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Nativity and Cardiovascular Dysregulation: Evidence from the 2001–2016 National Health and Nutrition Examination Survey

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Abstract

Objectives To examine nativity-based differences in 3 cardiovascular biomarkers commonly used to assess cardiovascular dysregulation.

Methods Data was pooled from the 2001–2016 National Health and Nutrition Examination Survey to compare biomarker risk scores for the US-born ($n = 4693$) and foreign-born ($n = 2968$) Black adults. We used multivariable-adjusted logistic regression to assess the association between nativity and cardiovascular biomarkers, controlling for gender, age, health behaviors, and socio-economic status.

Results In the full model, a foreign-born health advantage was not observed in all 3 cardiovascular biomarkers. In fact, foreign-born Blacks were almost twice as likely to have high mean diastolic blood pressure compared with the US-born individuals (OR = 1.82; 95% CI = 1.15, 2.88) and had an increased risk of high 60-s pulse. Foreign-born individuals living in the USA for less than 5 years were 62% less likely to have high mean systolic blood pressure than individuals living in the USA for 20 years or more.

Conclusions The foreign-born health advantage among Blacks was not observed in the cardiovascular biomarkers under study, suggesting that the commonly cited Healthy Immigrant Effect may need to be reassessed.

Keywords Nativity · Cardiovascular risk · Biomarkers

Introduction

The Healthy Immigrant Effect (HIE) describes the phenomenon in which people who migrate to the United States (US) experience better health outcomes than those born in the USA. Immigrants' cardiovascular risk profile has garnered special attention as cardiovascular disease rates increase in the USA and globally. Recently, attention has shifted to the health of Black immigrants as this population has seen rapid growth, increasing by over 800,000, an 11-fold increase, between 1970 and 2000. In 2015, 2.1 million Africans lived in the USA and this rapid growth is expected to increase [1, 2].

Cardiovascular health disparities between all non-Hispanic Blacks and Whites in the USA have been well-documented with the general consensus that non-Hispanic Blacks bear a disproportionately higher burden of cardiovascular disease than Whites [3, 4]. The risk of cardiovascular disease increases as blood pressure increases and puts individuals at risk for developing hypertension and other chronic diseases that lead to negative health outcomes. Hypertension, or chronically elevated blood pressure, is a major health concern for non-

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Hispanic Blacks in particular, as this group has the highest rate of hypertension in the world [5]. Studies of nativity and hypertension indicate that the US-born Blacks have a higher risk of being diagnosed with hypertension and tend to be diagnosed at younger ages compared with non-Hispanic Whites and other ethnic minority groups [5]. However, an important limitation of these studies is the lack of an examination of nativity-based differences that consider the heterogeneity within the US Black population. An examination of these differences can provide valuable evidence to better understand disparities in this area.

Past views on the cardiovascular health of foreign-born Blacks were that only after living in the USA did they acquire high blood pressure, hypertension, and cardiovascular disease [6]. However, the prevalence of cardiovascular disease is on the rise on the African continent and other Black-majority nations [7–9], leading to a significant number of immigrants arriving to the USA with already compromised cardiovascular systems and disease. In many African countries, cardiovascular disease is the leading cause of death [6, 7], and the prevalence of risk factors for cardiovascular disease such as the diagnoses of diabetes and hypertension is also increasing in many African developing areas [10]. Hypertension is seen as the most common underlying risk factor for cardiovascular disease in Africa [11]. In 2025, adults living with hypertension are expected to increase by 60%, equating to approximately 1.56 billion total individuals that will be burdened by the disease [12].

