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BRIEF COMMUNICATION

Self-Reported and Measured Hypertension Among Older US- and Foreign-Born Adults

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Abstract Self-reported hypertension is frequently used for health surveillance. However, little is known about the validity of self-reported hypertension among older Americans by nativity status. This study compared self-reported and measured hypertension among older black, white, and Hispanic Americans by nativity using the 2006 and 2008 Health and Retirement Study ($n = 13{,}451$). Sensitivity and specificity of self-reported hypertension were calculated using the Seventh report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure definition. Sensitivity was high among older blacks (88.9%), whites (82.8%), and Hispanics (84.0%), and both foreign-born (83.2%) and US-born (84.0%). Specificity was above 90% for both US-born and foreign-born, but higher for whites (92.8%) than blacks (86.0%). Despite the potential vulnerability of older foreign-born Americans, self-reported hypertension may be considered a reasonable estimate of hypertension status. Future research should confirm these findings in samples with a larger and more ethnically diverse foreign-born population.

Keywords Self-reported hypertension · Race/ethnicity · Nativity · Validity · Health and Retirement Study

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Introduction

Hypertension is an established risk factor for cardiovascular disease (CVD) mortality and morbidity and plays a major role in contributing to racial/ethnic disparities in CVD [1]. Many large scale chronic disease surveillance systems and population-based studies on the prevalence of hypertension risk rely on self-reported data [2, 3]. The accuracy of self-reports may be compromised by lack of awareness of hypertension, recall bias, or social desirability [4]. However, self-reported data are extremely attractive due to time and cost efficiency advantages. Although the validity of self-reported hypertension has been assessed by gender, race, Hispanic ethnicity, and socioeconomic status [5–8], the validity of self-reported hypertension by nativity status has received little attention.

Older foreign-born individuals may be less likely to be aware of their hypertension status due to differential use or quality of medical care or screening practices in the US or the country-of-origin. It is crucial to evaluate the performance of common health surveillance measures, such as self-reported hypertension, in this potentially vulnerable population. This study evaluated the validity of self-reported hypertension among older US- and foreign-born black, white, and Hispanic Americans in the Health and Retirement Study (HRS).

Methods

Study Population

HRS is a longitudinal national sample of US adults aged 50+. Details of the sample design and measurements have been documented elsewhere [9, 10]. Enrollment was staggered by birth cohort with enrollments in 1992, 1993, and 1998. In 1992, baseline face-to-face interviews were initiated and ongoing biennial follow-up interviews have been conducted through 2008. The original response rate was 81.4% and subsequent wave-to-wave retention rates have ranged between 85 and 90%. Data for this analysis is from the 2006 and 2008 interviews, when direct biomarker assessments in randomly selected subsamples of the study population were collected. Respondents were excluded if they were unable or unwilling to participate in the blood pressure assessment [11]. Our analyses include individuals with direct assessments of blood pressure ($n = 13{,}451$), which comprised 62% of the eligible sample.

Measures

Self-reported hypertension was based on the question: "Has a doctor ever told you that you have high blood pressure or hypertension?" Subjects who reported a hypertension diagnosis were then asked about current use of medication to lower blood pressure.

Blood pressure measurement protocol is described elsewhere [12]. The measures were based on an average of three readings; the Cronbach's internal consistency coefficient was above 0.93. We defined "measured hypertension" in accordance with the Seventh report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC 7) [13] as: (1) anyone with an average systolic blood pressure (SBP) $\geq$140 mmHG, or (2) an average diastolic blood pressure (DBP) $\geq$90 mmHG, or (3) self-reported use of medications to manage hypertension[13]. Individuals whose measured blood pressure met the criteria for hypertension but did not self-report a diagnosis of hypertension were considered "unaware" and hypertensive individuals who self-reported a diagnosis were considered "aware".

