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Undiagnosed and Uncontrolled Hypertension and Hyperlipidemia among Immigrants in the US

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Abstract

Background—Cardiovascular disease is a major cause of mortality and disability.

Methods—We analyzed the National Health and Nutrition Examination Survey (1998–2008). We used logistic regression analysis to compare the odds of having undiagnosed and uncontrolled hypertension and hyperlipidemia among FB and US born adults sequentially adjusting for (1) age and gender, (2) income and education, and (3) insurance status. Among FB individuals, we identified factors independently associated with having each outcome using logistic regression analyses.

Results—Of 27,596 US adults, 22.6% were foreign-born. In age- and -gender adjusted analyses, FB were more likely to have undiagnosed hypertension (OR 1.35, 95%CI 1.13–1.63, $p < 0.001$), uncontrolled hypertension (OR 1.37, 95%CI 1.15–1.64, $p < 0.001$), and uncontrolled hyperlipidemia (OR 1.35, 95%CI 1.11–1.63, $p = 0.002$), while undiagnosed hyperlipidemia approached significance (OR 1.24, 95%CI 0.99–1.56, $p = 0.057$). Having insurance was associated with a 5–15% decrease in FB-US born disparities.

Discussion—Immigrants are at increased risk of undiagnosed and uncontrolled hypertension and hyperlipidemia.

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Keywords

immigrants; hypertension; hyperlipidemia

INTRODUCTION

Hypertension and hyperlipidemia are common in the United States and worldwide.^{1, 2} Complications from these conditions, including heart attack and stroke, are leading causes of death and disability among immigrants and US-born individuals.^{3, 4} With available therapies, these conditions can be controlled and their complications reduced.^{5, 6}

Immigrants, who comprise 12% of the US population,⁷ have worse access to care.^{8, 9} Immigrants are less likely than US-born Americans to receive preventive and screening services.¹⁰ This disparity may put immigrants at increased risk of having undiagnosed and uncontrolled conditions including hypertension and hyperlipidemia. A previous nationally representative study found that hypertensive Mexican immigrants were more likely than US-born Mexican Americans to have undiagnosed and uncontrolled disease.¹¹ However, no previous study has provided nationally representative data on the impact of nativity status on diagnosis and control rates of hypertension and hyperlipidemia.

Uninsured individuals are more likely to have undiagnosed and uncontrolled hypertension and hyperlipidemia.^{12, 13} Because immigrants are more often uninsured than US-born adults,¹⁴ uninsurance may be an important contributor to disparities in undiagnosed and uncontrolled hypertension and hyperlipidemia between these groups, but this is not known. While US-born low-income individuals are often eligible for Medicaid, which covers a broad range of physician and screening services, legal low-income immigrants residing in the US for <five years are excluded from non-emergent Medicaid coverage.¹⁵ The Patient Protection and Affordability Care Act (PPACA) enacted in 2010 continues this five year rule on Medicaid eligibility for legal immigrants.

We used nationally representative data to examine whether foreign-born individuals are at increased risk of undiagnosed and uncontrolled hypertension and hyperlipidemia. We also examined the extent to which socioeconomic factors, including health insurance, are associated with disparities in these outcomes according to nativity status. Finally, we examined socioeconomic and acculturation-related factors associated with these outcomes among foreign-born adults.

METHODS**Data source**

We analyzed data from the 1999–2008 National Health and Nutrition Examination Survey (NHANES). The NHANES, administered by the National Center for Health Statistics (NCHS), uses a multistage stratified probability sampling procedure to obtain nationally representative estimates of the non-institutionalized US population. Details of the data collection methods are described elsewhere.¹⁶ In brief, participants are invited via letters, and are interviewed in their homes in English, Spanish or other language by a trained

interpreter, during which the interviewer records current medications. Physical and laboratory examinations are conducted in mobile examination centers.

