Diet quality and hypertension in ethnically diverse U.S.-born and foreign-born Blacks: Quantitative and qualitative approaches

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Out of the huts of history's shame

I rise

Up from a past that's rooted in pain

I rise

I'm a black ocean, leaping and wide,

Welling and swelling I bear in the tide.

Leaving behind nights of terror and fear

I rise

Into a daybreak that's wondrously clear

I rise

Bringing the gifts that my ancestors gave,

I am the dream and the hope of the slave.

Excerpt from Maya Angelou's "Still I Rise"

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Abstract

According to existing epidemiological data, the morbidity and mortality of non-Hispanic Blacks (referred to as 'Blacks' hereafter) from diet-related diseases are higher than other racial/ethnic groups in the United States. Blacks in the U.S. are also generally reported to have poor diet quality and are less likely to meet national dietary recommendations. A major limitation of this epidemiological evidence, however, is the lack of consideration of the ethnic heterogeneity within the Black population. For example, this broad category includes African Americans, Sub-Saharan Africans (e.g., Kenyans and Nigerians), or Afro-Caribbeans such as Haitians and Jamaicans. Combined, Caribbean-born, self-identified Black immigrants and African-born immigrants make up an estimated 8.7% of the U.S. Black population and the Census Bureau projects that by 2060, 16.5% of U.S. Blacks will be immigrants. With this ethnic diversity among Blacks includes heterogeneity of cultures and social realities that would potentially influence lifestyle behaviors, food and taste preferences, diet, and ultimately disease risk.

Using quantitative and qualitative methods, this proposed research considered nativity/place of birth among Blacks in the examination of diet quality and the likelihood of having hypertension among this demographic. Aims 1 and 2 were based on pooled data from a nationally representative, cohort study of a sample drawn from the U.S. population, the National Health and Nutrition Examination Survey (NHANES) study. Aim 1 examined the association between nativity among Blacks and adherence to the Alternative Healthy Eating Index (AHEI)-2010 and the Dietary Approaches to Stop Hypertension (DASH) diet, while Aim 2 explored the association between nativity and the likelihood of having hypertension. Informed by Satia-Abouta's model of dietary acculturation, the final qualitative aim used focus groups and in-depth interviews to examine the influence of nativity and culture on dietary practices among ethnically heterogeneous Blacks in Boston.

The results from Aim 1 showed that foreign-born, non-Hispanic Blacks had significantly higher AHEI-2010, and DASH diet scores and more favorable intakes of fruit (excluding fruit juice), vegetables (excluding potatoes), whole grains, nuts, seeds, and legumes, and omega-3 fatty acids, and lower intakes of processed/red meat and sugar-sweetened beverages compared to U.S.-born Blacks after adjusting for covariates such as education and income. Among foreign-born Blacks, AHEI-2010 scores or its individual components did not significantly differ by length of residency. The results from Aim 2 found that nearly half (43.5%) of U.S.-born Blacks and only 27.8% of foreign-born Blacks had hypertension. After adjusting for major covariates, foreign-born Blacks were 39.0% less likely to have hypertension than their U.S.-born counterparts. Among foreign-born Blacks, length of U.S. residency was not significantly associated with risk of hypertension. In the qualitative analysis, Caribbean/Latin American-born and African-born Blacks in Boston cited the important role of their cultural

identity in influencing their dietary preferences, while U.S.-born Blacks demonstrated a variation of preferences for traditionally African American foods. Themes around availability, accessibility, and cost of culturally appropriate foods varied by place of birth. Among foreign-born Blacks, themes related to dietary preferences and values also varied by age of migration, length of residency, and income.

This study demonstrates that in the U.S. foreign-born Blacks generally have better diet quality and more favorable hypertension outcomes than their U.S.-born counterparts, and highlights the potential cultural influences of these differences. These study findings underscore the need for public health and nutrition research to consider the differences in nativity and ethnicity among the U.S. Black population and explore the underlying cultural, social, behavioral, and environmental factors contributing to these differences. Ultimately, this research helps to fill gaps in the literature and extend knowledge necessary to help address racial/ethnic health disparities among Blacks in the U.S. through the development of more culturally appropriate public health interventions.

Chapter 1: Introduction

While it is evident that morbidity and mortality from cardiovascular disease (CVD), cerebrovascular disease, and hypertension among non-Hispanic Blacks[1] is the highest among any other racial/ethnic group and diet quality among this group is poor, a major limitation of the epidemiological evidence is the lack of consideration of the ethnic diversity within this demographic (1-4). This dissertation was designed to address gaps in the literature by exploring potential variations in diet quality and hypertension risk within the non-Hispanic Black U.S. population in an effort to determine who is exactly at highest risk and improve the effectiveness of public health approaches to address hypertension and related diseases in this population. See Figure 1 for the framework for this dissertation research.

Aim 1: To examine the association between place of birth/nativity and the Alternative Health Eating Index (AHEI)-2010 and Dietary Approaches to Stop Hypertension (DASH) diet scores among self-identified non-Hispanic Blacks using pooled National Health and Nutrition Examination Survey (NHANES) data.