Elevated levels of diastolic and systolic blood pressure (DBP) (SBP) are both indicators of hypertension and predictors of cardiovascular disease [13]. Emerging evidence has shown that the variability of SBP has the potential to affect estimation of an individual's 10-year cardiovascular disease risk with increases in SBP nearly doubling the overall risk of stroke and coronary heart disease mortality [14, 15]. Of these two indicators, SBP is often considered the more clinically relevant marker as a strong predictor of cardiovascular disease among hypertensives. However, DBP is a stronger predictor of cardiovascular morbidity among individuals under the age of 50 [16]. Thus, DBP may be an equally important and often overlooked indicator of differences in cardiovascular morbidity risk between foreign-born Blacks and the US-born Blacks although few studies have explored this association [17]. One study found that SBP levels are higher in the US-born Blacks compared with foreign-born Blacks from sub-Saharan Africa, but to our knowledge, there are no studies exploring nativity differences in DBP [18].

In comparing foreign-born with the US-born Blacks, O'Connor et al., found that foreign-born Blacks had higher fasting glucose, a higher prevalence of hypertension, and greater visceral adiposity, all of which increased their cardiometabolic risk [6]. Other studies have found that African immigrants had higher rates of hypertension than African Americans [19–21]. Alternatively, a recent study found that foreign-born Blacks were close to 40% less likely to have hypertension than their US-born counterparts [17].

Studies examining the HIE provide insight into potential protective factors from the risk of cardiovascular disease. Foreign-born Blacks are more likely to have a higher SES and higher education level upon arrival, thus providing them with access to quality healthcare that might help to mitigate health risks [22]. When the foreign-born Black group is disaggregated, research shows that Caribbean-born Blacks have significantly lower rates of cardiovascular death and better health outcomes than the US-born Blacks [22]. However, when compared with West African-born Blacks, Caribbean-born Blacks had higher average systolic and diastolic blood pressures and had a higher prevalence of hypertension [23].

Given these inconsistent findings, it is important to understand how nativity might impact cardiovascular risk by examining the individual components of hypertension; SBP, DBP, and 60-s pulse. While hypertension is a composite measure of SBP and DBP, our study examines these components separately to determine what may drive differences in these biomarkers, and how sociodemographic variables influence associations between nativity and individual biomarkers. Several large epidemiological studies, such as the Framingham Heart Study, have suggested that SBP and pulse may have more influence on blood pressure than DBP [24]. To our knowledge, no other study has examined nativity-based differences in individual cardiovascular biomarkers. The objective of the current study is to examine the nativity-based differences in cardiovascular biomarkers and assess the sociodemographic variables that may influence these factors. We also examine how the sociodemographic variables under study work differently in the US-born and foreign-born populations.

Methods

We pooled data from the 2001–2016 National Health and Nutrition Examination Survey (NHANES) to create the analytical sample. NHANES uses a stratified, multistage probability sample to provide national estimates of the nutritional status and health for the civilian, noninstitutionalized population of the USA [25]. Pregnant women were excluded from the analysis and the sample included respondents above the age of 20 years who were medically examined and had laboratory tests. The analytical sample included 4693 US-born Blacks and 2968 foreign-born Blacks. We analyzed data using SAS 9.3 [26]. We weighted descriptive statistics and logistic regressions using the mobile examination centers survey weight provided by NHANES and utilized survey commands to account for the complex sampling design of the data.

Dependent Variables Systolic blood pressure, diastolic blood pressure, and 60-s pulse were measured by trained medical personnel. DBP and SBP were calculated by taking the average of two readings. We dichotomized each biomarker, using the 75th percentile to categorize respondents at greater risk of developing disease relative to the rest of the sample. Respondents with a reading at or above the 75th percentile were considered "high" risk (score = 1), with measures below the 75th percentile considered "low" risk (score = 0) for each biomarker. Individuals who reported taking medication for hypertension were coded in the high risk category when scoring blood pressure [27, 28].