We excluded from our analysis participants ≤ 18 years old ($N=22,771$), with positive pregnancy tests ($N=1,256$) and for whom nativity status was missing ($N=31$). Of the 27,596 remaining participants, 94.0% ($N=25,944$) underwent physical examinations including three consecutive standardized blood pressure measurements and 42.7% ($N=11,796$) underwent fasting laboratory examinations. Participants who did not undergo physical and fasting laboratory examinations were excluded from the hypertension and hyperlipidemia analyses, respectively. For the hyperlipidemia analyses, we excluded participants with triglycerides >400 mg/dl ($N=308$) due to the technical inaccuracy of calculating LDL cholesterol in such patients.¹⁷

We determined nativity status based on the question “In what country were you born?” and dichotomized responses into foreign- vs. US-born.

The Institutional Review Board at Cambridge Health Alliance approved this study.

Outcomes

Identification of hypertension and hyperlipidemia—We defined participants as having hypertension if they: (1) reported ever having been told by a doctor or health professional that they had hypertension or high blood pressure or; (2) reported currently taking an antihypertensive medication or; (3) had a mean systolic blood pressure (SBP) >140 mmHg or mean diastolic blood pressure (DBP) >90 mmHg. We defined participants as having hyperlipidemia if they: (1) reported ever having been told by a doctor or health professional that they had high blood cholesterol levels or; (2) reported currently taking an anti-hyperlipidemic medication, or; (3) had fasting lipids above Adult Treatment Panel (ATP) II or ATP III goals for hyperlipidemia (depending on whether the participant was surveyed before or after 2001 when ATP III began): (1) LDL >100 mg/dl and coronary heart disease (CHD) or a CHD equivalent, (2) LDL >130 mg/dl and two CHD risk factors, or (3) LDL >160 mg/dl and zero to one CHD risk factors.^{6, 18, 19}

Definition of undiagnosed disease—We defined participants as having undiagnosed disease if they: (1) had physical or laboratory evidence of the disease and; (2) reported that they had never been told by a doctor or health professional that they had the disease and; (3) were not taking a medication for the disease.

Definition of uncontrolled disease—We defined participants as having uncontrolled disease if their physical or laboratory examination revealed inadequate control according to commonly accepted guidelines. For hypertension, we considered participants to be uncontrolled if their SBP ≥ 140 mm Hg or their DBP ≥ 90 mm Hg. For hyperlipidemia, we determined control according to the ATP II guidelines for 1999–2002 and ATP III guidelines for 2003–2008.^{6, 18, 19}

Statistical Analysis

Underdiagnosis and undertreatment of hypertension and hyperlipidemia among foreign and US-born adults—We conducted bivariate analyses comparing demographic characteristics of foreign and US-born subjects using chi square analyses. We considered a $p < 0.05$ to be statistically significant.

We determined the association between immigrant status and underdiagnosis and undertreatment of hypertension and hyperlipidemia by fitting multivariable logistic regression models. For each outcome we adjusted models for sociodemographic characteristics but were particularly interested in the extent to which foreign-born—US-born disparities diminished with addition of insurance to the full model. Thus, for each outcome we constructed a series of three logistic regression models to determine the odds of the outcome occurring among foreign-born as compared to US-born subjects. Model 1 controlled for age (18–39, 40–64, 65+) and gender. Model 2 controlled for factors in model 1 plus income (<\$20K, \$20K, missing) and education (<high school degree, high school degree). Model 3 controlled for factors in model 2 plus insurance status (insured vs. uninsured). We tested for effect modification by including an interaction term between foreign birth and insurance status in model 3 for each outcome.

We tested all variables for collinearity, and considered variables to be collinear if they were associated with a >10% change in the standard error for foreign birth and addition of that variable to the model resulted in exclusion of foreign birth from the model. By these criteria, primary language was excluded from analyses comparing foreign to US-born adults.

Factors associated with diagnosis and control rates among foreign-born adults—In order to determine which factors were associated with undiagnosed and uncontrolled disease among foreign-born adults, we conducted separate logistic regression analyses using only foreign-born participants. For each outcome, we controlled for variables previously described in the literature as affecting access to preventive care for immigrants, including age, gender, insurance, race/ethnicity, income, education, primary language spoken at home,²⁰ citizenship status,²¹ and duration of residence in the US.^{20, 22}

Subgroup analyses—Because Hispanics comprised nearly half of the foreign-born sample, we tested whether our results were driven by trends among Hispanics. We conducted supplementary logistic regression analyses for each outcome in which we determined age- and -gender adjusted odds ratios for foreign-born compared to US-born Hispanics. For each outcome, we examined the odds ratios for foreign-born vs. US-born Hispanics and all foreign-born participants vs. US-born participants.

