

Association of Birthplace and Coronary Heart Disease and Stroke Among US Adults: National Health Interview Survey, 2006 to 2014

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Background—The proportion of foreign-born US adults has almost tripled since 1970. However, less is known about the cardiovascular morbidity by birthplace among adults residing in the United States. This study's objective was to compare the prevalence of coronary heart disease (CHD) and stroke among US adults by birthplace.

Methods and Results—We used data from the 2006 to 2014 National Health Interview Survey. Birthplace was categorized as United States or foreign born. Foreign born was then grouped into 6 birthplace regions. We defined CHD and stroke as ever being told by a physician that she or he had CHD or stroke. We adjusted for select demographic and health characteristics in the analysis. Of US adults, 16% were classified as foreign born. Age-standardized prevalence of both CHD and stroke were higher among US- than foreign-born adults (CHD: 8.2% versus 5.5% for men and 4.8% versus 4.1% for women; stroke: 2.7% versus 2.1% for men and 2.7% versus 1.9% for women; all $P < 0.05$). Comparing individual regions with those of US-born adults, CHD prevalence was lower among foreign-born adults from Asia and Mexico, Central America, or the Caribbean. For stroke, although men from South America or Africa had the lowest prevalence, women from Europe had the lowest prevalence. Years of living in the United States was not related to risk of CHD or stroke after adjustment with demographic and health characteristics.

Conclusions—Overall, foreign-born adults residing in the United States had a lower prevalence of CHD and stroke than US-born adults. However, considerable heterogeneity of CHD and stroke risk was found by region of birth. (*J Am Heart Assoc.* 2018;7:e008153. DOI: 10.1161/JAHA.117.008153.)

Key Words: birthplace • coronary heart disease • stroke • surveillance

Heart disease and stroke are the first and fifth leading causes of death in the United States, respectively.¹ Previous studies have shown significant associations between birthplace and cardiovascular disease mortality.^{2,3} In general, studies have found that foreign-born adults had lower cardiovascular mortality rates than those born in the United

States.³ In addition, studies have shown birthplace had a significant impact on cardiovascular disease risk factors, including obesity, diabetes mellitus, and hypertension.^{4–8}

The foreign-born population in the United States has been increasing during the past 4 decades, from 9.6 million (4.7%) in 1970 to 31.1 million (11.1%) in 2000,⁹ then to 40.0 million (12.9%) in 2010.¹⁰ During this period, there has also been a shift in the regions of the world from which the foreign-born population hails. For example, in the 1960s, 75% of foreign-born residents were from Europe, whereas in 2010, >80% of foreign-born individuals were from Latin America and the Caribbean or Asia.¹⁰ With the increasing and changing foreign-born populations in the United States and differential prevalence of cardiovascular disease risk factors and related health behaviors compared with US-born adults, there is need for information on the relationship between birthplace and coronary heart disease (CHD) and stroke in the United States. In this study, we used data from the National Health Interview Survey (NHIS) to test the hypothesis that, among US adults, the self-reported prevalence of CHD and stroke would differ by region of birth.

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Accompanying Tables S1 and S2 are available at <http://jaha.ahajournals.org/content/7/7/e008153/DC1/embed/inline-supplementary-material-1.pdf>

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Clinical Perspective

What Is New?

- In the United States, the prevalence of coronary heart disease and stroke was higher among US-born adults compared with those of foreign-born adults; however, this effect was attenuated when the comparison included race/ethnicity.
- There was heterogeneity in the risk of coronary heart disease and stroke among foreign-born adults by region of birth.
- Among foreign-born adults, after adjusting for health and demographic factors, risk for coronary heart disease or stroke was not related to the length of time they had resided in the United States.

What Are the Clinical Implications?

- Identifying high-risk populations with cardiovascular disease could help to target prevention interventions.

Methods

Data

We analyzed data from the 2006 to 2014 NHIS, a nationally representative survey of civilian noninstitutionalized US residents conducted by the National Center for Health Statistics.¹¹ The data, analytic methods, and study materials are available to other researchers for purposes of reproducing the results or replicating the procedure.¹² NHIS data were collected by Census Bureau staff during in-person interviews, although some telephone interviewing was permitted to complete missing portions of the interview. Most interviews were conducted in English or Spanish. If respondents preferred, interpreters could be used to conduct the interview in another language. In this study, 9 years of data were combined to have sufficient sample size to produce reliable estimates of CHD and stroke by the world regions of interest. During these years, no new sample design was implemented, so the strata and primary sampling units (PSUs) were largely consistent across years. Therefore, the inferences reflect an “average” target population for the 9-year period.

We used data from the NHIS Sample Adult and Family Core survey modules in this study. In the Family module, data were collected via self-reporting or proxy reporting from a family respondent. An adult (the “sample adult”) was then randomly selected to receive the Sample Adult module, in which she or he self-reported on additional health information (unless she or he was mentally or physically unable to do so, then a knowledgeable adult served as a proxy respondent). The final response rate for sample adults (≥ 18 years of age) ranged from 70.8% in 2006 to 58.9% in 2014. The NHIS used a

multistage complex probability sample, which included clustering, stratification, and oversampling of minority subpopulations (including non-Hispanic black, Hispanic, and non-Hispanic Asian). Detailed information about the NHIS can be found at <http://www.cdc.gov/nchs/nhis.htm>.

The NHIS has maintained approval to operate by the Research Ethics Review Board of the National Center for Health Statistics (current protocol 2015-08) and the US Office of Management and Budget (current control 0920-0214). Written consent to participate in the NHIS was not received, but instead informed consent was given orally by all respondents before participation.

