RACIAL AND ETHNIC DIFFERENCES IN HYPERTENSION RISK: NEW DIAGNOSES AFTER AGE 50

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Objectives: Our study examines the differences in estimated risk of developing hypertension in Whites, Blacks, and Mexican-Americans aged ≥50 for a period of 11 years.

Design, Setting, and Participants: Data came from 9,259 respondents who reported being hypertension-free at the baseline in the Health and Retirement Study (HRS) with up to five time intervals (1998–2006). Discrete-time survival models were used to analyze ethnic variations in the probability of developing hypertension.

Main Outcome Measure: Estimated odds of developing hypertension.

Results: The risk of newly diagnosed hypertension increased between 1995 and 2006 for HRS participants aged≥50. After adjusting for demographic and health status, the probability of incident hypertension among Black Americans was .10 during the period of 1995/96–1998, which increased steadily to .17 in 2004–2006, with cumulative incidence over the 11-year period at 51%. In contrast, among White Americans the risk was .07 during 1995/96–1998 and .13 in 2004–2006, with cumulative incidence at 43%. For Mexican-Americans, the probability also increased from .08 during 1995/96–1998 to .14 during 2004–2006, with cumulative incidence at 42%.

Conclusions: Relative to White and Mexican-Americans, Black Americans had an elevated risk of incident hypertension throughout the 11-year period of observation. These variations persisted even when differences in health behaviors, socioeconomic status, demographic, and time-varying health characteristics were accounted for. (*Ethn Dis.* 2012;22(2):175–180)

Key Words: Ethnic Differences, Hypertension Incidence, Discrete-Time Survival Analysis

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INTRODUCTION

Hypertension continues to be the most prevalent form of cardiovascular disease, and an important contributor to mortality in the United States.[1–2] Associated with these increases in morbidity are rising health care costs. This makes efforts to better elucidate trends in hypertension risk and increase prevention efforts a policy imperative.[1–3] Despite national goals to reduce and eliminate ethnic disparities in health outcomes,[4] disparities in cardiovascular conditions persist. Surveillance data reveal high prevalence of hypertension among Black adults, and identify Hispanics and persons of low socioeconomic status to be most at risk for developing cardiovascular disease.[5] Although control of well-established clinical risk factors has improved for adults that age into Medicare, ethnic and socioeconomic disparities in cardiovascular disease burden have not diminished.[6] To the contrary, recent findings[7] cite greater increases in hypertension prevalence for Black Americans, with widening disparities over working ages.

Less is known about the incidence of hypertension among older adults. The risk factors for hypertension onset are frequently studied for young adults and the elderly alike.[8] However, why racial disparities in hypertension exist is not fully understood. High residual lifetime risk of hypertension, even among older Americans,[3] represents a large public health burden and dictates a need for primary prevention not to be limited to middle-aged and younger individuals. Our study aims to contribute to the current understanding of health disparities by examining newly diagnosed hypertension differences over a period of 11 years for middle-aged and older White, Black and Mexican Americans.

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METHODS

Data and Measures

Our study used biennial data from the Health and Retirement Study (HRS). The HRS respondents are a nationally-representative sample of community-based adults aged ≥51. The HRS has been approved by the University of Michigan's Health Sciences Institutional Review Board. Consistent with on-going HRS practice respondents are read a confidentiality statement when first contacted, and give oral or implied consent by agreeing to be interviewed. Due to wave incompatibility of key independent variables, these analyses are limited to HRS data from 1995–2006. Data management and analysis was conducted with Stata 10.0.[9]

Self-reported hypertension was constructed as a binary variable. Self-reported health and disease status have been well established and validated in earlier studies[10–11] The HRS asks respondents if they have been diagnosed with hypertension by a physician each interview year. In subsequent interviews, individuals could dispute preloaded responses

from the previous interview. In order to deal with conflicting disease reports over time, we examine additional information reported by respondents. Each dispute was corroborated with prior wave information on use of hypertensive medication to verify diagnosis.

Time-varying health covariates were included to partially account for population heterogeneity. We included self-rated health (SRH), functional limitations, depressive symptoms, chronic disease comorbidities, BMI and current smoker status covariates as time-varying lagged values and change scores. Both, previous period health information and net health changes were conceptualized as contributing unique predictive information in models of new hypertension cases.