Measures

Nativity was measured as a dichotomous variable indicating whether an individual was born outside or in the USA (1 = foreign-born; 0 = US-born). NHANES defines length of time in the USA in years as a variable with 9 categories, which we recoded into three categories (1 = < 5 years; 2 = 5–19 years, 3= > 20 years), consistent with other studies on immigrant health. Age was measured as a continuous variable defined as participants' age in years at the time of the screening interview. Gender was based on self-reported information on whether a respondent was male or female (1 = woman; 0 = man). We defined education as a 4-level categorical variable (1 = < high school; 2 = high school diploma or general equivalency diploma; 3 = > high school diploma, some college, or an associate's degree; 4 = > college degree). NHANES defines the poverty income ratio (PIR) as a ratio of family income to the federal poverty level based on family size in a calendar year with values ranging from 0 to 5. A PIR value of 1 is 100% of the federal poverty level, a

Table 1 Weighted descriptive statistics for US-born Blacks and foreign-born Blacks by nativity: National Health and Nutrition Examination Survey, United States, 2001–2016

Characteristic	All (n^a=7661) %	Foreign-born (n^a=2968) %	US-born (n^a=4693) %	*P*
Systolic blood pressure, mean (SD)[b]	126.06 (0.32)	126.41 (0.53)	125.92 (0.42)	0.816
Diastolic blood pressure, mean (SD)[b]	72.18 (0.26)	71.27 (0.42)	72.50 (0.29)	0.011
60-s pulse, mean (SD)	72.48 (0.21)	72.11 (0.37)	72.78 (0.24)	0.065
Age, mean (SD)	44.1 (0.29)	44.2 (0.53)	44.0 (0.34)	0.778
Gender				
Male	51.48	53.47	49.85	0.001
Female	48.52	46.53	50.15	
Length of US residence (years)[c]				
< 5	NA	24.14	NA	
5–19	NA	37.77	NA	
20 +	NA	38.09	NA	
Cigarette smoking status				
Current non-smoker	30.78	69.55	68.24	0.380
Current smoker	69.22	30.45	31.76	
Marital status				
Unmarried	33.07	37.29	30.77	< .0001
Married/living with partner	44.04	41.45	45.35	
Divorced/separated/widowed	22.89	21.26	23.88	
Poverty income ratio				
< 300% Federal poverty level	63.39	70.57	67.42	0.200
≥ 300% Federal poverty level	31.61	29.43	32.58	
Education				
Less than high school/no diploma	33.77	20.08	27.45	< .0001
High school diploma	19.07	26.57	26.08	
Some college or AA	24.71	35.33	32	
College graduate or above	22.45	18.02	14.47	

NA = Not Applicable

[a] Refers to unweighted totals

[b] Normal systolic blood pressure is < 120 and normal diastolic blood pressure is < 80, per American Heart Association Guidelines

[c] Length of US residence only applies to foreign-born respondents

Table 2 Logistic regression results for diastolic blood pressure among Blacks by nativity status (US- or foreign-born): National Health and Nutrition Examination Survey, United States, 2001–2016

	Model 1 OR (95% CI)			Model 2 OR (95% CI)		
	All	Foreign	US	All	Foreign	US
Nativity	0.86 (0.75, 0.97)*			1.52 (1.01, 2.30)*		
Time in the USA						
20 + years		1.0 (ref)			1.0 (ref)	
5–19 years		0.38 (0.20, 0.74)*			0.57 (0.28, 1.18)	
< 5 years		0.21 (0.09, 0.50)*			0.35 (0.14, 0.85)*	
Age				1.07 (1.05, 1.08)*	1.05 (1.02, 1.08)*	1.07 (1.05, 1.08)*
Gender						
Female				1.0 (ref)	1.0 (ref)	1.0 (ref)
Male				1.12 (0.74, 1.69)*	1.13 (0.61, 2.09)	1.21 (0.65, 2.24)
Marital status						
Married/partnered				1.0 (ref)	1.0 (ref)	1.0 (ref)
Divorced/widowed				0.84 (0.51, 1.37)	0.76 (0.41, 1.41)	0.93 (0.43, 2.02)
Unmarried				0.71 (0.42, 1.20)	0.70 (0.34, 1.48)	0.61 (0.28, 1.35)
Poverty income ratio						
> = 300% FPL						
< 300%FPL						
Education						
College grad or above						
Some college or AA						
High school grad						
No HS diploma/GED						
Smoking						
Non-smoker						
Smoker						