Exploratory Aim 1*: Among foreign-born non-Hispanic Blacks, examine scores on the AHEI-2010 DASH diet scores by length of residency*

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[1] Note that the term 'Blacks' references both U.S. born and those of African descent who have immigrated to the U.S. 'African Americans' refers to Blacks with roots in the U.S. sociopolitical system of slavery.

Hypothesis 1*: Foreign-born, non-Hispanic Blacks will have higher scores on the AHEI-2010 and DASH diet scores than U.S.-born, non-Hispanic Blacks.*

Exploratory Hypothesis 1*: Foreign-born, non-Hispanic Blacks residing in the U.S. for ≥ 30 years will score lower on the AHEI-2010 and DASH diet scores in comparison to those who have been in the U.S. for shorter periods of time.*

Aim 1 utilizes pooled NHANES data for NHANES, 2003-2004 through NHANES, 2011-2012 and compares diet quality scores of the AHEI-2010 and DASH diet scores by nativity (U.S.-born, non-Hispanic Blacks and foreign-born, non-Hispanic Blacks). Research on the DASH diet shows the diet to be more effective at lowering both systolic and diastolic blood pressure in Blacks compared to other racial/ethnic groups (12.6 mmHg lower systolic blood pressure for Blacks and 9.5 mm Hg lower systolic for others; 7.2 mmHg lower diastolic for Blacks and 6.9 mm Hg lower diastolic blood pressure for others), providing the rationale for using the DASH diet score as one of the outcomes for Aim 1 (5). Additionally, research suggests an association between higher AHEI-2010 scores with a lower risk for a range of chronic diseases—from CVD and diabetes to chronic obstructive pulmonary disease (6-11).

Aim 2: To examine the association between place of birth/nativity and hypertension among self-identified non-Hispanic Blacks using pooled NHANES data.

Hypothesis 1: *Hypertension risk will be higher among U.S.-born, non-Hispanic Blacks than foreign-born, non-Hispanic Blacks.*

Exploratory Aim 2: To examine any potential differences in the likelihood for hypertension by length of residency among foreign-born, non-Hispanic Blacks.

In Aim 2, we used pooled NHANES data for 2003-2004 through 2013-2014. This aim is significant because it identifies the subpopulations among Blacks at greatest risk for hypertension to support the development of more targeted interventions.

Aim 3: To qualitatively examine perceptions of cultural influences on dietary practices, diet quality, and dietary adherence among ethnically diverse Blacks in Boston.

Objective 3*: To gain preliminary understanding of how ethnicity, place of birth/nativity, and culture influence eating patterns and diet quality of an ethnically diverse Black population in Boston.*

In Aim 3, we used qualitative methods to enhance our understanding of the findings from the first two aims of this dissertation. Particularly, applying Satia Abouta's model of dietary acculturation (12), this aim creates a more in-depth picture of the cultural influences on diet and the nature of potential differences in eating and lifestyle patterns among Blacks that might otherwise be hidden in the analysis of large datasets. Through focus groups (FGs) and in-depth interviews, this aim explores diet and cultural, demographic, and psychosocial influences on diet, among 3 subcategories of Blacks: those of African descent born in the Caribbean and Latin America; those of African descent from African countries and those born in the U.S with roots in the U.S. sociopolitical system of slavery. Overall, Aim 3 expands our knowledge of the association between diet

quality, culture, and nativity among Blacks in an urban setting in the northeast U.S. in order to better address these racial/ethnic health disparities.