Study Measures

Birthplace information was obtained with the question, “Were you born in the United States?” Respondents who were born outside of the 50 US states were then asked, “In what country were you born?” Although information about individual US territory or country is obtained during the interview, birthplace is recoded into regions in the publicly available NHIS files. We classified respondents as “US born,” representing those born in the 50 US states or “foreign born,” representing those born outside of the 50 US states. Foreign-born respondents were further classified into 6 regions: “Mexico, Central America, and Caribbean,” “South America,” “Europe” (including those born in Russia and the Middle East), “Africa,” “Indian subcontinent,” and “Asia” (including those born in Southeast Asia). The 0.5% of foreign-born respondents not categorized into these 6 categories (including those born in Guam, Bermuda, Canada, Greenland, Oceania, or elsewhere) were omitted from these analyses. People born outside of the 50 US states were also asked, “About how long have you been in the United States?” Years of living in the United States were categorized as follows: <5 , ≥ 5 to <10 , ≥ 10 to <15 , or ≥ 15 years. Pregnant women were excluded from the analysis to eliminate the impact of specific cardiovascular risk factors (eg, hypertensive pregnancy disorders, gestational diabetes mellitus, and eclampsia) that could differ between US- and foreign-born women.^{13,14}

Respondents were identified as having CHD if they answered “yes” to any of the following 3 questions: (1) “Have you ever been told by a physician or other health professional that you had CHD?” (2) “Have you ever been told by a physician or other health professional that you had angina (also called angina pectoris)?” and (3) “Have you ever been told by a physician or other health professional that you had a heart attack (also called myocardial infarction)?” Respondents were identified as having had a stroke if they answered “yes” to the question “Have you ever been told by a physician or other health professional that you had a stroke?”

Other health conditions used as covariates in this analysis included diabetes mellitus and hypertension. Diabetes mellitus was assessed using the question “[Other than during pregnancy], have you ever been told by a physician or other health professional that you have diabetes mellitus or sugar diabetes mellitus?” Hypertension was defined by affirmative answers to both of the following questions: (1) “Have you ever been told by a physician or other health professional that you had hypertension, also called high blood pressure?” and (2) “Were you told on ≥ 2 different visits that you had hypertension, also called high blood pressure?”

Demographic characteristics included age (18–24, 25–44, 45–64, or ≥ 65 years), sex, and level of education (less than high school graduate, high school graduate, some college, or college graduate). Health insurance status was defined as insured (adults who had health insurance at the time of the interview, including private health insurance, Medicare, Medicaid, State Children’s Health Insurance Program, a state-sponsored health plan, other government programs, or military health plan) and not insured. Health risk factors included smoking status (current smoker or not current smoker) and body mass index (BMI). BMI was based on self-reported height and weight and categorized as underweight/normal weight (BMI < 25.0 kg/m²), overweight (BMI 25.0–29.9 kg/m²), or obese (BMI ≥ 30 kg/m²), using a standard calculation (weight in kilograms/height in meter squared).¹⁵

Statistical Analysis

Respondents’ characteristics by birthplace were compared between US- and foreign-born adults, overall, and by foreign-born region, using the χ^2 test for categorical variables and ANOVA for continuous variables. Age-standardized prevalences of CHD and stroke were estimated by birthplace for men and women, as well as by years of living in the United States among foreign-born respondents using the projected 2000 US standard population, with the age groups of 18 to 24, 25 to 44, 45 to 64, and ≥ 65 years as the standard.¹⁶ Using multiple logistical regression models, we calculated unadjusted odds ratios of risk for CHD and stroke among foreign-born adults by birthplace, using US-born adults as reference (model 1). Adjusted odds ratios were then calculated (models 2–3). Model 2 adjusted for age, sex, education, health insurance, smoking, BMI, diabetes mellitus, and hypertension. Model 3 adjusted for all variables from model 2 plus years of living in the United States (for US-born adults, age was used as years of living in the United States). In addition, among foreign-born adults, we conducted logistic regression analysis to assess whether duration of US residence was associated with risk of CHD and stroke, using foreign born with < 5 years of residence in the United States as reference. Model 1 was used to assess unadjusted odds

ratios. Model 2 was adjusted for age only. Model 3 was adjusted for age, plus region of birth, sex, health insurance, education, BMI, smoking, hypertension, and diabetes mellitus.

Although the main objective of this report is to assess the impact of regions of birth on risk of CHD and stroke among US adults, supplemental analyses were conducted to assess the impact of race/ethnicity on the association of birthplace and risk of CHD/stroke. Comparisons made in the supplemental analysis explored differences between (1) US-born Hispanics and Mexico, Central America, and Caribbean born, as well as South America born; (2) US-born white and European-born white; (3) US-born black and African-born black; and (4) US-born Asian and Indian subcontinent born and Asia born. (Approximately 7% of US-born Asian sample adults in the NHIS are “Asian Indian,” which reflects Indian subcontinent ancestry.)

Sampling weights were used to produce national estimates that are representative of the adult civilian noninstitutionalized population living in the United States.¹⁷ All analyses, including subgroup analyses and regressions, were performed using SAS, version 9.3, and SAS-callable SUDAAN, version 10 (Research Triangle Institute, Research Triangle Park, NC)¹⁸ to account for the complex sample design. For all subgroup analyses, the entire survey data set was used. The SUDAAN SUBPOPN statement was used to define the subgroup(s) of interest in the analyses. All statistical tests were 2 tailed, and statistical significance was defined at $P < 0.05$.

Results

The total sample adults from 2006 to 2014 were 263 130. After excluding those from unknown regions ($n=267$) or regions outside of the preassigned categories ($n=1304$) and women who were pregnant ($n=2697$), the final analytic sample included 258 862 sample adults. Among US adults, 16.4% were foreign born (Table 1). Among those classified as foreign born, approximately half (50.1%) were from Mexico, Central American, or the Caribbean; 17.3% were from Asia; 16.2% were from Europe; and 6.5%, 6.0%, and 4.0% were from South America, the Indian subcontinent, and Africa, respectively. Overall, 60.6% of foreign-born adults reported living in the United States for ≥ 15 years, and 10.2%, 14.0%, and 15.2% reported living in the United States for < 5 , ≥ 5 to < 10 , and ≥ 10 to < 15 years, respectively. Table 1 shows heterogeneity between the groups. On average, those born in Africa were the youngest group (mean age, 40.0 years), and those born in Europe were the oldest group (mean age, 48.9 years). The percentage of men ranged from 43.5% (Asia) to 56.7% (Indian subcontinent). Those without health insurance ranged from 13.7% (US-born adults) to 46.4% (those born in Mexico, Central America, or the Caribbean). The percentage with a college degree ranged from 9.5% (Mexico, Central America, or