We considered three race/ethnicity groups: Hispanics (regardless of race), non-Hispanic whites, and non-Hispanic blacks. Self-reported place of birth was dichotomized into US-born versus foreign-born. Other variables included in the analysis were gender (male/female) and age (used as a continuous variable and as a quadratic term). Other characteristics such as education and income were not adjusted in the models due to the primary interest in examining overall differences, rather than differences resulting from specific mediators [14].

Data Analysis

Prevalence of self-reported and measured hypertension was estimated by race/ethnicity and nativity status. Validity of a self-reported hypertension diagnosis was assessed by calculating the following measures by race/ethnicity and

Table 1 Sociodemographic characteristics of the study sample, Health and Retirement Study participants, 2006 and 2008

Characteristic	Total[a]		Black		Hispanic		White	
	N	%	*N*	%	*N*	%	*N*	%
	13,451		1,859	13.8	1,024	7.6	10,568	78.6
Age, in years (mean, SD)	68.6	10.4	67.2	10.1	66.4	10.4	69.2	10.4
Gender								
Male	5,521	41.0	655	35.23	399	40.0	4,467	42.3
Female	7,930	59.0	1,204	64.77	625	61.0	6,101	57.7
Country of origin								
US-born	12,342	91.7	1,764	94.9	438	42.8	10,140	96.0
Foreign-born	1,109	8.2	95	5.1	586	57.2	428	4.0
Hypertension medication								
No	6,322	47.0	604	32.5	499	48.7	5,219	49.4
Yes	7,129	53.0	1,255	67.5	525	51.3	5,349	50.6
Education								
Less than high school	2,879	24.5	655	35.8	605	59.1	1,609	15.3
High school graduate	4,581	34.2	559	30.1	208	20.3	3,814	36.2
More than high school	5,946	44.4	633	34.1	210	20.5	5,103	48.5

SD Standard Deviation

[a] Sample size across different categories may not add up to 13,451 due to missing data

Table 2 Test characteristics for self-reported hypertension by race/ethnicity and nativity status

	Self-reported hypertension			Measured hypertension[a]			Sensitivity	Specificity	Positive predictive value	Negative predictive value
	N	%	95% CL	*N*	%	95% CL	(95% CL)	(95% CL)	(95% CL)	(95% CL)
Total	13,451			8,968	66.7	(65.9, 67.5)	83.9 (83.1, 84.7)	92.0 (91.1, 92.8)	95.4 (95.0, 95.9)	74.1 (72.9, 75.2)
US-born	7,250	58.7	(57.9, 59.6)	8,250	66.8	(66.0, 67.7)	84.0 (83.1, 84.8)	92.3 (91.3, 93.0)	95.6 (95.0, 96.0)	74.1 (72.8, 75.3)
Foreign-born	636	57.4	(54.4, 60.3)	718	64.7	(61.9, 67.6)	83.2 (80.2, 85.8)	90.3 (86.6, 92.8)	93.8 (91.7, 95.6)	74.2 (70.2, 78.3)
Blacks	1,375	74	(71.9, 76.0)	1,488	80	(78.2, 81.8)	88.9 (87.2, 90.4)	86.0 (82.0, 89.3)	96.2 (95.1, 97.2)	65.9 (61.5, 70.1)
US-born	1,311	74.3	(72.2, 76.3)	1,417	80.3	(78.4, 82.2)	89.1 (87.3, 90.6)	85.9 (81.8, 89.4)	96.3 (95.1, 97.2)	65.8 (61.2, 70.2)
Foreign-born	64	67.4	(57.0, 76.6)	71	74.7	(64.7, 83.1)	85.9 (77.8, 94.0)	87.5 (67.6, 97.3)	95.3 (86.9, 99.0)	67.7 (48.6, 83.3)
Whites	5,910	55.9	(55.0, 56.8)	6,811	64.4	(63.5, 65.4)	82.8 (81.9, 83.7)	92.8 (91.9, 93.6)	95.5 (94.9, 96.0)	74.9 (73.6, 76.1)
US-born	5,680	56	(55.0, 57.0)	6,539	64.5	(63.6, 65.4)	83.0 (82.0, 84.0)	92.9 (92.0, 93.7)	95.5 (94.9, 96.0)	75.0 (73.7, 76.2)
Foreign-born	230	53.7	(49.0, 58.5)	272	63.6	(58.8, 68.1)	79.8 (74.5, 84.4)	91.7 (86.2, 95.5)	94.4 (90.5, 97.0)	72.2 (65.4, 78.3)
Hispanics	601	58.7	(55.7, 61.7)	669	65.3	(62.3, 68.3)	84.0 (81.0, 86.7)	89.0 (85.3, 92.1)	93.5 (91.2, 95.4)	74.7 (70.3, 78.9)
US-born	259	59.1	(54.4, 63.8)	294	67.1	(62.5, 71.5)	82.7 (77.8, 86.8)	88.9 (82.6, 93.5)	93.8 (90.2, 96.4)	71.5 (64.3, 78.0)
Foreign-born	342	58.4	(54.3, 62.4)	375	64	(60.0, 67.9)	85.1 (81.1, 88.5)	89.1 (84.1, 93.0)	93.3 (90.0, 95.7)	77.1 (71.3, 82.2)