Lagged covariates were constructed as health status at time (t-1) and predict hypertension risk at time t. Lagged SRH was measured with a 5-item scale (1=excellent, 2=very good, 3=good, 4=fair and 5=poor). Lagged functional status (0–11) incorporates activities of daily living (0–6) and instrumental activities of daily living (0–5), with higher scores reflecting increasing number of difficulties. Lagged depressive symptoms were measured with the Center for Epidemiological Studies Depression Scale (0–9) with higher scores reflecting higher depressive symptoms. Lagged comorbidity was a count of chronic diseases (stroke, heart disease, arthritis, lung disease, diabetes and cancer, 0–6). Lagged BMI was calculated using respondent self-reported weight and height. Lagged current smoker was included as a binary variable. Change scores for these measures were constructed as the difference between time t and time (t-1). Positive change scores reflected an increase in health grievances, while negative scores denoted improvement. A change score of zero denoted no change in health conditions across adjacent periods.

We constructed binary variables for non-Hispanic White, non-Hispanic Black and Mexican-ethnicity individuals. Age was a continuous variable measured at each interval. Education was measured as a continuous variable denoting years of schooling (0–17). Lagged and change in income was inflation-adjusted to 2006 levels, and re-scaled (reported per 1000s of dollars). Marital status was constructed as a lagged time-varying covariate. The change in marital status (range −1 to 1) reflected dissolution/widowhood, no change, and acquisition of partners at each point in time over the study period, respectively.

Data Analysis

We estimated the incidence of hypertension among nonhypertensives during the 11 years of observation (1995–2006). Date of hypertension diagnosis is not readily available in the HRS, therefore it is problematic to directly calculate incidence rates or estimate continuous time survival models of incidence. However, our analyses result in estimates of risk onset comparable to a continuous time model.[12]

Discrete-time survival analysis was used to model the onset of hypertension diagnosis. The discrete-time hazard represents the risk of event occurrence in each discrete time period among people in the risk set. The risk of hypertension was estimated for those respondents who have not been previously diagnosed.[12] There were 7719 participants (46% of total individuals at baseline; 43% of Whites, 62% of Blacks, and 43% of Mexican Americans) who were already diagnosed with hypertension and therefore excluded from the discrete-time survival analyses.

We used Stata macros developed by Dinno[13] to estimate the model using the logit link and adjust for clustering within households. In estimating discrete time hazard models, the logistic transformation yields the conditional log-odds of the risk of hypertension onset. Model 0 (M_0) was estimated to determine the shape of the baseline hypertension hazard. Model 1 (M_1) included covariates for race/ethnic group. Model 2 (M_2) built on M_1 to include demographic and socioeconomic covariates. Model 3 (M_3) built on M_2 to include health status covariates. Table 2 reports the model results as fitted odds ratios. Model coefficients are transformed into predicted probabilities of the hazard.[13] We employed multiple imputation[14] of incomplete multivariate data under a normal model software (NORM) to handle missing data. Specifically, three complete data sets were imputed, analyses were replicated on each of these data sets and estimates were averaged to generate a single point-estimate.

RESULTS

Table 1 details sample descriptive statistics collected at the baseline interview. The mean age for our total sample was 66 years, and 56% were female. The ethnic composition of our sample shows 10% of respondents were Black and 5% were of Mexican origin. Table 1 also details the number of excluded individuals with prevalent hypertension at baseline.

Table 2 presents the discrete-time hazard model results for the risk of developing hypertension. The baseline hazard for hypertension in M_0 (unadjusted by any predictors) demonstrates a steady increase in the risk of incident hypertension over time. The probability of being diagnosed with hypertension in the first period is .098 and rises to .155 by the final time period. In examining models M_1–M_3, we are able to determine pronounced differences in the probability of newly diagnosed hypertension for Black relative to White Americans. Results detail significantly higher odds of hypertension for Blacks (in M_1, OR=1.483, $P<.001$; in M_2, OR=1.377, $P<.001$; in M_3, OR =1.278, $P=.001$). The odds attenuated across the models, yet remain significantly higher relative to Whites after accounting for differences socioeconomic covariates and health status changes, respectively.