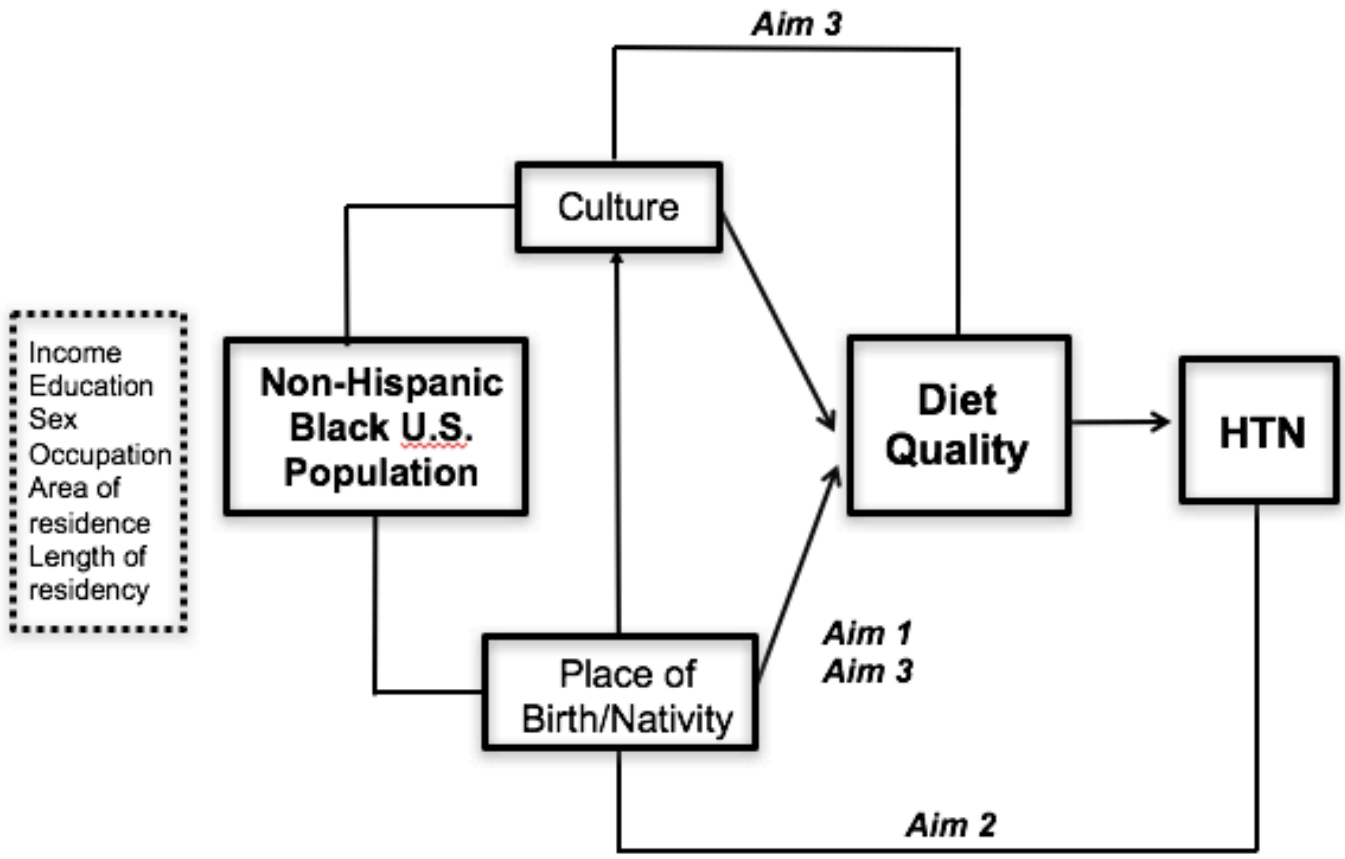

Figure 1: Study Framework

Chapter 2: Review of the Literature

2.1 Overview: Disparities in Health Outcomes

The morbidity and mortality of Blacks from diet-related diseases and conditions such as cardiovascular and cerebrovascular disease and hypertension are significantly higher than other racial/ethnic groups in the United States, representing major health disparities (1-3). Specifically, compared to their White counterparts[†], Blacks are 40% more likely to be diagnosed with hypertension and 30% more likely to die from heart disease (1-3). These higher rates of hypertension and related chronic diseases among Blacks are caused by a myriad of influences, including dietary and lifestyle factors, genetic predisposition to salt sensitivity, and physiological responses to chronic stress (13-17). Although beyond the scope of this dissertation research, other upstream social determinants of health underpinning these disparities include inequities in the U.S. educational system, socioeconomic deprivation in Black communities, racial segregation, and racially biased practices within the U.S. judicial system.

2.2 Race and Ethnicity in the U.S.

Race and ethnicity are commonly used in public health and epidemiological literature to compare the prevalence and risk of certain diseases and health outcomes between different groups. The classification system by race,

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[†] Counterparts are defined as a comparative group in which demographic factors such as socioeconomic status, sex, age, and level of educational attainment are controlled for.

however, is a social construct which, historically, developed largely to justify systems of oppression such as slavery in the Americas and thereafter evolved to continue to socially and economically divide populations (18). Today, in research, the race variable is thought to measure a combination of some aspect of social class, culture, and genetics, however only serving as a rough proxy for each (19, 20). While race is a social construct, and ethnicity is generally used to describe a more distinctive cultural tradition, there is no clear consensus of a standardized definition of these terms. These labels are in fact often used interchangeably (19). The U.S. Office of Budget and Management classify individuals under four distinct racial categories (White, Black or African American, American Indian or Alaskan Native, or Native Hawaiian or other Pacific Islander) and one ethnic category (Hispanic or Latino and Not Hispanic or Latino) (21). These categories are broad, however, and do not consider the extent of the heterogeneity within each group and arguably prevent researchers to truly understand health disparities at the national level.

Influenced by politics, the categorization of race has evolved throughout history, however. For example, from 1790 to 1840, the U.S. Census categorized the majority of the "Non-White" U.S. population as "Colored," and this changed to also include "Mulattoes" from 1850 to 1890 in order to differentiate between full-blooded Blacks and those who were of mixed race (18). During this time frame, Chinese, Japanese, and American Indians were also enumerated in certain states. In 1870, enumerators were given further instructions for Mulattoes and Indians, which were to be classified as quadroons and octoroons in order to

describe individuals having any trace of African blood (18). Today, most national public health surveys use the traditional racial/ethnic categories described by the U.S. Office of Budget and Management, however, some public health surveys assess for more racial/ethnic information. For example, the National Health Interview Survey probes for Hispanic origin or ancestry (i.e., Puerto Rican, Dominican, etc.), as well as specific Asian subgroups (i.e., Chinese, Filipino, Japanese, etc.), but does not probe for Black subgroups. To better understand the nature of racially and ethnically based health disparities, however, this non-invasive information is important to gather in additional national surveys for all races.