CL confidence limits

[a] Individuals who self-reported using medication to control their hypertension are included in the definition of measured hypertensives

nativity status: sensitivity (number of persons who self-report hypertension and have measured hypertension divided by the number of person who have measured hypertension); specificity (number of person who do not self-report hypertension and do not have measured hypertension divided by number of persons who do not have measured hypertension); positive predictive value (PPV, number of persons who self-report hypertension and have measured hypertension divided by number of persons who self-report hypertension), and negative predictive value (NPV, number of persons who do not self-report hypertension and do not have measured hypertension divided by the number of persons who do not self-report hypertension). The comparison of test characteristics was made by comparing overlapping 95% confidence intervals.

Differences in mean SBP and DBP by race/ethnicity and nativity were assessed using linear regression. We considered the full sample; "aware" hypertensives; and "unaware" hypertensives. Models were adjusted for sex and age and "aware" models were additionally adjusted for hypertension medication.

To improve sample size, we pooled data from 2006 and 2008 (results from models stratified by year were nearly identical). The HRS sample was drawn with a multi-stage complex sample design in order to be nationally representative of the US non-institutionalized population age 50 and older. Because we pooled across 2 years to maximize the sample size in each stratum, it was not possible to apply weights or corrections for this design.

Results

Table 1 summarizes the sociodemographic characteristics of the study sample. Prevalence of self-reported hypertension was lower than the prevalence of measured hypertension for all racial/ethnic groups and by nativity status (Table 2). Self-reported and measured hypertension prevalence was highest among blacks compared to whites and Hispanics. No significant differences were observed in the overall prevalence of hypertension among foreign-born compared to US-born adults (64.7% vs. 66.8%, respectively, $P = 0.1549$). Sensitivity of self-reported hypertension was high across each racial/ethnic group (88.9% blacks, 82.8% whites, and 84.0% Hispanics). There were no significant differences in sensitivity between US- and foreign-born adults among blacks (89.1% vs. 85.9%, P value $= 0.410$), whites (83.0% vs. 79.8%, P value $=$ 0.175), or Hispanics (82.7% vs. 85.1%, P value $= 0.398$). Specificity was highest among whites (92.8%) compared to blacks and Hispanics (86.0 and 89.0%, respectively) and no statistically significant differences were observed by nativity status. PPV was high across race/ethnic groups and

Table 3 Systolic and diastolic blood pressure among aware and unaware hypertensives, by race/ethnicity and nativity, Health and Retirement Study participants, 2006 and 2008