	Model 3 OR (95% CI)			Model 4 OR (95% CI)		
	All	Foreign	US	All	Foreign	US
Nativity	0.97 (0.85, 1.10)			1.82 (1.15, 2.88)*		
Time in the USA						
20 + years		1.0 (ref)			1.0 (ref)	
5–19 years					0.66 (0.25, 1.77)	
< 5 years					0.45 (0.16, 1.28)	
Age	1.07 (1.06, 1.08)*	1.05 (1.02, 1.09)*	1.06 (1.05, 1.08)*	1.07 (1.05, 1.09)*	1.06 (1.02, 1.10)*	1.07 (1.06, 1.09)*
Gender						
Female	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)
Male	1.06 (0.94, 1.19)	1.11 (0.54, 2.29)	1.29 (0.73, 2.28)	1.21 (0.77, 1.91)	0.95 (0.40, 2.24)	1.49 (0.86, 2.59)

Table 2 (continued)

Marital status						
Married/partnered	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)
Divorced/widowed	0.94 (0.81, 1.10)	0.75 (0.33, 1.74)	1.02 (0.46, 2.26)	0.86 (0.45, 1.65)	0.64 (0.25, 1.60)	1.06 (0.41, 2.75)
Unmarried	0.79 (0.68, 0.90)*	0.84 (0.36, 1.93)	0.69 (0.31, 1.55)	0.81 (0.43, 1.53)	0.81 (0.30, 2.20)	0.69 (0.29, 1.67)
Poverty income ratio						
> = 300% FPL	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)
< 300%FPL	1.04 (0.89, 1.21)	0.61 (0.25, 1.51)	0.74 (0.36, 1.49)	0.66 (0.38, 1.14)	0.55 (0.19, 1.62)	0.78 (0.41, 1.49)
Education						
College grad or above	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)
Some college or AA	1.15 (0.94, 1.40)	0.90 (0.37, 2.19)	1.21 (0.53, 2.74)	1.04 (0.58, 1.88)	0.85 (0.35, 2.03)	1.27 (0.54, 3.01)
High school grad	1.19 (0.99, 1.44)	1.64 (0.71, 3.77)	0.72 (0.35, 1.48)	0.78 (0.45, 1.35)	1.11 (0.51, 2.41)	0.62 (0.33, 1.17)
No HS diploma/GED	1.12 (0.90, 1.40)	1.22 (0.54, 2.76)	1.52 (0.66, 3.46)	1.25 (0.64, 2.42)	1.09 (0.39, 3.05)	1.31 (0.53, 3.23)
Smoking						
Non-smoker				1.0 (ref)	1.0 (ref)	1.0 (ref)
Smoker				1.55 (0.69, 3.49)	2.83 (0.70, 11.47)	1.07 (0.65, 3.21)

OR = odds ratio, *CI* = confidence interval. *$P < .05$

value of 2 is 200% of the federal poverty level, and so forth. We coded values of 4 and above as 5 to protect individuals' anonymity. We recoded this variable into 2 categories: between 0.00 and 2.99, and 3.00 and greater to reflect individuals who were at or below $59,800 and those who were at or above $59,801. Marital status was coded into a 3-level categorical variable (1 = never married; 2 = married or living with a partner; 3 = widowed, divorced, or separated). Smoking status was defined using questions asking about the average number of cigarettes smoked per day in the past 30 days. Current non-smokers were defined as those who had never smoked at least 100 cigarettes in their lifetime and did not smoke at the time of the interview. We designated individuals who smoked at least 100 cigarettes in their lifetime and currently smoked as current smokers (1 = smoker; 0 = non-smoker).