Table 1. Percentage Distribution (SE) of Selected Characteristics Among US Adults, by Birthplace, NHIS, 2006 to 2014

Variable	Total	US-Born Adults	Mexico, Central America, Caribbean	South America	Europe	Africa	Indian Subcontinent	Asia
N (unweighted)	258 862	209 786	26 767	3208	5754	1833	2769	8745
%	100.0	83.6 (0.2)	8.2 (0.2)	1.1 (<0.1)	2.7 (0.1)	0.7 (<0.1)	1.0 (<0.1)	2.8 (0.1)
% Within foreign born			50.1 (0.7)	6.5 (0.2)	16.2 (0.4)	4.0 (0.2)	6.0 (0.3)	17.3 (0.4)
Age, mean (SE), y	46.5 (0.1)	46.9 (0.1)	42.6 (0.2)*	44.7 (0.3)*	48.9 (0.3)*	40.0 (0.5)*	40.8 (0.5)*	46.8 (0.3)*
Age group, % (SE), y								
18–24	12.6 (0.2)	13.3 (0.2)	10.3 (0.3)*	8.4 (0.7)*	9.2 (0.6)*	14.4 (1.3)*	8.0 (0.8)*	7.5 (0.4)*
25–44	35.1 (0.2)	33.0 (0.2)	49.3 (0.5)	44.4 (1.0)	34.8 (0.8)	50.7 (1.5)	57.7 (1.6)	40.4 (0.7)
45–64	34.9 (0.2)	35.4 (0.2)	30.6 (0.4)	35.7 (1.2)	34.3 (0.8)	29.0 (1.5)	26.5 (1.4)	37.2 (0.7)
≥65	17.3 (0.2)	18.3 (0.2)	9.8 (0.3)	11.5 (0.6)	21.7 (0.7)	5.9 (0.6)	7.8 (0.7)	15.0 (0.6)
Sex, % (SE)								
Men	48.8 (0.1)	48.5 (0.2)	52.5 (0.4)*	48.0 (1.0)	48.0 (0.7)	55.6 (1.5)*	56.7 (1.4)*	43.5 (0.7)*
Women	51.2 (0.1)	51.5 (0.2)	47.5 (0.4)	52.0 (1.0)	52.0 (0.7)	44.4 (1.5)	43.3 (1.4)	56.5 (0.7)
Health insurance, % (SE)								
Yes	83.2 (0.2)	86.3 (0.1)	53.6 (0.7)*	65.9 (1.3)*	85.0 (0.7)	73.3 (1.5)*	85.4 (0.9)	84.8 (0.5)*
No	16.8 (0.2)	13.7 (0.1)	46.4 (0.7)	34.1 (1.3)	15.0 (0.7)	26.7 (1.5)	14.6 (0.9)	15.2 (0.5)
Smoking status, % (SE)								
Yes	19.3 (0.2)	20.9 (0.2)	10.6 (0.2)*	11.0 (0.7)*	16.7 (0.7)*	7.6 (0.8)*	6.1 (0.6)*	10.7 (0.4)*
No	80.7 (0.2)	79.1 (0.2)	89.4 (0.2)	89.0 (0.7)	83.3 (0.7)	92.4 (0.8)	93.9 (0.6)	89.3 (0.4)
Body mass index, % (SE) [†]								
Normal weight	37.3 (0.2)	36.6 (0.2)	29.7 (0.4)*	42.1 (1.2)*	43.3 (0.9)*	41.0 (1.4)*	55.2 (1.2)*	66.0 (0.8)*
Overweight	34.9 (0.1)	34.3 (0.1)	41.9 (0.4)	40.4 (1.1)	37.0 (0.8)	39.9 (1.4)	35.1 (1.2)	26.6 (0.7)
Obesity	27.8 (0.2)	29.1 (0.2)	28.4 (0.4)	17.6 (0.8)	19.7 (0.7)	19.1 (1.1)	9.7 (0.8)	7.4 (0.4)
Education, % (SE)								
Less than high school graduate	17.6 (0.2)	14.8 (0.2)	52.7 (0.6)*	17.8 (1.0)*	11.1 (0.6)*	10.1 (0.9)*	7.3 (0.9)*	13.0 (0.6)*
High school graduate	24.4 (0.2)	25.3 (0.2)	21.6 (0.3)	24.7 (1.1)	21.5 (0.7)	17.4 (1.1)	10.0 (0.9)	16.6 (0.6)
Some college	30.3 (0.2)	32.3 (0.2)	16.2 (0.4)	26.6 (1.0)	26.5 (0.7)	30.1 (1.2)	10.2 (0.7)	23.5 (0.6)
College graduate	27.6 (0.3)	27.6 (0.3)	9.5 (0.3)	30.9 (1.1)	40.9 (0.9)	42.3 (1.6)	72.5 (1.3)	46.9 (0.9)
Diabetes mellitus, % (SE)								
Yes	8.9 (0.1)	9.0 (0.1)	10.0 (0.3)*	5.9 (0.5)*	7.1 (0.4)*	6.2 (0.7)*	8.7 (0.7)	8.1 (0.4)*
No	91.1 (0.1)	91.0 (0.1)	90.0 (0.3)	94.1 (0.5)	92.9 (0.4)	93.8 (0.7)	91.3 (0.7)	91.9 (0.4)
Hypertension, % (SE)								
Yes	29.5 (0.2)	30.9 (0.2)	21.9 (0.4)*	18.4 (0.8)*	26.4 (0.7)*	19.8 (1.2)*	17.1 (1.0)*	24.0 (0.6)*
No	70.5 (0.2)	69.1 (0.2)	78.1 (0.4)	81.6 (0.8)	73.6 (0.7)	80.2 (1.2)	82.9 (1.0)	76.0 (0.6)
Years in the United States, % (SE) [‡]								
<5	10.2 (0.3)	NA	8.2 (0.3)	9.7 (0.8)	8.4 (0.5)	18.5 (1.2)	23.5 (1.7)	10.9 (0.5)
≥5–<10	14.0 (0.2)	NA	14.0 (0.3)	19.7 (0.9)	10.3 (0.5)	23.0 (1.2)	19.6 (1.0)	11.3 (0.4)
≥10–<15	15.2 (0.2)	NA	16.5 (0.3)	19.7 (0.9)	11.2 (0.6)	20.2 (1.2)	17.9 (1.0)	11.7 (0.5)
≥15	60.6 (0.5)	NA	61.3 (0.6)	50.9 (1.2)	70.2 (0.9)	38.2 (1.4)	39.0 (1.8)	66.1 (0.8)

NA indicates not applicable; NHIS, National Health Interview Survey; and SE, standard error.