All analyses were conducted using SAS 9.2 (Cary, North Carolina) using PROC SURVEYLOGISTIC to account for the complex survey design.

RESULTS

Among the interviewed sample of 27,596 individuals, 22.6% were foreign-born. Foreign-born participants were more likely to be young, male, uninsured, speak primarily Spanish at home, and have incomes of <\$20,000 or missing income data (Table 1).

Undiagnosed and uncontrolled hypertension and hyperlipidemia among foreign and US-born adults

In unadjusted analyses, foreign-born adults with hypertension or hyperlipidemia were more likely to have undiagnosed or uncontrolled disease (undiagnosed hypertension: 27.7% vs. 21.9%, $p<0.001$; uncontrolled hypertension: 61.6% vs. 54.7%, $p=0.002$; undiagnosed hyperlipidemia: 35.4% vs. 28.9%, $p=0.009$; uncontrolled hyperlipidemia: 65.2% vs. 57.0%, $p<0.001$);

In age- and gender-adjusted analyses, foreign-born individuals were more likely than US-born individuals to have undiagnosed and uncontrolled hypertension and hyperlipidemia, although the p -value for undiagnosed hyperlipidemia was of borderline significance (Table 2). Adding income and education to age- and gender-adjusted models resulted in small to moderate reductions in foreign-born—US-born disparities (range: 0–15%) (Table 2). Insurance further reduced disparities even after adjusting for income and education; including insurance reduced the odds ratio point estimates for hyperlipidemia by 14–18% and hypertension to a lesser degree.

We detected an interaction between insurance and nativity status for undiagnosed hyperlipidemia only ($p=0.03$). We found no interaction between insurance and nativity status for the other outcomes. For undiagnosed hyperlipidemia, this interaction suggested that uninsurance was associated with twice the likelihood of having undiagnosed hyperlipidemia among foreign-born as compared to US-born adults (OR for foreign-born: 4.95, 95% CI 3.09–7.94; OR for US-born 2.25, 95% CI 1.65–3.08).

Factors associated with control and diagnosis of hypertension and hyperlipidemia among foreign-born adults

In multivariate models restricted to foreign-born adults we found no association between race/ethnicity, education, primary language spoken at home, citizenship status, and duration of residence in the US and undiagnosed hypertension, undiagnosed hyperlipidemia or uncontrolled hypertension. The only modifiable factors--those whose influence may be affected by policy or intervention--associated with any of the outcomes were insurance status and education (Table 3). Uninsured foreign-born participants with hyperlipidemia were nearly four times as likely as their insured counterparts to have undiagnosed hyperlipidemia and twice as likely to have uncontrolled hyperlipidemia. Uninsured foreign-born participants with hypertension were nearly twice as likely as their insured counterparts to have undiagnosed hypertension. Insurance status was not associated with control rates among hypertensive foreign-born adults. Having a high school degree was associated with a decreased risk of undiagnosed hyperlipidemia.

Subgroup analyses

For all outcomes except uncontrolled hypertension, trends among Hispanics mirrored trends observed in the full sample (data not shown). Though we detected a difference in the odds of uncontrolled hypertension between the overall foreign and US-born participants (OR 1.39 [95% CI 1.16–1.63]), there was no difference in the odds of uncontrolled hypertension between foreign-born Hispanics and US-born Hispanics (OR 1.10 [95% CI 0.86–1.40]).

DISCUSSION

Millions of adults in the US have undiagnosed and uncontrolled hypertension and hyperlipidemia.¹² In our nationally representative sample, foreign-born adults were more likely than US-born adults to bear this burden of unrecognized or untreated conditions—both strong risk-factors for cardiovascular mortality. After controlling for age, gender, income and education levels, having insurance was associated with a reduction in these disparities. Among foreign-born adults, insurance was the main modifiable factor associated with diagnosis and control rates.