Data Analysis

First, we compared the distribution of each biomarker between foreign- and the US-born Blacks utilizing *t* tests for continuous variables and Rao-Scott modified chi-square tests to account for the complex survey design for categorical variables. We then fit multivariable-adjusted logistic regression models to assess the association between nativity and each cardiovascular biomarker, adding covariates in a step-wise fashion across four models: Model 1, unadjusted; Model 2, adjusted for time in the USA (foreign-born only), age, gender, and marital status; Model 3, added PIR and education; and Model 4, fully adjusted (added smoking status). Because there are few variables that could affect nativity, and thus act as true confounders, adding potential mediating variables, such as PIR, education, and smoking, in a step-wise fashioned, allowed use to evaluate changes in effect sizes with the addition of each variable. We tested models for the full sample as well as separate models for foreign- and the US-born Blacks to examine associations between sociodemographic variables and cardiovascular biomarkers in each population of interest.

Results

Table 1 shows the stratified descriptive statistics for the sociodemographic variables and dependent variables by nativity. Both foreign- and the US-born had the same mean age of 44 years and had similar profiles with regard to the proportion of smokers and non-smokers. Compared with the US-born, a larger proportion of the foreign-born were male (54% vs 50%), unmarried (37% vs 31%), and had a college degree or above (18% vs 14%). A larger proportion of the US-born were female (50% vs 46%). There were no statistically significant differences in mean SBP, or 60-s pulse; however,

Table 3 Logistic regression results for 60 second pulse among Blacks by Nativity status (US- or Foreign-Born): National Health and Nutrition Examination Survey, United States, 2001–2016

	Model 1 OR (95% CI)			Model 2 OR (95% CI)		
	All	Foreign	US	All	Foreign	US
Nativity	1.63 (0.99, 2.67)			1.52 (0.91, 2.54)		
Time in the USA						
20 + years		1.0 (ref)			1.0 (ref)	
5–19 years		0.96 (0.51, 1.79)			0.76 (0.38, 1.53)	
< 5 years		1.19 (0.51, 2.77)			1.02 (0.40, 2.61)	
Age				0.99 (0.98, 1.01)	0.98 (0.96, 1.00)	0.99 (0.98, 1.02)
Gender						
Female				1.0 (ref)	1.0 (ref)	1.0 (ref)
Male				0.44 (0.30, 0.65)*	0.32 (0.17, 0.60)*	0.59 (0.37, 0.93)*
Marital status						
Married/partnered				1.0 (ref)	1.0 (ref)	1.0 (ref)
Divorced/widowed				1.01 (0.57, 1.79)	0.98 (0.47, 2.02)	1.09 (0.45, 2.66)
Unmarried				1.46 (0.80, 2.65)	1.59 (0.76, 3.32)	1.29 (0.49, 3.43)
Poverty income ratio						
> = 300% FPL						
< 300%FPL						
Education						
College grad or above						
Some college or AA						
High school grad						
No HS diploma/GED						
Smoking						
Non-smoker						
Smoker						

	Model 3 OR (95% CI)			Model 4 OR (95% CI)		
	All	Foreign	US	All	Foreign	US
Nativity	1.49 (0.88, 2.53)			1.78 (1.02, 3.10)**		
Time in the USA						
20 + years		1.0 (ref)			1.0 (ref)	
5–19 years		0.77 (0.33, 1.82)			0.81 (0.33, 1.99)	
< 5 years		0.71 (0.29, 1.77)			0.95 (0.39, 2.32)	
Age	0.99 (0.98, 1.02)	0.98 (0.96, 1.01)	0.99 (0.98, 1.02)	0.99 (0.97, 1.01)	0.98 (0.95, 1.01)	0.99 (0.96, 1.02)
Gender						
Female	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)
Male	0.44 (0.30, 0.64)	0.37 (0.20, 0.70)*	0.49 (0.31, 0.79)*	0.42 (0.27, 0.66)*	1.95 (0.85, 4.50)	0.36 (0.19, 0.70)*

Table 3 (continued)