2.3 Black Immigration to the U.S

While some Blacks have been in the U.S. for many generations with roots in the U.S. sociopolitical system of slavery, others are recent immigrants of African descent from places such as Africa and the Caribbean. Specifically, the operational definition of "Black or African American" according to the U.S. Census is having origins in any of the Black racial groups of Africa (22). This broad category includes African Americans, Sub-Saharan Africans (e.g., Kenyan and Nigerian), or Afro-Caribbeans such as Haitians and Jamaicans (22). From the historical perspective, while the countries in the Caribbean were involved in the forced migration of African slaves in the trans-Atlantic slave trade, the voluntary migration of those from the Caribbean to the U.S. did not begin until the 1900's and did not become more widespread until immigration reform in 1965 (23). Specifically, the Immigration and Nationality Act of 1965 signed into law by

President Lyndon Johnson lifted the quotas based on country of origin and instead replaced them with an immigration system based on family re-unification and employment (23). Since then, immigration of those of African descent has, as expected, markedly increased. Combined, Caribbean-born, self-identified Black immigrants and African-born immigrants make up an estimated 8.7% of the U.S. Black population and Census Bureau projects that by 2060, 16.5% of U.S. Blacks will be immigrants (23-25). Based on American Community Survey data the largest proportion of Black immigrants migrate from Jamaica, Haiti, Trinidad and Tobago, and Nigeria (See Table 1). To our knowledge, there is no existing data on the figure of first, second, and third generation descendants from immigrants of African descent, which would further influence the diversity among Blacks. Accounting for the figures above, however, there is considerable ethnic diversity among Blacks, which includes heterogeneity of cultures, social realities, and lifestyle patterns.

Table 1: Black Immigrants as Share of All Immigrants in the United States from Caribbean and African Origins, 2008-09

	Total immigrants (thousands)	Black Immigrants (thousands)	% Black
All U.S. Immigrants	*38,234*	*3,267*	*9*
Born in the Caribbean	*3,437*	*1,701*	*49*
St. Kitts-Nevis	12	12	100
Haiti	541	534	99
Barbados	50	48	96
Jamaica	638	612	96
St. Lucia	19	18	95
Antigua-Barbuda	18	17	94
St. Vincent	18	17	94
Grenada	31	29	94
Bahamas	29	26	90
Other West Indian countries	34	29	85
Trinidad and Tobago	220	181	82
Other Caribbean countries	23	16	70
Dominica	34	16	47
Dominican Republic	785	110	14
Cuba	985	34	3
African Immigrants	1,457	1,081	74
Cameroon	31	30	99
Ghana	111	110	99
Somalia	68	67	99
Nigeria	204	201	99
Ethiopia	146	143	98
Eritrea	23	22	98
Liberia	66	64	97
Guinea	11	11	97
Sierra Leone	36	34	95
Senegal	16	16	95
Other West African countries	55	52	95

Other African countries	145	124	86
Sudan	40	34	86
Kenya	82	68	83
Uganda	19	14	75
Other East African	33	22	67
Zimbabwe	17	11	64
Cape Verde	36	22	63
Tanzania	18	10	53
Other North Africa	15	2	15
South Africa	82	11	14
Morocco	53	5	9
Egypt	135	7	5
Algeria	16	1	3

Data source: Migration Policy Institute, 2008-2009 American Community Survey (18, 19)

2.4 Acculturation and the Healthy Immigrant Hypothesis

Relevant to Black immigrant groups is the concept of acculturation, which is described as a process of cultural and psychological change as a result from intercultural contact and the extent that ethnic minorities and immigrant groups participate in the dominant cultures' values, beliefs, assumptions, and practices (26-29). Additional cultural domains include interpersonal relationships and language preferences. Originally described by Psychologist, John Berry, some researchers view acculturation as a combination of two different dimensions---adherence to the dominant culture and maintenance of original culture (28). In this view, the acculturation process comprises of four aspects: assimilation, separation, integration, and marginalization (27-29). Meanwhile, other researchers argue that acculturation is unidimensional, ranging from immersion in the existing cultural context to immersion in the individual's culture of origin on either end of

the spectrum (30). Both viewpoints of the acculturation process, however, have been difficult to operationalize, and a variety of proxy measures are used to estimate levels of acculturation. These proxy measures include immigration status, length of residence, nativity, language, and more advanced acculturation scales (31). In public health studies, acculturation has been used to explore the relationship between cultural change and health outcomes. For the purposes of this research, nativity and length of residency will be used as proxies for acculturation.