Although several previous studies have examined disparities in health outcomes between immigrants and non-immigrants in the US at the population level,^{8, 23–25} we are unaware of any previous studies examining disparities in hypertension and hyperlipidemia diagnosis and control rates between US- and foreign-born adults. These studies identified several potential reasons for such disparities including that foreign-born adults have less physician contact,^{8, 23} including fewer preventive health care visits²⁵ and experience linguistic and cultural barriers.²⁰ Immigrants may also experience greater levels of stigma and discrimination^{26, 27} in seeking health care. Two prior studies examining diagnosis and control rates for hypertension and hyperlipidemia among the general US population have identified associations between these outcomes and age¹³ and insurance.^{12, 13} In this analysis, we found that income and education are associated with decreased disparities, and that insurance is associated with decreased disparities over and above these socioeconomic variables. Since primary language was collinear with foreign birth for our outcomes, we could not control for primary language. Because the NHANES does not explore cultural beliefs, we could not control for this factor.

Insurance status significantly impacts diagnosis and control rates for hypertension and hyperlipidemia in the general US population.¹¹ Our finding that insurance is associated with decreased disparities in diagnosis and control rates between foreign- and US-born adults mirrors the effect of gaining Medicare coverage on racial disparities in blood pressure control.²³ Furthermore, for all but one of the outcomes, foreign birth did not modify the effect of insurance status. This suggests that the impact of having insurance on these outcomes is no less for foreign-born than for US-born adults.

The significant interaction we detected between foreign birth and insurance status for undiagnosed hyperlipidemia is likely due to the necessity for medical encounters to diagnose hyperlipidemia. While blood pressure measurements are available at pharmacies, health fairs, and emergency rooms, and lifestyle modification can be undertaken without physician supervision, specific blood tests are required to diagnose hyperlipidemia. Uninsured foreign-

born individuals may be less likely than US-born uninsured adults to visit physicians for several reasons. Foreign-born adults have lower disposable incomes after sending remittances to their country of origin²⁸ making them more reliant on insurance. Low-income US-born Americans are more likely to have intermittent insurance (i.e., moving on and off of Medicaid, or with job-related coverage)²⁹ than foreign-born adults who are more often stably uninsured. Low-income US-born participants in our sample may therefore be more likely to have had insurance in the past, and been diagnosed at that time.

Previous literature highlights the importance of acculturation as a mediator of health including infant mortality, overall cancer rates, and high blood pressure.³⁰ As many other studies have done, we used English language use, place of birth, and duration of residence in the US³¹ as proxies for acculturation. Interestingly, in our study no measure of acculturation was associated with undiagnosed and uncontrolled disease after adjusting for non-modifiable and socioeconomic factors including insurance. However, our results are consistent with other studies finding no association between acculturation and cardiovascular disease risk factor control.^{32, 33}

Elevated rates of undiagnosed and uncontrolled cardiovascular risk factors among foreign-born adults have demographic, clinical, health care system and policy implications. Our findings may help explain the observation that although immigrants arrive in the US healthier than US-born adults, this ‘healthy immigrant effect’ erodes with duration of residence.³⁰ Furthermore, high rates of undiagnosed and uncontrolled disease among foreign-born adults likely result in high rates of preventable mortality and disability from cardiovascular disease. Though immigrants already consume fewer health care dollars,³⁴ including fewer publicly funded insurance dollars,³⁵ than US-born citizens, better identification and control of cardiovascular risk factors might further reduce public health spending for immigrants by minimizing costly downstream sequelae of hypertension and hyperlipidemia. In fact, chronic renal failure, cerebrovascular and heart disease, three potential complications of uncontrolled cardiovascular risk factors, account for the majority of emergency Medicaid expenditures for immigrants after pregnancy and injuries.³⁶

Low-income legal immigrants continue to be ineligible from Medicaid for their first five years under PPACA. Consequently, many immigrants only receive emergency care via emergency Medicaid or hospital compliance with Emergency Medical Treatment and Active Labor Act laws. We found an association between foreign birth and increased risk of uncontrolled and undiagnosed disease. In these cross-sectional data, the association between nativity status and uncontrolled and undiagnosed disease is diminished by insurance. This may suggest that if foreign-born adults were more often insured, their increased rates of undiagnosed and uncontrolled disease may be lessened. In addition, we speculate that if expanded insurance coverage reduced undiagnosed and uncontrolled disease, the cost for this expansion (for example, eliminating the five year ban on Medicaid for legal immigrants) may be partially offset by reduced downstream costs. Longitudinal data will be required to assess this possibility.