**P*<0.05 compared with US-born adults. Some percentage distributions may not add up to 100.0% because of rounding.

[†]Body mass index (kg/m²) categories were defined as normal weight (<25), overweight (25–29.9), and obese (≥30).

[‡]Only among foreign-born adults.

SE - standard error

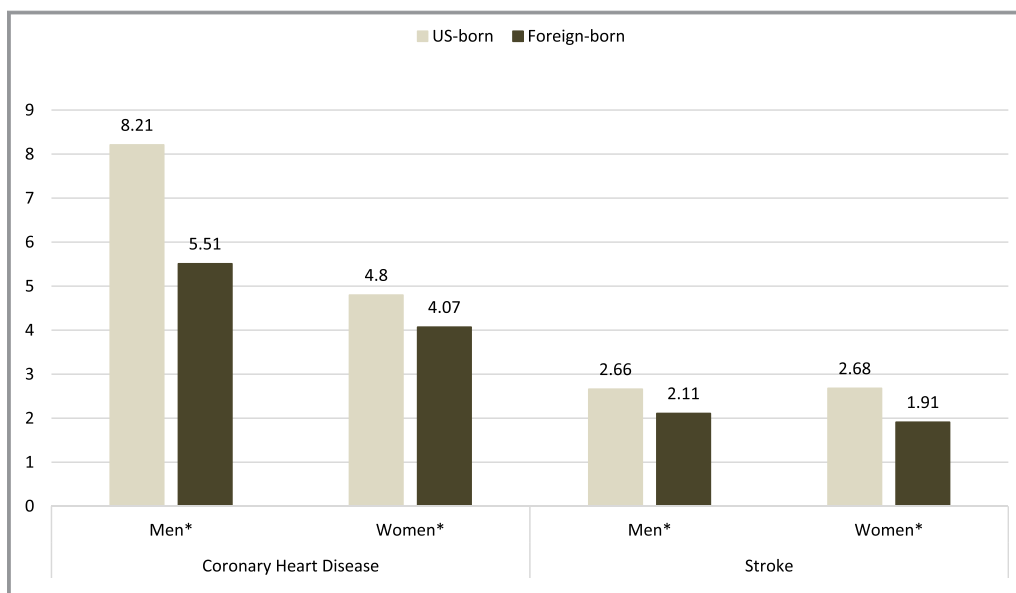


Figure 1. Age-standardized percentage of self-reported coronary heart disease and stroke by sex and birthplace. * $P < 0.05$.

the Caribbean born) to 72.5% (Indian subcontinent born). The percentage of current smoking and obesity was highest among US-born adults (20.9% and 29.1%, respectively); the percentage with diabetes mellitus was highest among foreign-born adults from Mexico, Central America, or the Caribbean (10.0%); and the percentage with hypertension was highest among US-born adults (30.9%). Adults from the Indian subcontinent represented the largest percentage of foreign-born adults living in the United States for <5 years (23.5%).

The overall age-standardized prevalences of CHD and stroke were higher among US-born than foreign-born adults for both men and women (Figure 1). By region, the age-standardized percentage of CHD ranged from 3.1% (African-born adults) to 6.4% (US-born adults) (Table 2). The age-standardized percentage of stroke ranged from 1.1% (South American-born adults) to 2.7% (US-born adults) (Table 2). However, the prevalence of both CHD and stroke by sex differed by region. For example, prevalence of CHD among women was lowest among those born in Africa (1.6%); for men, the lowest prevalence was found among those born in Asia (3.9%). Although African-born men had the lowest percentage of stroke (0.8%), African-born women had the highest percentage (2.9%). In addition, age-standardized percentage of CHD increased with length of years living in the United States; however, this trend was not observed for stroke (Figure 2).

Both unadjusted and adjusted odds ratios, with US-born adults as the referent, indicated that risk for CHD and stroke among foreign-born adults varied by region of birthplace (Table 3). Although most foreign-born adults had lower risk of

CHD and stroke than US-born adults, after full adjustment with demographic, behavioral, and health characteristics, as well as years living in the United States, men from Mexico, Central America, or the Caribbean had 43% lower risk of CHD and those from Asia had 53% lower risk of CHD than US-born men. This reduction was also seen for women (albeit at a smaller magnitude). Compared with US-born women, the risk of CHD was 17% lower among foreign-born adults from Mexico, Central America, or the Caribbean and 35% lower among foreign-born adults from Asia. In addition, compared with US-born women, those born in South America had 40% lower risk of CHD and those born in Africa had 73% lower risk of CHD. For stroke, men from Mexico, Central America, or the Caribbean (26%), South America (64%), and Africa (67%), and women from Mexico, Central America, or the Caribbean (25%), Europe (38%), and Asia (28%) had lower risk than those of US-born adults (Table 3). Adjustment for demographic characteristics and cardiovascular risk factors eliminated the association of CHD and stroke for some regions. Further adjustment for years living in the United States did not affect the associations with CHD and stroke for most groups, with the exception of risk of stroke among women. After adjustment for years in the United States, the risk of stroke for women born in South American and the Indian subcontinent was no longer significantly different from women born in the United States.