	All[a]			Aware hypertensives[b,c]			Unaware hypertensives[a,d]		
	b	95% CL	*P* value	*b*	95% CL	*P* value	*b*	95% CL	*P* value
Systolic									
Mean among US-born non-Hispanic white	127.4	(126.9, 127.9)		136.1	(134.5, 137.7)		148.2	(147.5, 154.9)	
Average difference among:									
Foreign-born white	0.5	(−1.5, 2.4)	0.623	1.3	(−1.4, 4.1)	0.336	0.4	(−3.4, 4.2)	0.837
Non-Hispanic Black									
US-born Black	6.8	(5.7, 7.8)	<0.001	5.2	(3.9, 6.4)	0.015	4.8	(2.4, 7.2)	<0.001
Foreign-born Black	6.6	(2.6, 10.6)	<0.001	6.3	(1.2, 11.4)	0.005	−0.2	(−8.9, 8.6)	0.972
Hispanic									
US-born Hispanic	3.9	(2.0, 5.8)	<0.001	3.7	(1.1, 6.3)	<0.001	0.5	(−3.5, 4.4)	0.818
Foreign-born Hispanic	3.3	(1.7, 5.0)	<0.001	4.6	(2.4, 6.9)	<0.001	−2.0	(−5.9, 1.8)	0.301
Diastolic									
Mean among US-born non-Hispanic white	79.5	(79.9, 79.8)		86.1	(84.6, 87.6)		90	(87.6, 92.3)	
Average difference among:									
Foreign-born white	0	(−1.1, 1.2)	0.934	−0.3	(−1.9, 1.3)	0.698	2	(−0.3, 4.4)	0.092
Non-Hispanic Black									
US-born Black	2.6	(2.0, 3.2)	<0.001	1.7	(0.9, 2.4)	<0.001	1.7	(0.20, 3.2)	0.026
Foreign-born Black	2.1	(−0.2, 4.4)	0.077	2	(−0.9, 4.9)	0.184	0.9	(−4.5, 6.4)	0.743
Hispanic									
US-born Hispanic	0.8	(−0.3, 1.9)	0.178	0	(−1.5, 1.5)	0.807	−0.8	(−3.3, 1.7)	0.537
Foreign-born Hispanic	0.1	(−0.9, 1.0)	0.882	0.7	(−0.6, 2.0)	0.272	−2.4	(−4.8, 0.0)	0.05

CL Confidence limits

[a] Models adjusted for sex, age (65 year old female defined as the reference group)

[b] Aware hypertensives are defined as individuals who self-reported a diagnosis

[c] Models additionally adjusted for hypertension medication use

[d] Unaware hypertensives are individuals whose measured blood pressure met the criteria for hypertension but did not self-report a diagnosis of hypertension

comparable across nativity status. Overall, NPV was lowest among blacks (65.9%) compared to whites and Hispanics (74.9 and 74.7%, respectively).

Mean SBP among US-born whites was 127.4 mmHg, and there was no significant elevation among foreign-born whites (Table 3). However, US- and foreign-born blacks averaged 6.8 and 6.6 mmHg higher SBP, respectively, compared to their white counterparts. Both US- and foreign-born Hispanics also had higher SBP levels than whites. Only US-born blacks had significantly elevated DBP compared to US-born whites.

These patterns were identical for hypertensives aware of their condition. SBP among US- and foreign-born blacks and Hispanics were significantly higher when compared to US-born whites. Among aware hypertensives, only US-born blacks had significant elevation of DBP compared to US-born whites, although the point estimate for foreign-born blacks was similar but not statistically significant.

Average blood pressure was highest among unaware hypertensives. Unaware black hypertensives had 4.8 mmHg higher SBP than unaware US-born white hypertensives. Unaware foreign-born black and Hispanic hypertensives did not have higher SBP than unaware US-born white hypertensives. Unaware foreign-born Hispanic hypertesnives had lower SBP compared to unaware US-born white hypertensives, but this difference was not statistically significant. For DBP, unaware black hypertensives had elevated DBP compared to unaware US-born white hypertensives and foreign-born Hispanic hypertensives had significantly lower DBP than US-born white hypertensives.