Several caveats apply to our findings. We ascertained whether participants were aware of their diagnosis but were unable to verify whether participants’ providers had made the

diagnosis. By including prescribed medications in the definition of diagnosed disease, we likely captured patients whose providers had diagnosed them but were unaware of the name of their disease. In addition, our findings are most likely applicable to legal immigrants. Though face-to-face interviews are believed to capture more undocumented immigrants than other survey recruitment methods, undocumented immigrants probably remain under-represented in NHANES; they may be less likely to respond to letters from US government agencies inviting participation in a survey due to fear of having their undocumented status detected. Diagnosis and control rates may vary by country of origin, a factor that is known to affect obesity rates and cancer screening rates.^{37, 38} We were unable to stratify our data according to country of birth and thus were unable to assess variation in foreign-born—US-born disparities according to country of birth. Elucidation of heterogeneity among different countries of origin in future studies could be useful in designing public health outreach efforts targeting immigrants at highest risk for underdiagnosis and treatment of hypertension and hyperlipidemia. Our outcomes require access to health care (i.e., participants are unlikely to be diagnosed with hyperlipidemia and even less likely to have hyperlipidemia controlled without seeing providers), making access to care tautological with our outcomes. We therefore did not include access to care variables in our models. Finally, our sensitivity analyses comparing US to foreign-born Hispanics involved small sample sizes.

There are also limitations of the NHANES data collection methods. They include: (1) The NHANES diagnoses hypertension with repeated measurements on one day, instead of the recommended two or more days, which could artifactually elevate disease rates. Though not identical to the definition used in clinical care, the NHANES is used by the CDC and other researchers to estimate population prevalence of hypertension.^{39, 40} (2) We excluded participants with triglycerides >400 mg/dl, many of whom likely have hyperlipidemia as well. (3) While the ATP guidelines use family history of coronary artery disease in male relatives <55 and female relatives <65, the NHANES asks participants to identify first degree relatives who have suffered heart attacks or angina before fifty. Because there is no *a priori* reason to expect a differential effect by nativity status, these limitations are unlikely to alter our main findings.

In sum, our findings indicate that foreign-born adults are at increased risk of undiagnosed and uncontrolled cardiovascular risk factors. Insurance is the main modifiable risk factor associated with diagnosis and control rates and may therefore represent the single risk factor most likely to improve diagnosis and control rates.

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Table 1

Demographic characteristics by nativity status, interviewed sample, NHANES, 1999–2008, N=27,596

	Foreign-Born N=6,242 (22.6%) %	US-Born N=21,323 (77.4%) %	P value
Age			
18–39	48.2	38.7	<0.0001
40–64	40.8	43.8	
65	11.0	17.6	
Gender			
Male	52.7	48.3	<0.0001
Race			
White, non Hispanic	22.5	79.7	<0.0001
Black, non Hispanic	6.6	12.0	
Hispanic	51.4	5.7	
Other	19.4	2.6	
Income			
<\$20,000	20.1	15.9	<0.0001
\$20,000	70.3	78.0	
Missing	9.5	6.1	
Insurance			
Private	46.3	59.8	<0.0001
Medicare	9.0	18.2	
Medicaid	7.9	6.6	
Uninsured	36.8	15.4	
Acculturation			
Years in US			
5	56.0	N/A	
>5	44.0		
Language spoken at home			
Primarily English	27.8	97.3	<0.0001
English and Spanish equally	5.7	1.2	
Primarily Spanish	40.0	0.7	
Primarily Other	26.4	0.8	
Citizen			
Yes	44.1	N/A	

* percentages weighted to US population

Table 2

Undiagnosed and Uncontrolled Hypertension and Hyperlipidemia among Foreign- and US- Born Adults, 1999–2008 *