Among all foreign-born residents, unadjusted odds ratios showed those living in the United States ≥ 10 to <15 or ≥ 15 years had higher risk of CHD, whereas those living in the United States ≥ 15 years had higher risk of stroke than those

Table 2. Age-Standardized Prevalence of CHD and Stroke by Sex and Birthplace, NHIS, 2006 to 2014

Variable	Total	US-Born Adults	Mexico, Central America, Caribbean	South America	Europe	Africa	Indian Subcontinent	Asia
CHD								
Total	6.1 (0.1)	6.4 (0.1)	5.0 (0.2) [‡]	4.1 (0.4) [‡]	5.4 (0.3) [†]	3.1 (0.7) [‡]	5.1 (0.7)	3.4 (0.2) [‡]
Men	7.8 (0.1)	8.2 (0.1)	5.3 (0.3) [‡]	5.6 (0.7) [‡]	6.7 (0.5) [†]	4.4 (1.2) [‡]	7.0 (1.0)	3.9 (0.3) [‡]
Women	4.7 (0.1)	4.8 (0.1)	4.8 (0.2)	3.0 (0.5) [‡]	4.3 (0.4)	1.6 (0.6) [‡]	2.7 (0.8) [†]	3.1 (0.3) [‡]
Stroke								
Total	2.6 (<0.1)	2.7 (<0.1)	2.3 (0.1) [†]	1.1 (0.2) [‡]	1.8 (0.2) [‡]	1.9 (0.6)	1.7 (0.4) [†]	1.9 (0.2) [‡]
Men	2.6 (0.1)	2.7 (0.1)	2.3 (0.2) [*]	0.8 (0.3) [‡]	2.3 (0.3)	0.8 (0.3) [‡]	2.0 (0.5)	2.1 (0.3)
Women	2.6 (<0.1)	2.7 (0.1)	2.4 (0.2)	1.4 (0.3) [‡]	1.4 (0.2) [‡]	2.9 (1.0)	1.2 (0.5) [†]	1.7 (0.2) [‡]

Data are given as percentage (SE). CHD indicates coronary heart disease; NHIS, National Health Interview Survey; and SE, standard error.
^{*}P<0.05, [†]P<0.01, [‡]P<0.001 (compared with US-born adults).
 SE - standard error

living in the United States <5 years (Table 4). After adjusting for age, those living in the United States ≥15 years had higher risk of both CHD and stroke than those living in the United States <5 years. When further adjusted by birthplace, sex, education, health insurance, BMI, smoking status, history of hypertension, and diabetes mellitus (model 3), there was no association between years living in the United States and history of CHD or stroke.

Supplemental analyses were conducted to examine differences in US-born adults by racial/ethnic groups and foreign-born adults from comparable regions. Table S1 included the age-standardized prevalence of CHD and stroke for US-born adults by race/ethnicity and by foreign-born regions. Table S2 included data from logistic regression models assessing the

odds of CHD and stroke among foreign-born adults from different regions, using comparable racial/ethnic groups among those US-born adults as referent. The protective associations of birth in Mexico, Central America, the Caribbean, South America, or Asia did not persist when compared with US-born Hispanics or US-born Asians, respectively. In fact, Indian subcontinent-born men had a significantly higher risk of CHD than US-born Asian men. However, the lower risk of CHD among African-born women and the lower risk of stroke among African-born men persisted when compared with US-born non-Hispanic black women and men, respectively. The lower risk of stroke among European-born women persisted when compared with US-born non-Hispanic white women.

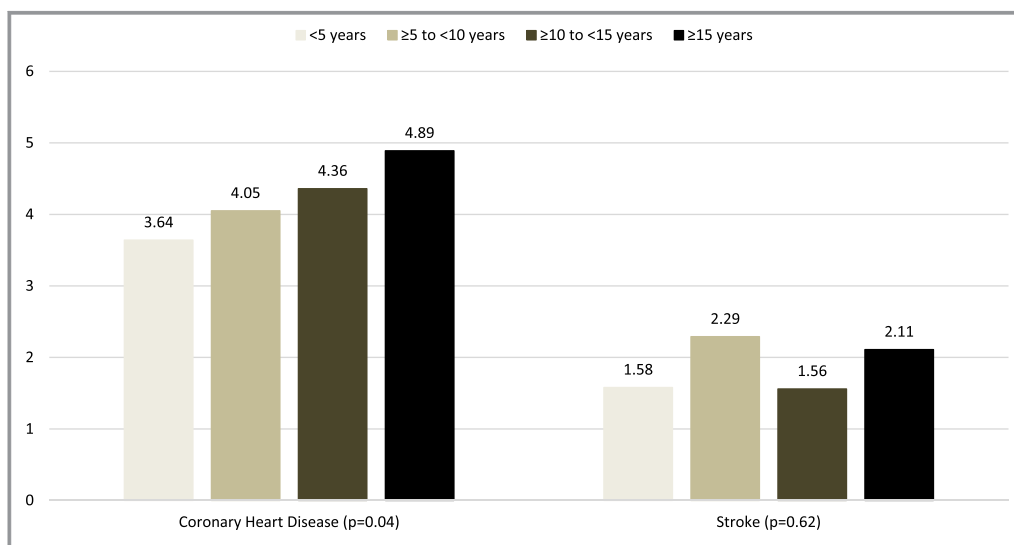


Figure 2. Age-standardized percentage of self-reported coronary heart disease and stroke by years living in the United States among foreign-born adults.