Most of the acculturation literature, however, focuses on Hispanic and Asian groups, in which, albeit mixed, research show an association between migration and acculturation and changes in disease risk, lifestyle behaviors, and dietary composition (32-35). A study among Mexican Americans, for example, found that CVD risk was highest among U.S.-born, Spanish speaking Mexicans and lower among foreign-born Mexicans (33). Meanwhile, studies among Hispanics overall that examined dietary change have shown mixed results—from an association between acculturation and fat avoidance among women to greater levels of acculturation and lower intakes of fiber and higher intakes of calorically dense foods (36, 37). A systematic review on this topic, concluded overall, however, that less acculturated Hispanics consumed less sugar and sugar-sweetened beverages, milk, and used fat in food preparation (38). Many of these, studies, use inconsistent measures of acculturation (i.e., nativity vs. language preferences) and dietary assessment methods (38). Nevertheless, noteworthy is

the importance of examining the ethnic subgroups within the larger racial categories.

2.5 Hypertension among Blacks

Hypertension among U.S.-born Blacks is reported as the highest prevalence of hypertension worldwide, over 40% (1). An early comparative study, called the International Collaborative Study of Hypertension in Blacks, examined the prevalence of hypertension of Blacks in Nigeria, Cameroon, Jamaica, St. Lucia, Barbados, and the United States and found a consistent gradient in blood pressure prevalence rising from 16% in the West African countries, 26% in the Caribbean countries, and 33% in the U.S. While this study was conducted in 1997, the findings suggest an important role of social and possibly genetic contexts in the development of this condition (39).

A variety of social, behavioral, and biological theories have been proposed to explain this higher prevalence in hypertension in the U.S. These include genetic and physiological factors related to lower activity of the renin angiotensin system (RAS) and fluid and sodium balance and retention, psychosocial factors such as exposure and perception of stress and discrimination, environmental factors and conditions, as well as diet and other behavioral factors, such as physical activity and smoking habits. These contributing factors are described in brief below.

2.5.1 Genetic factors

A host of physiological, genetically based differences may contribute to the higher prevalence of hypertension among Blacks. For example, Blacks who have been diagnosed with hypertension are more likely to exhibit salt sensitivity in comparison to their hypertensive counterparts of other races/ethnicities (13). Salt sensitivity is a term used to describe a person with acute blood pressure fluctuations in response to changes in salt intake and data suggests that it may play a role in the pathogenesis of hypertension (13, 40-42). Other research points to endothelium dysfunction caused by lowered bioavailability of the potent vasodilator, nitric oxide, reduced dietary potassium intake and its association with increased activity of the Na-Cl cotransporter responsible for water retention, and reduced sodium excretion (13). Additionally, research suggests that Blacks have lower plasma renin activity and lower RAS activity overall in comparison to their white counterparts. Due to these genetic differences, anti-hypertension therapy targeting the RAS has not been shown to work effectively among Blacks with hypertension, meanwhile diuretics, salt restriction, and calcium channel blocker are common recommended approaches (43). In fact, the recommended medical therapy for Blacks with hypertension is different from that of other racial/ethnic groups (44) .

While controversial, there have been numerous historically based hypothesis aiming to explain the higher prevalence of hypertension among U.S. Blacks (45). One posited hypothesis is based on historical evidence of the transatlantic slave trade and slavery in the Americas from the 16th century to the

19th century. According to the hypothesis, the conditions of slaves during the middle passage and within the plantation systems created an environment for "natural selection," in which those genetically pre-disposed to retain salt had a selective advantage for survival (17, 46). Specifically, the major causes of death during this time were thought to be salt-depletive diseases such as dehydration, diarrhea, fevers, and vomiting. Applying Darwin theory, the slaves who were genetically fit for survival were also likely to carry on their genotype to subsequent generations of Western Hemisphere Blacks.

Related to the gradient of the prevalence of hypertension of Blacks throughout the African Diaspora as described above, this hypothesis therefore predicts that Blacks in the Americas and the Caribbean would have a greater frequency of individuals with an enhanced genetic-based ability to conserve salt compared to modern-day Blacks in West Africa. Although speculative, it may be this historically based genetic underpinning and ancestral involvement in the transatlantic slave trade and slavery in the New World that contributes to the higher incidence of hypertension among Blacks in the U.S. today compared to those from Africa.

2.5.2 Psychosocial factors

Research suggests psychosocial factors such as exposure and perception of racism and discrimination, perceived stress and stress coping styles, internalized anger, and socioeconomic-based stress may contribute to the elevated risk for hypertension and other health outcomes among Blacks in the U.S. (14, 47-52).

Racism, in its multiple forms (personally-mediated, internalized, and institutionalized) (53), is often an insidious, inescapable, distressing reality of everyday life for many African Americans and other racial minorities. In an early review examining the psychosocial factors contributing to hypertension among Blacks, the authors discussed suppressed hostility and an active stress coping style (coined "John Henryism" (54)) in response to environmental stressors as associated factors in the development of high blood pressure (14) . Similarly, the work of the social epidemiologist, Nancy Krieger, has shown differences in high blood pressure outcomes based on whether a person challenges perceived unfair treatment, with those who do not challenge the discriminatory treatment more likely to have elevated blood pressure compared to those challenged the experienced racism (55, 56).