Conclusion

In this sample of Americans age 50+, sensitivity, specificity, PPV, and NPV of self-reported hypertension was largely comparable by nativity status among blacks, whites, and Hispanics. Among both aware and unaware hypertensives, SBP and DBP were substantially higher in blacks than US-born whites. SBP was moderately elevated among Hispanic hypertensives compared to whites.

The estimates of the test characteristics in our study are better than those reported in some prior research. Using data collected from the National Health and Nutrition Examination 1988–1991, Vargas and colleagues showed that the sensitivity of self-reported hypertension among white, black, and Mexican-American women 60 years of age and older was 74, 83, and 64%, respectively [6]. The differences in the estimates may be partly attributable to the years of assessment. Significant improvements in hypertension awareness among older adults have been observed in recent decades [15, 16]. Our findings are more consistent with recent studies examining the validity of self-reported hypertension regionally [17, 18]. Okura et al. [17] utilized a sample from Olmstead County, Minnesota where all of the study participants were age 45 and older and found high sensitivity and specificity among participants ages 45–64 (91.1, 85.3, respectively) and 65–96 (94.7 and 79.5%, respectively).

Consistent with prior evidence, we found that US born blacks were more aware of their hypertension status compared to other racial/ethnic groups [16, 19]. Additionally, foreign-born blacks were also highly aware of their hypertension status. However, contrary to Bersamin et al. we found no difference in awareness among foreign-born Hispanics compared to US-born Hispanics. This discrepancy in findings may be attributable to the fact that Bersamin et al. solely focused on Mexican Americans, where as the HRS sample of Hispanics may be more heterogeneous with respect to Hispanic ethnicity.

Previous work has documented racial/ethnic differences in blood pressure [14]. Our findings contribute to further understanding the nature of these disparities by additionally examining nativity status. Black and Hispanic hypertensives aware of their hypertension diagnosis had higher SBP than whites aware of their hypertension, regardless of nativity. This suggests that racial disparities in successful management are not attributable to differences in hypertension awareness. This finding may be indicative of other potential barriers to the effective and long-term management of hypertension, such as experiences of discrimination in the health care system or neighborhood environmental constraints [20].

There are several limitations of this study. Given the small sample sizes of foreign-born participants, we were unable to determine the test characteristics by country of origin or length of duration in the US. This study omitted other racial/ethnic groups from the analysis due to sample size considerations. These analyses were not weighted and are therefore not considered generalizable to a nationally representative population. However, we think this has little consequence for the primary results. For example, among whites (the largest group), the sensitivity of self-reported blood pressure in 2006 was estimated as 79% when we did not apply the weights, and 78% when applying the sample weights. Another limitation of this study is the possible misclassification of individuals who successfully managed their hypertension as false positives. The JNC 7 definition classifies individuals controlling their hypertension using non-pharmacologic lifestyle modifications (i.e. diet, physical activity) methods as false positives. This misclassification could affect at most 2.6% of the sample, and so is unlikely to considerably modify the validity estimates.

Overall, this study contributes to the literature on validity of self-reported hypertension by focusing on nativity status among older adults, which to our knowledge, has not been reported in prior studies. Given the demographic shift of the US population in terms of age and nativity status, ensuring the validity of common public health surveillance tools for foreign-born individuals is important. Epidemiologic studies generally rely on self-reported data to obtain estimates of disease prevalence. Our findings indicate that self-reported hypertension provides a reasonable estimate of hypertension for older immigrant populations and that hypertension awareness does not differ considerably by nativity status. Despite slightly higher levels of awareness of hypertension status among US-born and foreign-born blacks in comparison to other racial/ethnic groups, blacks experience a larger burden of hypertension prevalence. Future studies should examine the socioeconomic and contextual characteristics that may prevent US- and foreign-born blacks from successfully controlling hypertension. Future research should be conducted with younger foreign-born populations and additionally include other information regarding length of time in the US and country of origin in order to assess the generalizability of these findings.

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