Table 3. ORs for CHD and Stroke Risk Among US- and Foreign-Born Adults, NHIS, 2006 to 2014

Variable	Model 1	Model 2	Model 3
	OR (95% CI)	AOR (95% CI)	AOR (95% CI)
CHD, men			
US-born adults	1	1	1
Mexico, Central America, Caribbean	0.41 (0.36–0.45)	0.54 (0.48–0.61)	0.57 (0.50–0.64)
South America	0.52 (0.39–0.68)	0.79 (0.59–1.07)	0.83 (0.61–1.13)
Europe	0.87 (0.74–1.04)	0.87 (0.72–1.05)	0.90 (0.74–1.09)
Africa	0.30 (0.17–0.55)	0.55 (0.28–1.06)	0.60 (0.31–1.16)
Indian subcontinent	0.50 (0.37–0.69)	0.94 (0.66–1.33)	1.01 (0.71–1.45)
Asia	0.41 (0.35–0.49)	0.44 (0.36–0.54)	0.47 (0.38–0.58)
CHD, women			
US-born adults	1	1	1
Mexico, Central America, Caribbean	0.76 (0.67–0.85)	0.84 (0.74–0.96)	0.83 (0.73–0.94)
South America	0.45 (0.33–0.61)	0.62 (0.45–0.86)	0.60 (0.43–0.84)
Europe	1.00 (0.81–1.24)	1.03 (0.82–1.30)	1.01 (0.81–1.28)
Africa	0.16 (0.08–0.33)	0.28 (0.13–0.63)	0.27 (0.12–0.60)
Indian subcontinent	0.30 (0.18–0.50)	0.65 (0.38–1.13)	0.61 (0.35–1.08)
Asia	0.54 (0.45–0.66)	0.68 (0.56–0.82)	0.65 (0.54–0.8)
Stroke, men			
US-born adults	1	1	1
Mexico, Central America, Caribbean	0.53 (0.44–0.63)	0.69 (0.57–0.84)	0.74 (0.60–0.91)
South America	0.23 (0.12–0.43)	0.37 (0.19–0.72)	0.36 (0.18–0.74)
Europe	0.92 (0.68–1.24)	0.95 (0.69–1.31)	0.99 (0.73–1.35)
Africa	0.25 (0.10–0.65)	0.30 (0.15–0.58)	0.33 (0.17–0.67)
Indian subcontinent	0.43 (0.26–0.71)	0.76 (0.45–1.29)	0.83 (0.48–1.43)
Asia	0.74 (0.55–0.98)	0.78 (0.56–1.08)	0.79 (0.58–1.08)
Stroke, women			
US-born adults	1	1	1
Mexico, Central America, Caribbean	0.68 (0.58–0.80)	0.70 (0.59–0.84)	0.75 (0.63–0.90)
South America	0.43 (0.27–0.68)	0.61 (0.38–0.98)	0.69 (0.43–1.09)
Europe	0.58 (0.46–0.74)	0.58 (0.45–0.76)	0.62 (0.47–0.80)
Africa	0.44 (0.22–0.89)	0.87 (0.42–1.81)	1.01 (0.49–2.09)
Indian subcontinent	0.17 (0.07–0.46)	0.35 (0.13–0.95)	0.41 (0.15–1.13)
Asia	0.57 (0.44–0.73)	0.67 (0.52–0.88)	0.72 (0.55–0.95)

Model 1 was unadjusted. Model 2 adjusted for age, health insurance, education, body mass index, smoking status, hypertension, and diabetes mellitus. Model 3 adjusted for all variables from model 2 plus years living in the United States. AOR indicates adjusted odds ratio; CHD, coronary heart disease; CI, confidence interval; NHIS, National Health Interview Survey; and OR, unadjusted odds ratio.

Discussion

The findings of this study showed that US-born residents had a higher risk of CHD and stroke compared with foreign-born residents; however, these differences were heterogeneous and only existed for foreign-born adults from certain regions. For example, the prevalence of CHD and stroke among foreign-born residents varied, with prevalence of CHD ranging

from 3.1% among African-born adults to 5.4% among European-born adults. In addition, the prevalence of stroke ranged from 1.1% among South American-born adults to 2.3% among those born in Mexico, Central America, or the Caribbean. The number of years of living in the United States did not affect the risk of CHD or stroke after adjustment for sociodemographic and health characteristics.

Table 4. CHD and Stroke Among Foreign-Born Adults by Years of Residence in the United States, NHIS, 2006 to 2014

Variable	Model 1	Model 2	Model 3
	OR (95% CI)	AOR (95% CI)	AOR (95% CI)
CHD, y			
<5	1	1	1
≥5–<10	1.16 (0.82–1.65)	1.08 (0.76–1.54)	0.96 (0.65–1.43)
≥10–<15	1.57 (1.13–2.20)	1.27 (0.91–1.78)	1.05 (0.71–1.56)
≥15	4.35 (3.39–5.58)	1.52 (1.17–1.97)	1.20 (0.88–1.62)
Stroke, y			
<5	1	1	1
≥5–<10	1.83 (0.90–3.75)	1.70 (0.83–3.46)	1.48 (0.68–3.2)
≥10–<15	1.62 (0.88–2.96)	1.28 (0.70–2.33)	1.12 (0.60–2.07)
≥15	6.35 (3.53–11.44)	2.12 (1.14–3.92)	1.71 (0.89–3.28)

Model 1 is unadjusted. Model 2 adjusted for age. Model 3 adjusted for age, birthplace, sex, health insurance, education, body mass index, smoking status, hypertension, and diabetes mellitus. AOR indicates adjusted odds ratio; CHD, coronary heart disease; CI, confidence interval; NHIS, National Health Interview Survey; and OR, unadjusted odds ratio.

The disparities of respondent-reported prevalence of CHD and stroke observed in the current study are, in some ways, consistent with the earlier studies assessing cardiovascular disease mortality. Previous studies in the United States have shown that risk for death attributable to cardiovascular disease is higher among US-born residents than among foreign-born residents.^{2,3,19} Although our data showed that foreign-born adults with a longer history of living in the United States (>15 years) had a higher reported history of CHD and stroke than those living in the United States for a shorter duration (<5 years), the comparison was no longer significant after adjustments for demographic and health characteristics.

