment, y		
50–64	1.0 (reference)	
65–79	2.0 (1.6–2.5)	<0.001
Body mass index, kg/m^2, year 3		
<25	1.0 (reference)	
25 to <30	1.6 (1.3–2.1)	<0.001
≥30	2.2 (1.7–2.9)	<0.001
P_{trend}	<0.001	
Family history of diabetes, stroke, MI, no. of conditions at baseline, 0–3	1.1 (1.0–1.2)	0.04
History of high cholesterol requiring pills, year 3	1.5 (1.1–2.0)	<0.01
Treated diabetes, pills or shots, year 3	1.6 (1.2–2.2)	<0.01
History of cardiovascular disease, year 3	1.6 (1.2–2.2)	<0.01
No health insurance coverage, ascertained at baseline	1.4 (1.0–1.8)	0.03
Current smoker, year 3	0.6 (0.4–1,0)	0.04
Total energy expenditure/week, year 3, MET-hours		
0 to <3.0	1.0 (reference)	
3.0 to <11.75	0.8 (0.7–1.1)	0.17
≥11.75	1.0 (0.8–1.2)	0.75
P_{trend}	0.74	
Alcohol intake		
Nondrinker	1.0 (reference)	
Past drinker	1.0 (0.7–1.4)	0.94
<7 drinks per week	0.9 (0.7–1.2)	0.35
≥7 drinks per week	0.9 (0.5–1.5)	0.68
Hosmer and Lemeshow goodness-of-fit	*P* = 0.48	
Area under the receiver operating characteristic curve	0.6480	

Data were obtained from a multivariable logistic regression analysis based on women with complete covariable data who were normotensive or prehypertensive at Women's Health Initiative enrollment (n = 2,706).

Abbreviations: CI, confidence interval; GED, General Education Development; MET, metabolic equivalent; MI, myocardial infarction; OR, odds ratio; WHI, Women's Health Initiative.

DISCUSSION

This study is one of the few recent studies focused on incidence of prehypertension and hypertension among postmenopausal Hispanic women. The data revealed three major findings: (i) Associations with education are inconsistent. Lower levels of education are associated with hypertension status at baseline, yet the transition from prehypertensive to hypertensive status is associated with higher levels of education after high school. (ii) Higher rates of incident hypertension are associated with lack of health insurance coverage. (iii) Women progress from normotensive to prehypertensive and from prehypertensive to hypertensive over a 3-year period at a relatively high rate.

A strong body of evidence demonstrates that low socioeconomic status as measured by lower levels of education[19–21] independently and significantly contributes to increases in chronic conditions, especially among women, and to hypertension, a major CVD risk factor.[21] Our data show that higher education levels are associated with lower prevalence at baseline but higher incidence of hypertension at follow-up. This non-intuitive finding is the first, to our knowledge, to be reported for incident hypertension among a Hispanic cohort. The data suggest that education may operate differently for women in this sample, who are predominantly Mexican American. Recent analyses of National Health and Nutrition Examination Survey 1998–2008 data found that higher education was associated with higher odds of hypertension and high waist circumference for Mexican-origin men and women regardless of nativity.[21] Several explanations have been proffered to explain this phenomenon. One is that higher levels of education may not necessarily translate into employment-related health insurance benefits, and thus access to diagnostic services is not readily available. Other investigators have suggested that higher education places one in work and school situations where one is more likely to experience unwelcoming, stressful life events, such as discrimination, that may contribute to adverse health conditions.[22,23]

Closely related was the finding that higher rates of incident hypertension were associated with lack of health insurance coverage. A greater share of Hispanic women compared with other groups lack health insurance coverage, do not have a personal doctor/health care provider, and delay or forego health care because of cost burden. Hispanic women are also disproportionately poor with low educational status, factors that contribute to their access to health care and overall health status. Among Hispanic women, approximately one-quarter report spending less on other basic needs to have enough money to pay for health expenses.[1] Hispanic women (38%) were more likely to be uninsured than non-Hispanic white women in 2009 (14%). Further, Hispanics, compared with blacks and white, poor/near poor and uninsured, have the highest percentage of adults aged ≥18 with hypertension.[24] Our last result shows high rates of incident hypertension among Hispanic women. These seemingly accelerated rates and transitions from normotensive to hypertensive and from prehypertensive to hypertensive over a 3-year period may be associated with a high burden of risk factors. Hispanic

Table 5. Incident prehypertension and hypertension at year 3 follow-up among Hispanic women who were normotensive at enrollment