Table 1. Characteristics at first interval

	Total N= 9259		White *n*= 7880		Black *n*= 936		Mexican *n*= 443	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Age	66.25	10.26	66.49	10.27	65.20	10.40	64.23	9.48
Female	.56	.50	.56	.50	.58	.50	.52	.50
Education, years	12.30	3.20	12.71	2.79	11.17	3.54	7.50	4.59
Proxy, t_{t-1}	.06	.24	.06	.23	.07	.26	.13	.34
Married, t_{t-1}	.76	.43	.77	.42	.59	.49	.79	.41
Income, t_{t-1}	66.00	94.46	70.78	99.21	44.24	61.62	28.11	27.80
Functional, t_{t-1}	.31	1.14	.27	1.07	.50	1.43	.52	1.59
SRH, t_{t-1}	2.42	1.09	2.36	1.08	2.70	1.08	2.97	1.14
CESD, t_{t-1}	1.49	1.78	1.42	1.73	1.79	1.87	2.12	2.19
Comorbidities, t_{t-1}	.76	.85	.73	.80	.89	1.08	.67	.71
BMI, t_{t-1}	27.71	5.34	27.32	5.09	29.56	6.20	28.85	5.42
Smoker, t_{t-1}	.14	.35	.14	.34	.17	.38	.14	.35
Δ proxy	.02	.21	.02	.19	.04	.26	.00	.30
Δ marital	−.02	.14	−.02	.13	−.02	.15	−.02	.13
Δ income	.75	114.78	.92	123.11	−1.93	50.32	3.47	29.07
Δ functional	.13	1.15	.12	1.09	.20	1.44	.16	1.40
Δ SRH	.27	.94	.26	.91	.27	1.04	.21	1.13
Δ CESD	.36	1.95	.34	1.87	.45	2.19	.48	2.66
Δ comorbidities	.13	.36	.12	.34	.22	.47	.00	.33
Δ BMI	−.03	2.06	−.02	1.91	−.07	2.65	−.02	2.47
Δ smoker	−.01	.20	−.01	.19	−.01	.23	−.01	.23

SRH, self-rated health; CESD, Center for Epidemiological Studies Depression Scale.

Figure 1 plots the probability of developing hypertension for Black, White and Mexican Americans using model M_3 estimates. Overall, the risk of newly diagnosed hypertension increased from 1995–2006 for HRS participants with hypertension risk highest for Black Americans. The probability of newly diagnosed hypertension among Black Americans was .10 in the first period and increased steadily to .17 by the final period. In contrast, among White Americans, the risk was .07 at the first period and rose to .13 by the last period. For Mexican Americans, the probability increased from .08 to .13. Figure 2 plots model M_3 estimates by race/ethnic group as well as by age. We examined differences in new diagnoses at the 25th and 75th percentile of the age distribution. Both middle-aged and older Black Americans exhibit significantly higher probabilities of hypertension than all other age/ethnic groups examined.

Model M_1 details higher odds of hypertension for Mexican-ethnicity individuals (OR=1.303, *P*=.001); however, once we account for socioeconomic differences (in M_2, OR=1.086, *P*=.429), and changing health status (in M_3, OR=.966, *P*=.752), Mexican-Americans no longer have significantly different odds of incident hypertension in comparison to Whites (Table 2).

We also examined the risk of mortality through separate discrete-time survival models of nonhypertensive persons at the baseline (not shown). Middle-aged and older Mexican Americans who are hypertension-free at study entry had lower risk of mortality compared to Whites. We found no differences in the risk of dying between Black and White Americans.

DISCUSSION

Our study moves beyond the cross-sectional designs and determines how interval-by-interval changes in hypertension risk differ for middle-aged and older Black, Mexican, and White Americans over an 11-year period. The cumulative incidence of developing hypertension over the entire period for the aggregate sample is 44%, with cumulative incidence of 43% for White Americans, 51% for Black Americans, and 42% for Mexican Americans.

Relative to White and Mexican Americans, Black Americans were 30% more likely to develop hypertension throughout the 11-year period of observation.

The risk of incident hypertension increases over time for individuals in the HRS. To a significant extent, increases in incident hypertension were a result of changing demographic and health attributes. Relative to White and Mexican Americans, Black Americans were 30% more likely to develop hypertension throughout the 11-year period of observation. These variations persisted even when differences in health behaviors, socioeconomic status, demographic, and time-varying health characteristics were adjusted. These results largely