Related to the John Henryism phenomenon among Blacks is the chronic stress that accompanies socioeconomic disadvantage (54, 57). Specifically, the John Henryism hypothesis posits those of lower socioeconomic status are exposed to life circumstances---for example, financial instability, job insecurity, family dysfunction, discriminatory acts, neighborhood violence, and limited access to health care---that result in greater levels of psychosocial stress. This chronic stress consequently would lead to physiological responses that may lead to hypertension and cardiovascular disease.

Specific to the topic of this dissertation research and the exploration of the impacts of nativity on health among Blacks, one known study compared racial discrimination and psychological distress between U.S.-born and foreign-born

Blacks. The authors found similarly high levels of severe psychological distress between the U.S.-born and foreign-born Blacks and increasing reports of exposure to racial discrimination with increased time spent in the U.S. among foreign-born Blacks (48).

2.5.3 Diet and behavioral factors

Related to the high prevalence of hypertension among Blacks are diet and other behavioral factors such as physical activity and smoking. Diet is a well-known contributor to the development of hypertension, with lower sodium intakes, higher potassium intakes, as well as increased fruit and vegetable consumption shown to help to lower blood pressure (5, 58, 59). Research suggests that adherence to the DASH diet, designed to prevent and manage hypertension, can lower both systolic and diastolic blood pressure. The seminal study demonstrating the effectiveness of this diet showed that compared to the control diet, those in the low-sodium DASH diet intervention group, had a systolic blood pressure that was 7.1 mmHg lower for participants without hypertension and 11.5 mmHg lower for those diagnosed with hypertension (60).

Non-Hispanic Blacks, however, are generally reported to have poor diet quality and not meet national dietary recommendations, such as the Dietary Guidelines for Americans (61-64). For example, studies have shown intakes of total vegetables, whole grains, milk, dietary fiber, potassium, and calcium to be lower than Whites (61-65). A study assessing adherence to the recommendations

proposed in the 2005 Dietary Guidelines, for example, demonstrated that 16.9% of non-Hispanic Blacks met or exceeded the minimum dietary requirements for fruit, 5.7% for vegetables, 1.7% for dry beans and peas, and only 0.4% for whole grains; these figures were 17.4%, 14.1%, 2.2%, and 0.9% among non-Hispanic Whites, respectively (61). Another study comparing scores on the Healthy Eating Index-2005 found that Blacks had significantly lower scores for total vegetables, whole grains, milk, saturated fat, and sodium (62).

Other behavioral factors such as smoking and physical activity habits may contribute to the higher rates of hypertension among the U.S.-Black population, given the body of research suggesting the role of both behaviors in the development of the condition (16, 66, 67). According to recent Center for Disease Control data, there is a decreasing trend of current smoking among non-Hispanic Blacks with 18.5% reported being a current smoker in 2013 and 21.5% being current smokers in 2005 (68). Comparatively, these figures are 19.4% and 21.9% among non-Hispanic Whites, respectively. Physical activity levels among non-Hispanic Blacks are also of concern, with research suggesting 24% to 36% of Black adults engaging in regular physical activity (69).

2.6 Related Studies on Other Health Outcomes

While limited research has explored the differences is diet-related disease outcomes and diet between U.S.-born and foreign-born Blacks, related research in other disciplines suggests the importance of these potential differences by nativity (70-73). For example, in an Illinois-based study, the rate of low birth weight infants of African-born Black women was closer to infants born of U.S.-born

White women compared to U.S.-born Black women (71). Another study based in Boston, found similar results, in which foreign-born Black women were found to have better pre-pregnancy nutrition status and prenatal health behaviors compared to U.S.-born Blacks (70). Meanwhile, studies examining differences in mental health outcomes, have found varying results. Findings from the National Study of American Life found mental health risk to be associated with ethnic diversity within the U.S. population. Black Caribbean men had higher risk for psychiatric disorders, meanwhile Black Caribbean women had lower odds for 12-month and lifetime risk for psychiatric disorder as compared to their U.S.-born counterparts (73). Overall, these studies within other disciplines suggest the importance of this dissertation research in order to better understand the nature of race/ethnic disparities in diet-related disease outcomes.

2.7 Preliminary studies/data

While research shows that Blacks have some of the highest rates of morbidity and mortality from cardiovascular and cerebrovascular disease, few studies have disaggregated the data and explored disease outcomes or dietary patterns by the various ethnic groups that comprise the Black/African American racial category. One known study compared the diets of African Americans and Haitian Americans with and without type 2 diabetes, in which Haitian Americans were shown to have significantly higher AHEI-2010 scores than the African American study participants (74). In their conclusion, the authors emphasized the importance of disaggregating ethnicities when assessing diets (74). A study based

out of Baylor College of Medicine compared the prevalence of high blood pressure between African-born and African American health professionals and found that African-born subjects were less likely to have hypertension than their U.S.-born counterparts (75). The authors concluded the need for larger-scaled studies to explore the high prevalence of hypertension among African Americans.