	Prehypertension		Hypertension	
Characteristic	**OR (95% CI)**	***P* value**	**OR (95% CI)**	***P* value**
Education				
Less than high school	1.0 (reference)		1.0 (reference)	
High school diploma or GED, vocational or training school	0.7 (0.4–1.0)	0.04	1.1 (0.6–1.9)	0.86
Some college or associate degree	0.8 (0.5–1.2)	0.21	0.8 (0.4–1.4)	0.39
College graduate and above	0.6 (0.4–0.9)	0.02	0.3 (0.2–0.7)	<0.01
P_{trend}	0.09		< 0.01	
Age at WHI enrollment, y				
50–64	1.0 (reference)		1.0 (reference)	
65–79	1.6 (1.1–2.2)	<0.01	1.9 (1.1–3.2)	0.01
Body mass index, kg/m^2, year 3				
<25	1.0 (reference)		1.0 (reference)	
25 to <30	2.1 (1.6–2.9)	<0.001	2.9 (1.7–5.1)	<0.001
≥30	2.5 (1.7–3.5)	<0.001	3.7 (2.1–6.7)	<0.001
P_{trend}	< 0.001		< 0.001	
Family history of diabetes, stroke, MI, no. of conditions, 0–3	1.0 (0.9–1.2)	0.53	1.1 (0.9–1.4)	0.53
History of high cholesterol requiring pills, year 3	0.9 (0.6–1.3)	0.55	1.0 (0.6–1.9)	0.93
Treated diabetes, pills or shots, year 3	1.2 (0.7–2.1)	0.46	2.3 (1.2–4.5)	0.01
History of cardiovascular disease, year 3	0.8 (0.5–1.3)	0.32	2.0 (1.1–3.5)	0.02
No health insurance coverage, ascertained at baseline	0.8 (0.5–1.1)	0.18	1.2 (0.7–2.1)	0.45
Current smoker, year 3	0.9 (0.5–1.4)	0.60	0.6 (0.3–1.5)	0.28
Total energy expenditure/week, MET-hours				
<3.0	1.0 (reference)		1.0 (reference)	
3.0 to<11.75	1.1 (0.8–1.5)	0.50	1.1 (0.9–1.3)	0.40
≥11.75	1.0 (0.8–1.4)	0.84	0.8 (0.7–1.0)	0.13
P_{trend}	0.73		0.07	
Alcohol intake				
Nondrinker	1.0 (reference)		1.0 (reference)	
Past drinker	1.1 (0.7–1.6)	0.79	1.1 (0.5–2.1)	0.88
<7 drinks per week	1.0 (0.7–1.5)	0.97	1.1 (0.6–2.1)	0.69
≥7 drinks per week	2.2 (1.2–4.1)	0.01	1.6 (0.5–5.0)	0.39
Likelihood ratio	120.4 (DF = 34), $P < 0.0001$			
Max-rescaled R^2	0.1048			

Data were obtained from a multivariable multinomial logistic regression model. Analyses were conducted in women who were normotensive at Women's Health Initiative enrollment with complete data on all covariables included in the model (n = 1,338). Comparison group is women who were normotensive at year 3.

Abbreviations: CI, confidence interval; GED, General Education Development; MET, metabolic equivalent; MI, myocardial infarction; OR, odds ratio; WHI, Women's Health Initiative.

Table 6. Odds of incident hypertension at year 3 follow-up in Hispanic women who were prehypertensive at enrollment

Characteristic	OR (95% CI)	*P* value
Education		
Less than high school	1.0 (reference)	
High school diploma or GED, vocational or training school	1.4 (1.0–1.9)	0.07
Some college or associate degree	1.6 (1.1–2.3)	0.01
College graduate and above	1.7 (1.2–2.5)	<0.01
P_{trend}	0.005	
Age at WHI enrollment, y		
50–64	1.0 (reference)	
65–79	1.7 (1.3–2.3)	<0.001
Body mass index, kg/m^2, year 3		
<25	1.0 (reference)	
25 to <30	1.2 (0.9–1.7)	0.21
≥30	1.5 (1.1–2.1)	0.02
P_{trend}	0.02	
Family history of diabetes, stroke, MI, no. of conditions at baseline, 0–3	1.1 (1.0–1.3)	0.08
History of high cholesterol requiring pills, year 3	1.7 (1.2–2.4)	<0.01
Treated diabetes, pills or shots, year 3	1.4 (0.9–2.0)	0.12
History of cardiovascular disease, year 3	1.4 (1.0–2.1)	0.06
No health insurance coverage, ascertained at baseline	1.3 (0.9–1.8)	0.14
Current smoker, year 3	0.6 (0.3–1.1)	0.13
Total energy expenditure/week, year 3, MET-hours		
0 to <3.0	1.0 (reference)	
3.0 to <11.75	0.8 (0.6–1.1)	0.23
≥11.75	0.8 (0.6–1.1)	0.11
P_{trend}	0.10	
Alcohol intake		
Nondrinker	1.0 (reference)	
Past drinker	1.1 (0.8–1.6)	0.61
<7 drinks per week	0.8 (0.6–1.2)	0.33
≥7 drinks per week	0.8 (0.5–1.5)	0.55
Hosmer and Lemeshow goodness-of-fit	*P* = 0.28	
Area under the receiver operating characteristic curve	0.6170	

Data were obtained from a multivariable logistic regression analysis based on women with complete covariable data who were prehypertensive at Women's Health Initiative enrollment (n = 1,368).