Table 2. Hypertension diagnosis discrete-time survival results

	M_0			M_1			M_2			M_3		
	OR	SE	*P*	OR	SE	*P*	OR	SE	*P*	OR	SE	*P*
Period 1995/96–1998	.098	.036	[a]	.092	.037	[a]	.103	.271	[a]	.014	.340	[a]
Period 1998–2000	.123	.036	[a]	.117	.037	[a]	.157	.250	[a]	.018	.317	[a]
Period 2000–2002	.128	.040	[a]	.121	.041	[a]	.161	.252	[a]	.018	.321	[a]
Period 2002–2004	.138	.044	[a]	.132	.045	[a]	.182	.256	[a]	.020	.325	[a]
Period 2004–2006	.155	.054	[a]	.147	.055	[a]	.197	.260	[a]	.022	.332	[a]
Black				1.483	.057	[a]	1.377	.069	[a]	1.278	.073	[a]
Mexican-American				1.303	.082	[a]	1.086	.105		.966	.111	
Proxy, t_{t-1}							1.110	.100		1.249	.112	[c]
Δ proxy							1.621	.113	[a]	1.656	.126	[a]
Age							.997	.003		1.007	.003	[c]
Education							.979	.008	[b]	.987	.009	
Female							1.164	.046	[a]	1.209	.049	[a]
Married, t_{t-1}							.971	.053		.963	.057	
Δ married							1.063	.099		1.113	.109	
Income, t_{t-1}							.999	.000	[c]	1.000	.000	
Δ income							.999	.000	[c]	.999	.000	
BMI, t_{t-1}										1.038	.005	[a]
Δ BMI										1.030	.012	[b]
SRH, t_{t-1}										1.153	.030	[a]
Δ SRH										1.276	.030	[a]
CESD, t_{t-1}										1.011	.015	
Δ CESD										1.013	.014	
Functional, t_{t-1}										.966	.025	
Δ functional										.962	.023	
Comorbidities, t_{t-1}										1.043	.027	
Δ comorbidities										1.458	.051	[a]
Smoker, t_{t-1}										.846	.069	[c]
Δ smoker										.824	.127	
LL				−10560.04			−9739.32			−6887.80		
Wald χ^2				−10560.04			−9739.32			−8184.35		
Probability> χ^2				.000			.000			.000		

[a] $P<.05$
[b] $P<.01$
[c] $P<.001$
SRH, self-rated health; CESD, Center for Epidemiological Studies Depression Scale; LL, log-likelihood

support previous studies of increasing hypertension incidence with age[8] and extend beyond these studies by tracing persistent ethnic disparities in disease incidence into old age.

Examination of model findings by age groups also reveals interesting results. Although we plotted 25th and 75th age percentiles expecting a clear pattern of higher odds accruing to older age groups, this was not the case. Both, younger and older Blacks in our sample had highest odds of developing hypertension relative to Mexican and White Americans of any age.

Our study was able to examine hypertension risk for Mexican Americans. The results indicate that hypertension onset for Mexican ethnicity individuals broadly aligns with the concept of the Hispanic Paradox.[15] Mexican individuals in our study exhibit similar risk of developing hypertension compared to Whites despite lower average income and education levels (Table 1).

However, findings for Mexican Americans should be interpreted with caution. Bias may be introduced by socioeconomic differences in return migrants. Wong et al[16] suggest that older Mexican-origin individuals emigrating back to Mexico from the United States are more likely to be in the wealthiest strata of the income distribution. It is possible that we are not observing higher rates of newly diagnosed hypertension if HRS Mexican-origin participants with greater means are no longer captured in our study sample. In addition, in recent studies, differences in the control of cardiovascular risk factors between predominantly Spanish-speaking and English-speaking Hispanics are discernible.[17] Although we examined Spanish-language interviews (not shown) we found no differences in hypertension risk. Further study of immigration dynamics and cultural orientation for Mexican-Americans is needed.

There are a few additional limitations that need to be acknowledged. First, an important concern to using self-reported health measures, and specifically, self-reported hypertension indicators, is the reliability of responses and consistency in subsequent respondent re-interviews.[18]