	OR (Foreign vs US-Born) (95%CI)		
	Model 1	Model 2	Model 3
Hypertension			
Undiagnosed	1.35 (1.13–1.63) ^a	1.35 [1.12–1.63] ^a	1.30 [1.06–1.59] ^a
Uncontrolled	1.37 (1.15–1.64) ^c	1.29 [1.08–1.54] ^a	1.23 [1.03–1.47] ^b
Hyperlipidemia			
Undiagnosed	1.24 (0.99–1.56)	1.09 [0.87–1.36]	0.92 [0.73–1.17]
Uncontrolled	1.35 (1.11–1.63) ^a	1.20 [0.98–1.46]	1.06 [0.86–1.30]

Model 1 adjusted for: age and gender.

Model 2 adjusted for: age, gender, income and education.

Model 3 adjusted for: age, gender, income, education and insurance

* all p values are not significant unless otherwise indicated

^a 0.001 p value <0.01

^b 0.01 p value <0.05

^c p <0.001

Table 3

Factors associated with Undiagnosed and Uncontrolled Hypertension and Hypercholesterolemia among the Foreign-Born*

	Undiagnosed Hypertension OR (95%CI)	Undiagnosed Hyperlipidemia OR (95%CI)	Uncontrolled Hypertension OR (95%CI)	Uncontrolled Hyperlipidemia OR (95%CI)
Age				
18–39	Ref	Ref ^a	Ref ^a	Ref ^b
40–64	0.59 (0.39–0.91)	0.44 (0.29–0.66)	1.35 (0.84–2.15)	0.80 (0.51–1.27)
65	0.66 (0.41–1.05)	0.55 (0.30–1.00)	2.33 (1.45–3.74)	1.13 (0.54–2.37)
Gender				
Female	Ref	Ref ^c	Ref ^a	Ref ^b
Male	1.17 (0.86–1.61)	2.52 (1.58–4.01)	1.63 (1.18–2.25)	2.05 (1.30–3.23)
Insurance				
Insured	Ref ^b	Ref ^c	Ref	Ref ^a
Uninsured	1.66 (1.18–2.34)	3.74 (2.29–6.08)	1.26 (0.86–1.84)	1.94 (1.31–2.88)
Race				
White, non Hispanic	Ref	Ref	Ref	Ref
Black, non Hispanic	1.03 (0.58–1.81)	2.04 (0.99–4.19)	1.60 (0.86–2.97)	1.56 (0.70–3.48)
Hispanic	0.90 (0.48–1.66)	1.46 (0.69–3.09)	0.90 (0.53–1.54)	0.73 (0.39–1.37)
Other	0.96 (0.52–1.76)	0.92 (0.54–1.59)	1.37 (0.75–2.51)	0.58 (0.28–1.21)
Income				
<\$20,000	Ref	Ref	Ref	Ref
\$20,000	1.19 (0.88–1.60)	0.97 (0.60–1.56)	0.86 (0.63–1.17)	1.10 (0.67–1.78)
Missing	1.66 (0.95–2.91)	0.67 (0.26–1.71)	1.45 (0.82–2.58)	0.63 (0.28–1.42)
Education				
High school degree or higher	Ref	Ref ^b	Ref	Ref
Less than high school degree	1.15 (0.83–1.59)	1.53 (1.01–2.32)	1.36 (0.98–1.88)	1.24 (0.78–1.96)
Acculturation				
Years in US				
>5	Ref	Ref	Ref	Ref
5	0.73 (0.45–1.19)	1.44 (0.75–2.77)	0.65 (0.39–1.09)	1.80 (0.70–4.67)
Language spoken at home				
Primarily English	Ref	Ref	Ref	Ref
Other language as often or more than English	1.06 (0.64–1.76)	1.68 (0.87–3.25)	1.33 (0.78–2.29)	1.57 (0.90–2.74)
Citizen				
Yes	Ref	Ref	Ref	Ref
No	1.34 (0.97–1.86)	1.16 (0.79–1.72)	1.27 (0.89–1.81)	1.23 (0.76–2.01)

* all p values are not significant unless otherwise indicated

^a 0.001 p value <0.01

^b 0.01 p value <0.05

^c p <0.001

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