Marital status						
Married/partnered	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)
Divorced/widowed	1.02 (0.58, 1.81)	1.05 (0.52, 2.11)	0.98 (0.39, 2.47)	1.23 (0.66, 2.32)	1.22 (0.56, 2.67)	1.20 (0.42, 3.42)
Unmarried	1.77 (0.93, 3.40)	2.20 (0.97, 5.02)	1.34 (0.50, 3.62)	1.87 (0.94, 3.71)	2.20 (0.91, 5.32)	1.48 (0.52, 4.22)
Poverty income ratio						
> = 300% FPL	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)
< 300%FPL	1.28 (0.75, 2.17)	2.04 (0.89, 4.75)	0.91 (0.47, 1.77)	1.08 (0.59, 1.95)	1.95 (0.85, 4.50)	0.61 (0.27, 1.41)
Education						
College grad or above	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)
Some college or AA	1.28 (0.68, 2.43)	0.90 (0.38, 2.16)	1.62 (0.65, 4.08)	1.29 (0.67, 2.49)	0.82 (0.33, 2.02)	1.92 (0.74, 4.99)
High school grad	1.68 (0.74, 3.79)	1.35 (0.44, 4.08)	1.90 (0.57, 6.33)	1.40 (0.62, 3.16)	1.13 (0.45, 2.85)	1.32 (0.37, 4.76)
No HS diploma/GED	1.03 (0.46, 2.31)	0.58 (0.16, 2.14)	1.75 (0.66, 4.64)	1.02 (0.43, 2.46)	0.53 (0.14, 1.99)	2.07 (0.61, 7.01)
Smoking						
Non-smoker				1.0 (ref)	1.0 (ref)	1.0 (ref)
Smoker				0.49 (0.16, 1.54)	0.54 (0.10, 2.96)	0.34 (0.09, 1.34)

OR = odds ratio, *CI* = confidence interval. *$P < .05$

the US-born had a statistically significantly higher mean DBP compared with the foreign-born.

Full Sample

Tables 2, 3, and 4 show the results of logistic regression for mean SBP, mean DBP, and 60-s pulse. For the full sample, foreign-born Blacks were more likely to have high mean DBP and 60-s pulse compared with the US-born individuals. In the final model, foreign-born Blacks were almost twice as likely to have a high mean DBP compared with the US-born individuals (odds ratio [OR] = 1.82; 95% confidence interval [CI] = 1.15, 2.88). Foreign-born Blacks were more likely to have a high mean 60-s pulse, (OR = 1.78; 95% CI = 1.02. 3.10).

Of note, among the sociodemographic variables, compared with younger individuals, older individuals were more likely to have high DBP (OR = 1.07; 95% CI = 1.05, 1.09) and high mean SBP (OR = 1.10; 95% CI = 1.08. 1.13). Men were 58% less likely to have a risk of high 60-s pulse compared with women (OR = 0.42; 95% CI = 0.27, 0.66).

The US-Born

Older individuals were more likely to have high mean SBP and DBP compared with younger individuals (OR = 1.11; 95% CI = 1.07, 1.14), (OR = 1.07; 95% CI = 1.06, 1.09) respectively. Men were less than half as likely to have a high 60-s pulse compared with women (OR = 0.576; 95% CI = 0.496, 0.670). There were no other significant effects observed between sociodemographic variables or any outcome for the US-born Blacks.

Foreign-Born

Foreign-born Blacks living in the USA for less than 5 years were 62% less likely to have high SBP compared with those in the USA for 20 years or more (OR = 0.38; 95% CI = 0.18, 0.80). However, this effect did not remain significant when the other sociodemographic variables were added to the model. An effect for age was observed in the final mean SBP and mean DBP models when all variables were added to the model, such that older individuals were more likely to have high mean SBP and DBP compared with younger individuals (OR = 1.11; CI = 1.07, 1.15; OR = 1.06; CI = 1.02, 1.10). Foreign-born men were less likely to have a high 60-s pulse compared with women (OR = 0.37; CI = 0.20, 0.70). There were no other significant effects observed.