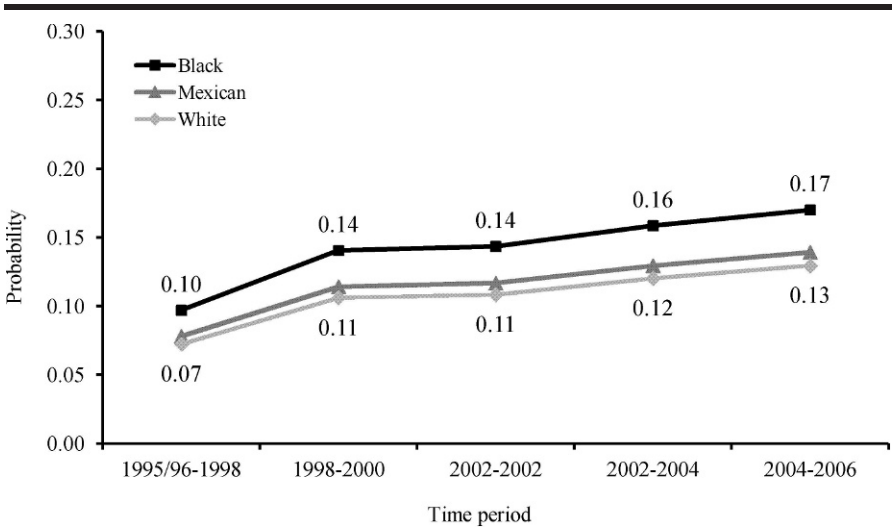

Fig 1. Conditional probability of developing hypertension (M_3) by ethnic group[a]
[a] Conditional probabilities evaluated at zero change scores and the mean of other covariates.

Specific procedures to explore the extent of inconsistencies across an individual's longitudinal record and provide more time-consistent disease indicators are reflected in these analyses. In addition, individuals may be unaware or underreport diagnoses of hypertension due to age and race/ethnicity biases and differential access to good quality clinical practitioners. Ostchega et al[19] found some substantiation for this concern. Initial comparison of self-reported and measured blood pressure data in the HRS indicate that the two are well correlated.[20]

Second, these findings are largely reliant on individuals in the HRS having access to a hypertension diagnosis through physician visits and health care system use. Although the majority of the study population is Medicare age-eligible, additional analyses (not shown) included time-varying health insurance coverage. Even after controlling for potential shifts in and out of health insurance coverage, incident hypertension remains elevated for Black relative to White Americans, and statistically similar for White and Mexican Americans.

Finally, it is difficult to ascertain a clear picture of minority health with the HRS sample since the study tracks individuals from middle age into old age and is not able to capture earlier-life selective mortality and hypertension onset. Health disadvantages and differential mortality that may have occurred before middle age are not traced here, and are an important consideration when interpreting the findings. The analyzed sample of Black, Mexican and White Americans that survive to middle and old age without diagnosed hypertension is very different than their respective representative populations due to differential morbidity and mortality that occurs earlier in the life-course. Still, these results indicate that hypertension prevention efforts for middle aged and older Black populations in the United States lag behind those for Whites.

Aggressive prevention of hypertension even into old age is essential, particularly for Black minorities in the United States. Similar to the recommendations from Mosley et al,[8] the dissemination of information and aggressive treatment of hypertension and risk factors for hypertension need not be targeted only to young adults. Targeted efforts are needed to reduce hypertension burden for older-aged Americans, and to older-aged Black Americans in particular.

Potential complications arising from new hypertension diagnosis have vast implications on the treatment and management of multiple diseases for elderly Americans.[21] Understanding chronic disease burden patterns and severity of

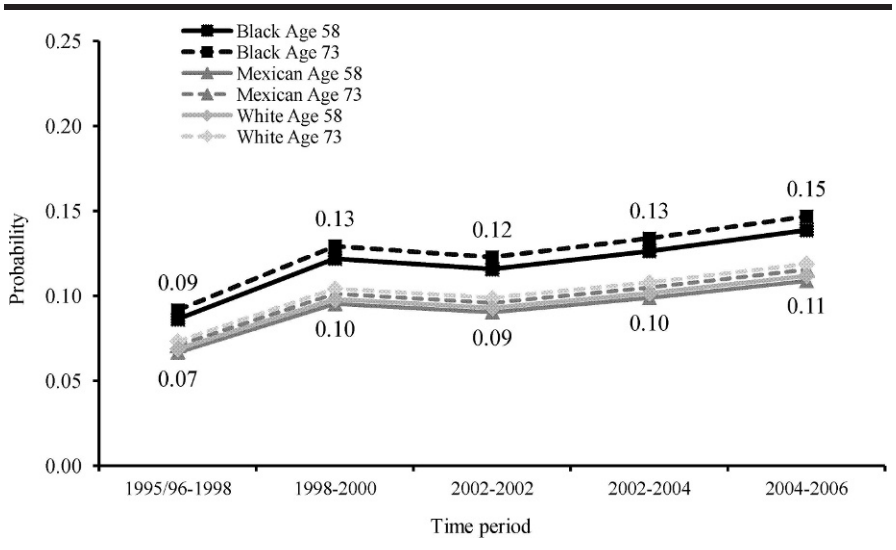

Fig 2. Conditional probability of developing hypertension (M_3) by ethnic group and age[a]
[a] Conditional probabilities evaluated at zero change scores and the mean of other covariates

conditions for aging minority Americans are important areas for further study.

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Manuscript draft: Quiñones
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