Although mortality ranking data show that most countries of Europe, Asia, and Africa have higher CHD or stroke mortality than the United States,²⁰ our analyses found that foreign-born adults from these regions had an overall lower risk of nonfatal CHD and stroke than those US-born adults. This could potentially be explained by the “healthy immigrant effect,”²¹ where those who decide to immigrate to another country are usually healthier than those left behind, attributable to either self-selection or physical/legal barriers to entering the receiving country.²²

In Canada, a large cohort study of first-generation adult immigrants from different global regions found 30% lower 10-year age-standardized incidence of major cardiovascular disease among immigrants compared with long-term Canadian residents.²³ In general, immigrants from Eastern European, South Asian, and Middle Eastern countries had higher risk of CHD and stroke than long-term Canadian residents.²⁴ In addition, immigrants from East Asia had the lowest

incidence of cardiovascular disease, whereas immigrants from South Asia had the highest incident rates in the same study.²³ A comparable mortality study among Asian Americans showed the heterogeneity of cardiovascular mortality among those traditionally classified as Asian American. In this study, Asian Americans had a higher mortality burden from cerebrovascular disease than non-Hispanic whites, and Asian Indians had higher mortality burden from CHD.²⁵ Unlike these studies, we were not able to separate European-born adults into Eastern and Western European-born adults. However, our data from supplemental analyses showed that Indian-born men had 89% higher risk of CHD than US-born Asian men. These findings demonstrate the complexity of these relationships. Previous research has also shown general agreement with our supplemental analyses (eg, South Asian immigrants had 1.5 to 2 times greater risk of cardiovascular disease than long-term Canadian residents,^{23,24} and Asian Indians in the United States had higher mortality from CHD than non-Hispanic whites).²⁵

For Hispanic immigrants in the United States, previous reports have found that Hispanic immigrants had a lower prevalence of cardiovascular disease compared with non-Hispanic white adults.²⁶ This is often noted as the “Hispanic health paradox,” in which Hispanics in the United States, while having a lower socioeconomic status and a higher prevalence of cardiovascular risk factors (diabetes mellitus, hypertension, and obesity), have lower cardiovascular disease outcomes than non-Hispanic whites.^{27–29} This is consistent with findings in the current study, where respondents born in Mexico, Central America, and the Caribbean had lower risk of reported CHD and stroke among both men and women than those US-born adults. For participants born in South America, a lower risk of CHD among women and lower risk of stroke among men was found compared with those born in the United States. Although there is no specific explanation for the Hispanic health paradox, it has been suggested that multiple factors could contribute to it, including dietary habits, culture, and social dynamics.²⁸ The “Healthy Migrant Effect” (self-selected immigration of healthy individuals, as well as reverse migration) indicates that when illness occurs, Hispanic immigrants could return to their native countries.³⁰ When comparing with US-born Hispanics, no differences in the risk for CHD and stroke were observed for those born in Mexico, Central America, the Caribbean, and South America.

Previous research has also explored the attribution of cardiovascular risk factors by country of origin. For example, a Canadian study found that the prevalence of traditional cardiovascular risk factors, including hypertension, diabetes mellitus, high cholesterol, and smoking, differed by country of origin. In general, the mean cardiovascular disease risk score (eg, risk of cardiovascular disease event) was lower among immigrants than among long-term residents.²³ In a

comparable study using NHIS data, a higher overall prevalence of hypertension was found among US-born adults than among foreign-born adults.⁵ This study also revealed the overall prevalence of hypertension among immigrants who lived in the United States for ≥ 15 years was significantly higher than those who had lived in the United States for < 5 years. In a similar study among US immigrants focused on obesity, years of living in the United States was associated with an increased obesity rate after living in the United States for > 10 years.⁷ In addition, the prevalence of being overweight and having diabetes mellitus differed between groups of US immigrants by region, with overweight being lowest among those from Central Asia and highest among those from Mexico, Central America, and the Caribbean, and diabetes mellitus being lowest among those from Europe and highest in those from the Indian subcontinent.⁴ These studies suggest wide variation in cardiovascular risk factors among immigrants in the United States. The observed low percentage of hypertension among those from Mexico, Central America, the Caribbean, and South America could be attributable to lower awareness of hypertension status among these populations because these immigrants also had lower rates of health insurance.³¹

The NHIS provides the opportunity to assess CHD and stroke prevalence by region of birthplace; however, there are several limitations for this report. First, the NHIS was conducted among noninstitutionalized US residents, and therefore, those in long-term care facilities were not included in the survey. It is possible that adults with CHD and/or stroke were more likely to be in these facilities than those without CHD and/or stroke, especially immediately after a cardiovascular disease event. It is also possible that foreign-born adults, who were less likely to have health insurance coverage, will be less likely to be in long-term care facilities. Second, the types of survey data collected were limited in method and breadth, because they were collected by self-report and proxy report. Questions on CHD and stroke may be subject to recall bias, and self-reported immigration status could be less reliable among those with unauthorized status in the United States.³² Additional factors important in CHD and stroke risk that may vary by region of birth, such as diet, were not collected on the NHIS for all of the years examined in this study. Third, the outcome of this study was prevalence of CHD and stroke, which could be affected by diagnosis, treatment, and survival. It is possible that the higher prevalence of CHD and stroke could be attributable to factors other than increased cardiovascular risk, such as increased diagnostic testing or increased survival rate. However, there is no information to determine which factors could have contributed to the observed prevalence. Fourth, birthplace information was obtained solely by the question “Were you born in the United States?” Further analysis showed that $\approx 4\%$ of those classified as “foreign born”

were children born abroad to US parents. An additional 4% of those classified as foreign born were born in US territories, such as Puerto Rico, the US Virgin Islands, and Guam. If these individuals were more similar to US-born adults in their CHD and stroke risk, then this analysis may have underestimated the protective association of foreign-born status with CHD and stroke. Finally, because of relatively small numbers of participants in some regions and relative low event rates (stroke $< 3\%$ and CHD $< 8\%$), we were unable to closely examine race/ethnic-specific percentages of CHD and stroke among foreign-born adults from each region. Self-reported race and ethnic categories were used for sensitivity analyses and are conceptually different than birthplace. Although these 2 concepts are correlated, they should not be used interchangeably.

Using a nationally representative sample of US adults, these analyses found that the prevalence of CHD and stroke was higher among US-born adults compared with those classified as foreign-born adults, although this effect was attenuated when the comparison included race/ethnicity. In addition, there was heterogeneity in the risk of CHD and stroke among foreign-born adults by region of birth. We also found that among foreign-born adults, risk for CHD or stroke was not related to the length of time they had resided in the United States after adjusting for health and demographic factors. These results may support efforts to target high-risk groups with public health interventions.