Discussion

This study aimed to examine nativity-based differences in the cardiovascular biomarkers mean SBP, mean DBP, and 60-s

Table 4 Logistic regression results for systolic blood pressure among Blacks by nativity status (US- or foreign-born): National Health and Nutrition Examination Survey, United States, 2001–2016

Nativity	Model 1 OR (95% CI)			Model 2 OR (95% CI)		
	All 0.89 (0.61, 1.30)	Foreign	US	All 1.29 (0.83, 2.00)	Foreign	US
Time in the USA						
20 + years		1.0 (ref)			1.0 (ref)	
5–19 years		0.41 (0.21, 0.81)*			0.87 (0.43, 1.77)	
< 5 years		0.38 (0.18, 0.80)*			1.10 (0.49, 2.47)	
Age				1.10 (1.08, 1.12)*	1.10 (1.06, 1.13)*	1.10 (1.08, 1.13)*
Gender						
Female				1.0 (ref)	1.0 (ref)	1.0 (ref)
Male				1.08 (0.71, 1.65)	0.80 (0.43, 1.51)	1.42 (0.82, 2.47)
Marital status						
Married/partnered				1.0 (ref)	1.0 (ref)	1.0 (ref)
Divorced/widowed				0.80 (0.46, 1.39)	0.80 (0.35, 1.81)	0.78 (0.36, 1.69)
Unmarried				0.99 (0.50, 1.96)	0.70 (0.30, 1.64)	1.41 (0.51, 3.86)
Poverty income ratio						
> = 300% FPL						
< 300%FPL						
Education						
College grad or above						
Some college or AA						
High school grad						
No HS diploma/GED						
Smoking						
Non-smoker						
Smoker						

Nativity	Model 3 OR (95% CI)			Model 4 OR (95% CI)		
	All 1.31 (0.83, 2.06)	Foreign	US	All 1.41 (0.86, 2.31)	Foreign	US
Time in the USA						
20 + years		1.0 (ref)			1.0 (ref)	
5–19 years		1.10 (0.49, 2.48)			1.38 (0.55, 3.45)	
< 5 years		1.21 (0.45, 3.30)			1.66 (0.55, 5.08)	
Age	1.10 (1.08, 1.12)*	1.11 (1.06, 1.15)*	1.10 (1.09, 1.10)*	1.10 (1.08. 1.13)*	1.11 (1.07, 1.15)*	1.11 (1.07, 1.14)*
Gender						
Female	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)
Male	1.31 (0.83, 2.05)	0.99 (0.47, 2.10)	0.91 (0.76, 1.08)	1.23 (0.74, 2.04)	0.75 (0.33, 1.70)	1.60 (0.86, 2.95)

Table 4 (continued)

Marital status						
Married/partnered	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)
Divorced/widowed	0.89 (0.48, 1.66)	0.86 (0.32, 2.33)	1.08 (0.88, 1.31)	0.87 (0.43, 1.77)	0.77 (0.24, 2.48)	0.82 (0.32, 2.09)
Unmarried	1.22 (0.61, 2.42)	0.92 (0.38, 2.22)	0.88 (0.70, 1.10)	1.16 (0.55, 2.44)	0.95 (0.36, 2.48)	1.55 (0.50, 4.77)
Poverty income ratio						
> = 300% FPL	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)
< 300%FPL	0.72 (0.39, 1.32)	0.60 (0.25, 1.42)	1.19 (0.99, 1.44)	0.71 (0.37, 1.36)	0.51 (0.21, 1.22)	0.83 (0.32, 2.16)
Education						
College grad or above	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)
Some college or AA	1.70 (0.86, 3.38)	1.78 (0.70, 4.52)	1.14 (0.88, 1.48)	1.67 (0.83, 3.33)	1.57 (0.56, 4.40)	1.66 (0.60, 4.57)
High school grad	1.53 (0.73, 3.23)	1.80 (0.58, 5.67)	1.20 (0.92, 1.56)	1.07 (0.52, 2.21)	0.90 (0.24, 3.37)	1.12 (0.46, 2.75)
No HS diploma/GED	1.31 (0.68, 2.52)	1.02 (0.39, 2.65)	1.10 (0.83, 1.45)	1.16 (0.57, 2.38)	0.79 (0.29, 2.17)	1.52 (0.59, 3.86)
Smoking						
Non-smoker				1.0 (ref)	1.0 (ref)	1.0 (ref)
Smoker				1.41 (0.86, 2.31)	2.73 (0.77, 9.70)	0.92 (0.31, 2.75)