2.8 Significance

This proposed study is novel in that, to our knowledge, it is one of the few of its kind in the U.S. to examine and compare the diet quality and patterns within the diverse Black population, considering the ethnic diversity among this group due to immigration. Studies based in the UK have explored the diets of British Afro-Caribbean populations providing possible insights into the diets of Afro-Caribbean immigrant populations in the U.S. (76-78). One study examined the diets of Afro-Caribbean subjects mostly of Jamaican origin and concluded that dietary modification suggestions for diet-related diseases such as obesity, diabetes, and hypertension need to consider cultural contexts (78). As the authors described, people of the Caribbean are from different countries, each with unique food habits and dietary patterns that persist in first and later generations after immigration. A similar study highlighted the dietary habits and foods consumed by British Afro–Caribbean populations, underscoring the potential variation in the diets of Afro-Caribbean populations in the U.S. (79). The only known study in the U.S. qualitatively compared the diets of Afro-Caribbean and African

American women, in which the authors found that there were cultural variations in traditions of food and food preparation between the two different groups (80).

The gaps in the current literature reinforce the importance of understanding the potential heterogeneity in the diets and diet-related disease outcomes among foreign-born Blacks from the Caribbean and Africa compared to Blacks born in the U.S. with known roots in the sociopolitical institution of slavery. The proposed study examined the potential differences in hypertension risk and dietary quality among populations of African descent in the United States. While this study is essential in filling in a major gap in the literature, it is limited by not capturing the full heterogeneity among Blacks given the data collected in available large national datasets. Nevertheless, this dissertation research is significant because it explores a field of study where existing literature is limited in order to address racial/ethnic health disparities through more tailored public health approaches in an increasingly diverse nation. Specifically, this dissertation research explored any potential variations in diet quality using the AHEI-2010 and DASH diet scores, as well as hypertension outcomes within the U.S. Black population in an effort to influence the effectiveness of public health approaches to address hypertension, heart disease and stroke among this high-risk population.

Chapter 3: Study Design and Methodology

3.1 Specific Aim 1: Diet Quality

3.1.1 Study Population and Dataset

We used pooled data from NHANES 2003-2012 to examine the association between diet quality among U.S-born and foreign-born, non-Hispanic Blacks. Conducted by the National Center for Health Statistics, NHANES is a cross-sectional nationally representative health and nutrition survey of the non-institutionalized U.S. population (81). The survey includes demographic, socioeconomic, and health- and diet-related questions and is carried out through complex, stratified, multistage probability sampling. The NHANES protocol was approved by the National Center for Health Statistics Research Ethics Review Board and all participants provided informed consent.

Inclusion criteria for the primary analysis include those who self-identified as non-Hispanic Blacks between the ages of 22-79. Exclusion criteria include pregnancy at the time of the data collection and ≤600 kcal and ≥4,800 kcal. To account for the average age of college-level educational attainment, we set the population to ≥22 years and given the age variable in NHANES is top coded at 80 years, we restricted our study populations to <80 years. Pregnant women were excluded given that pregnancy is associated with increased nutritional needs and may impact food intake (82). Extreme caloric intakes were also excluded to account for implausible energy intakes and following convention used in other studies among African Americans (83). Underreporting of dietary intake is a

widely-recognized limitation of dietary assessment methods, with obese participants showing a greater likelihood to underreport intake of high fat foods and those high in simple carbohydrates (84-86). Implausible energy intakes may therefore undermine the relationships explored in this analysis.

The dietary interview component of NHANES, called What We Eat in America (WWEIA), is conducted in partnership between the U.S. Department of Agriculture (USDA) and the U.S. Department of Health and Human Services' (DHHS) National Center for Health Statistics (87). Specifically, NHANES dietary intake data is based on two 24-hr recalls, in which the food and beverages consumed during the 24-hour period prior to the interview (midnight to midnight) is assessed in order to estimate intakes of energy, macronutrients, micronutrients, and food group components from the foods and beverages consumed (87, 88). Participants are also asked to report water consumption and salt use during the previous 24 hours and whether their intake on the previous day was usual or unusual. The first day is collected in the Mobile Examination Center (MEC) and data for the second day is collected by telephone 3 to 10 days later. All procedures are documented elsewhere (87-90).

We utilized the individual food files, which include detailed nutrient information about the individual foods participant reported they consumed. The USDA Food Patterns Equivalents (FPED) Database and the MyPyramid Equivalents Database (MPED), which disaggregate mixed foods into their component parts, were also used to determine the food-based components of the dietary scores (91, 92). FPED and MPED files were harmonized based on

different data collection procedures and definitions of food components from different data collection periods. For example, sodium adjustments were made based on a change in data collection procedures beginning in 2009-2010. Prior to 2009, salt adjustments were conducted based on the survey participants' responses to a selected set of questions on salt use in cooking and preparing foods in the household (87). This approach was discontinued given that grocery store purchases are not a proxy for home preparation given the widespread use of ready-to-eat, microwavable, and other pre-prepared convenience foods. Additionally, for the processed meats component, MPED files from 2003-2004 had to be corrected since the variable only included lunch/deli meats and excluded cured meats.