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Disclosures

None.

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SUPPLEMENTAL MATERIAL

Table S1. Age-standardized prevalence of coronary heart disease and stroke by sex and birthplace, comparison of foreign-born with US-born by race/ethnicity, † National Health Interview Survey, 2006-2014.

	US-born-NH white	US-born NH-Black	US-born Hispanic	US-born NH-Asia	Mexico, Central America, Caribbean	South America	Europe	Africa	Indian Subcontinent	Asia
					% (SE)	% (SE)	% (SE)	% (SE)	% (SE)	% (SE)
Coronary heart disease										
Total	6.3(0.1)	6.6(0.1)	5.7(0.2)	4.7(0.4)	5.0(0.2)*	4.1(0.4)*	5.4(0.3)**	3.1(0.7)***	5.1(0.7)	3.4(0.2)**
Men	8.4(0.1)	6.9(0.2)	6.9(0.4)	5.9(0.8)	5.3(0.3)**	5.6(0.7)	6.7(0.5)**	4.4(1.2)*	7.0(1.0)	3.9(0.3)*
Women	4.6(0.1)	6.3(0.2)	4.6(0.3)	3.7(0.6)	4.8(0.2)	3.0(0.5)**	4.3(0.4)	1.6(0.6)***	2.7(0.8)	3.1(0.3)
Stroke										
Total	2.4(0)	4.2(0.1)	2.8(0.2)	1.9(0.3)	2.3(0.1)*	1.1(0.2)***	1.8(0.2)***	1.9(0.6)***	1.7(0.4)	1.9(0.2)
Men	2.5(0.1)	4(0.2)	2.7(0.3)	2.3(0.5)	2.3(0.2)	0.8(0.3)***	2.3(0.3)	0.8(0.3)***	2.0(0.5)	2.1(0.3)
Women	2.4(0.1)	4.3(0.2)	2.9(0.2)	1.6(0.3)	2.4(0.2)	1.4(0.3)***	1.4(0.2)***	2.9(1.0)	1.2(0.5)	1.7(0.2)

p-values (*<0.05, **<0.01, ***<0.001) .

† 1) for Mexico, Central America and Caribbean-born and South American-born, comparison was US-born Hispanics; 2) for Europe-born, comparison was US-born Non-Hispanic white; 3) for African-born, the comparison was US-born Non-Hispanic black; 4) for Asian-born and Indian Subcontinent-born, the comparison was US-born Asian.

Table S2. Odds ratios for coronary heart disease and stroke risk among foreign-born adults, National Health Interview Survey, 2006-2014.

		Compared with US-born race/ethnic group [†]	Model 1 [‡]	Model 2 [§]	Model 3 [¶]
CHD	Men	Mexico, Central America, Caribbean	0.88(0.74-1.04)	0.85(0.69-1.04)	0.89(0.72-1.11)
		South America	1.12(0.83-1.51)	1.29(0.90-1.85)	1.31(0.88-1.94)
		Europe	0.79(0.66-0.94)	0.81(0.67-0.97)	0.87(0.70-1.06)
		Africa	0.43(0.24-0.79)	0.73(0.37-1.43)	0.67(0.33-1.34)
		Indian Subcontinent	1.06(0.66-1.69)	1.60(0.99-2.58)	1.89(1.12-3.20)
		Asia	0.87(0.60-1.27)	0.74(0.50-1.11)	0.80(0.53-1.22)
CHD	Women	Mexico, Central America, Caribbean	1.38(1.16-1.65)	1.16(0.95-1.40)	1.13(0.92-1.37)
		South America	0.82(0.58-1.14)	0.83(0.57-1.22)	0.94(0.63-1.40)
		Europe	0.98(0.79-1.21)	1.00(0.79-1.26)	0.97(0.76-1.23)
		Africa	0.15(0.07-0.29)	0.30(0.13-0.68)	0.28(0.08-0.90)
		Indian Subcontinent	0.57(0.31-1.04)	0.61(0.26-1.42)	0.99(0.47-2.11)
		Asia	1.02(0.70-1.51)	0.80(0.50-1.26)	0.76(0.48-1.20)
Stroke	Men	Mexico, Central America, Caribbean	0.91(0.69-1.21)	0.86(0.61-1.19)	0.91(0.65-1.28)
		South America	0.39(0.20-0.77)	0.46(0.22-1.00)	0.53(0.24-1.19)
		Europe	0.92(0.68-1.24)	0.98(0.71-1.34)	0.98(0.71-1.36)
		Africa	0.20(0.08-0.51)	0.17(0.09-0.35)	0.29(0.14-0.59)
		Indian Subcontinent	0.74(0.37-1.47)	0.94(0.46-1.96)	0.97(0.44-2.12)
		Asia	1.28(0.76-2.14)	0.94(0.52-1.68)	0.87(0.48-1.60)
Stroke	Women	Mexico, Central America, Caribbean	1.05(0.84-1.30)	0.93(0.72-1.19)	0.97(0.75-1.26)
		South America	0.66(0.41-1.08)	0.72(0.41-1.25)	0.71(0.39-1.30)
		Europe	0.60(0.47-0.77)	0.59(0.45-0.77)	0.64(0.50-0.83)
		Africa	0.32(0.16-0.64)	0.70(0.33-1.49)	0.72(0.29-1.76)
		Indian Subcontinent	0.41(0.14-1.18)	0.53(0.16-1.76)	0.76(0.24-2.40)
		Asia	1.34(0.82-2.18)	1.15(0.67-1.98)	1.22(0.70-2.13)

†. Used US-born Hispanic as reference when the models included respondents from Mexico, Central America and Caribbean-born, and South America-born; Used US-born Non-Hispanic-white as reference with the model for Europe-born; Used US-born Non-Hispanic-black as reference with the model for Africa-born; Used US-born-Asian as reference with the models for Indian Subcontinent-born and Asian-born. ‡. Model 1 unadjusted. §. Model 2 adjusted for age. ¶. Model 3 adjusted for age, birthplace, sex, health insurance, education, body mass index, smoking status, hypertension, and diabetes.