Abbreviations: CI, confidence interval; GED, General Education Development; MET, metabolic equivalent; MI, myocardial infarction; OR, odds ratio; WHI, Women's Health Initiative.

women show higher rates of BMI; are less likely to exercise; are more likely to report a family history of diabetes, stroke and/or myocardial infarction; are more likely to have a medical history of treated diabetes and hypercholesterolemia; and are less likely to have awareness of hypertension symptoms.[7–10,25]

However, multiethnic comparison studies on prevalence have produced contradictory evidence. Several studies report a similar prevalence of hypertension among Hispanics and whites,[26] other studies show a lower prevalence of hypertension among Hispanics compared with whites,[27] and a few studies have reported a higher prevalence among Hispanics than whites.[28] Only 3 prior studies have focused on incident hypertension among Hispanics, with conflicting results. The San Antonio Heart Study (8 years of follow-up) and the San Luis Valley Diabetes Study (4 years of follow-up) found similar overall incidence rates between Mexican Americans and non-Hispanic whites.[26,29] However, in those aged 55–64 years, the San Antonio Heart Study found higher incidence rates for Mexican Americans compared with whites for both men and women. Recently, the Multi-Ethnic Study of Atherosclerosis found Hispanics had higher incidence rates compared with whites in middle age (45–74 years) but similar rates at older ages (≥75 years).[30]

Our study is one of the first to document high progression rates to hypertension status in an older cohort of Hispanic women. These results are consistent with prior work from the non-Hispanic white population of the Framingham Study, which found that normotensive and prehypertensive older individuals progressed quickly over a 4-year period.[31] This high rate of hypertension progression is most likely due to 2 important factors. First, it is well documented that change in systolic blood pressure during follow-up varies directly with the initial level. Second, progression is also likely due to the high burden and clustering of many CVD risk factors among the participants in this study. These data may also lend support to prior findings demonstrating that the clustering of cardio-metabolic risk factors in a prospective (predominantly white) community cohort is predictive of both subclinical and clinical CVD and diabetes mellitus.[32,33]

Our study has several limitations, primarily regarding the generalizability of our sample cohort. All women were postmenopausal, and our findings cannot be generalized to younger women of reproductive age. Compared with National Health and Nutrition Examination Survey data of women in this age group, the BMI of the WHI subjects was similar to that of other women in this age range. Although the racial and ethnic population distribution of the sample was similar to that of all US women in this age distribution, the women in this cohort were healthier at baseline than women of this age in the general population, as indicated by lower baseline prevalence of diabetes, hypertension, CVD, high cholesterol levels that required medication, and cigarette use (smoking).[34] The medical history and health findings may be attributed to the voluntary recruitment strategy that was used for the WHI study. Although we accounted for traditional cardiovascular risk factors in multivariable regression models, we were unable to include all possible confounders, thus preventing any causal conclusions about

incident hypertension. The categorization of our exposures may have introduced confounding. For example, our dichotomous smoking habit variable does not fully capture the linear spectrum of smoking behavior. In addition, we did not include use of medication in management of prehypertension or initial drug therapy with compelling indications as suggested by the JNC7 report.

Socioeconomic factors such as level of education were reported to be higher among WHI participants, and fewer women reported no leisure-time physical activity compared with other Hispanic study cohorts. Further the WHI Hispanic sample is predominantly of Mexican origin, and these data may not be representative of other Hispanic subgroups.

Hispanics are the fastest growing demographic group in the United States and will constitute 25% of the total US population by 2050. CVDs are the second leading cause of mortality, behind cancer, among Hispanics.[35] Reliable health information is especially important for Hispanics, who are disproportionately uninsured, economically disadvantaged, and among the least able to afford health insurance coverage, least likely to have a usual source of care, and most likely to report poor doctor–patient communication.[8,12,14,15]

Hispanic women seem to be at increased risk of incident hypertension in their later adulthood. These data suggest the importance of screening for conditions such as diabetes and hypercholesterolemia after the childbearing years so as to identify early, treat, and manage cardiovascular risk factors. Prior work has demonstrated high rates of co-occurring conditions such as diabetes and a disproportionate rate of metabolic syndrome (diabetes, high cholesterol, and obesity),[15] compared with other non-Hispanic women, that contribute to the cardiovascular risk and mortality of postmenopausal Hispanic women.[35,36] Further, hypertension increases with age and is associated with low levels of physical activity—factors strongly associated with Hispanic ethnicity and low education levels.[20,37] Rate increases in transition to hypertension rates are equally likely to be associated with decreases in access to preventive care for low-income Hispanic groups with no usual personal doctor/health care provider, delayed or no health care because of inability to pay,[38,39] and psychosocial stressors because of neighborhood context.[40]

On a practical level, recommendations for preventive care and population-wide adoption of healthy behaviors may contribute to reductions in hypertension risk factors. Community-focused campaigns to engage in physical exercise, such as neighborhood walks to reduce obesity and increase physical activity, combined with nutritional programs may reduce rates of hypertension and diabetes. In addition, aggressive prevention and control of risk factors for hypertension are recommended to improve the future cardiovascular health of Hispanic women.

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DISCLOSURE

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