OR = odds ratio, *CI* = confidence interval. *$P < .05$

pulse. We also aimed to describe differences in associations between the sociodemographic variables under study and these outcomes among foreign- vs the US-born samples. Our findings suggest that there were no nativity-based differences in mean SBP; however, compared with the US-born, the foreign-born were more likely to have higher risks of mean DBP and 60-s pulse. This finding contradicts past views on the HIE and the foreign-born health advantage but is in line with more recent re-examinations of the HIE, highlighting that Black immigrants have higher rates of hypertension than their US-born counterparts [6, 19–21]. More current views of Black migration points to the notion that Africa and other Black-majority nations are becoming more urbanized with an increase in processed food consumption and less exercise. As a result, we can speculate that recent cohorts of immigrants may not be arriving in the USA as healthy as previous cohorts.

Due to the high prevalence of hypertension in the USA and globally and its associated morbidities as age increases, hypertension has become the dominant risk factor for cardiovascular disease in older individuals [29]. We found significant age differences in SBP and DBP and gender differences in 60-s pulse across the full sample and in the separate foreign- and the US-born models. We also consistently observed an increase in the risk of mean SBP and mean DBP with increased age in the full sample and among the foreign- and the US-born in separate models. These findings have been confirmed in other, larger epidemiological studies although there is a need for studies focused on immigrants from African and other Black-majority nations [24, 30].

Although time spent in the USA was a predictor of mean SBP among the foreign-born sample, this significant result disappeared in the final model. Due to the cross-sectional nature of the data, we cannot determine how covariates may have changed post-immigration. For example, changes in an individual's income may have mediated the association between time in the USA and SBP, which would attenuate the effect observed in unadjusted models. We found that individuals living in the USA for less than 5 years were less likely to have high SBP compared with those in the USA for 20 years or more. This is consistent with other studies demonstrating that over time, the foreign-born lose any health advantage that they may have possessed upon arrival as they adjust to the sociocultural environment of the USA. Furthermore, studies of other immigrant groups in industrialized societies have shown that each additional year of US residence is associated with increased odds of hypertension [30–32].

Limitations

This study is not without limitations. First, the study was cross-sectional in nature and therefore limits our ability to make conclusive statements regarding causality. While we cannot rule out pre-existing conditions, because our outcomes

were objective, we can be assured that immigration occurred prior to the collection of cardiovascular outcomes. Second, we were unable to examine birth country specific data which would be useful to further disaggregate the effects of nativity. Although hypertension and cardiovascular disease are a global public health concern, some nations are experiencing higher incidences than others, which may impact our assessment of nativity-based differences in the cardiovascular risk biomarkers. Lastly, our sociodemographic and nativity information was self-reported, which is vulnerable to recall and information bias.

Public Health Implications

Our results suggest that there is no foreign-born health advantage for any of the separate cardiovascular risk biomarkers evaluated in this study. Moreover, foreign-born Blacks were at higher risk of elevated mean DBP and 60-s pulse than their US-born counterparts. Among both populations, advanced age seems to work similarly and increases the risk of having higher mean SBP and mean DBP. Importantly, our results highlight that there is no nativity-based difference in mean SBP, the more commonly used measure in evaluating and controlling hypertension.

We considered that although hypertension is a useful measure of cardiovascular function, examining the biomarkers separately provides beneficial information about how various sociodemographic variables work among the foreign- and the US-born. Researchers should consider disaggregating hypertension data into its individual components in order to fully capture the mechanisms at play. Future research should continue to examine the HIE in larger Black immigrant populations, as well as the utility of the aggregate hypertension measure as a clinical marker for cardiovascular risk, as opposed to its individual components [33].

Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

Ethical Approval This article does not include any studies with human participants or animals performed by any of the authors.

Informed Consent No protocol approval for informed consent was required, as the data are secondary data and publicly available.

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