3.1.2 Diet Quality Scores

There are numerous diet quality measures aimed at assessing the overall diet and categorizing individuals according to the extent to which their eating behavior is "healthy" or meets dietary standards and recommendations. Some measures of diet quality are based on reducing risk for specific diseases and conditions (i.e., Dietary Approaches to Stop Hypertension, DASH, scores, AHA 2020 Impact Score) while others focus on promoting overall health and reducing general disease risk (HEI-2005, HEI-2010, AHEI-2010) (6, 93-96). For this study, several diet quality scores were considered as possibilities (see Table 2), including those particularly focusing on curbing hypertension, cardiovascular disease, and improving overall health.

Below is a brief description of the two diet quality scores used---AHEI-2010 and the Fung DASH diet score---and the other diet quality measures considered. We decided to use more food-based scores given the practical applications of these research findings for providing nutrition guidance and recommendations.

Alternative Health Eating Index-2010 (AHEI-2010): The AHEI-2010 was established as an alternative to the Healthy Eating Index-2010, a score developed to measure compliance with nutrition recommendations established through the Dietary Guideline for Americans (DGA) (see more detailed description below) (93). Research suggests an association between higher AHEI-2010 scores with a lower risk for a range of chronic diseases—from CVD and diabetes to chronic obstructive pulmonary disease (6-8). The score includes 11 dietary components including total daily consumption of: fruit (excluding fruit juice) (s/d); vegetables (s/d); whole grains (s/d); sugar sweetened beverages (s/d); nuts and legumes, (s/d); red/processed meat (s/d); trans fat (% kcal/d); long-chain omega-3 fats (mg/d); polyunsaturated fats (% kcal/d); sodium (mg/d); and alcohol (drinks/d) (6). Based on available valid dietary data in NHANES, an adapted version of the score excluding trans-fat and using adapted cut offs for whole grains was used in our analysis. Ounce-equivalent USDA definitions were used for whole grains and we also utilized the USDA oz-equivalents definition for "nuts, legumes, and vegetable protein" for the "nuts and legumes" component of the score (97). All AHEI-2010 components were scored from 0 (worst) to 10

(best) based on the established criteria (See Table 3) and intermediate values were scored proportionally, with a maximum possible score of 100.

Fung DASH Score: The Fung DASH score is a quintile-, food-based dietary score assessing adherence to the DASH diet. Components of the score include total consumption of vegetables, fruit, whole grain, nuts and legumes, low fat dairy, sodium, red and processed meat, and sweetened beverages (98) (See Table 4). We used an adapted version of the score excluding the low fat dairy category based on the exceptionally low intake of low fat dairy and inability to create accurate quintile groupings. Points were awarded based on quintiles of intakes and reverse scoring was used for the sodium, red and processed meat, and sweetened beverages components of the score, with a maximum possible score of 35 (98).

Other considered scores:

HEI-2010: The Healthy Eating Index (HEI) is a measure of diet quality aimed at assessing adherence to national nutrition recommendations established by the DGA. The 2010 version includes 12 components, with 9 encouraged components and 3 components encouraged to consume in moderation. These include: total fruit, whole fruit, total vegetables, greens and beans, whole grains, dairy, total protein foods, seafood and plant proteins, fatty acids, refined grains, sodium, and empty calories (93). Dietary components are also energy adjusted to 1,000 kcal or as a percent of calories (93). A limitation of this score includes the lack of accounting for the type of protein in the total protein foods category, for example, a processed or red meat would not be counted negatively in this

category if within the category cut points. The favorable scoring of all dairy intake, without the consideration of total fat content is also a limitation. Additionally, the "empty calories" category combines added sugar, solid fat, and alcohol instead of distinguishing between them.

AHA 2020 Impact Score: A recent dietary score was developed specific to cardiovascular disease and based on the American Heart Association's 2020 Strategic Impact Goals, which has been shown to be associated with lower cardiovascular and metabolic disease risk in numerous populations (95). The score comprises of both primary and secondary components. The 5 main dietary components were total consumption of fruits and vegetables, fish and shellfish, sodium, sugar-sweetened beverages, and whole grains and the secondary dietary components were nuts, seeds, and legumes; processed meat; and saturated fat (95). Each dietary component was scored from 0 to 10 for food component that are encouraged or reversed 10 to 0 for discouraged food components. Drawbacks of using this score include the combined fruit and vegetable intake category as well as the nutrient focus on saturated fat. This component would arguably have important implications for cultures that consume plant-based saturated fat, such as that found in coconut and palm oils, which are commonly consumed in Caribbean and African countries.

Other DASH scores: There have also been numerous DASH scores to assess adherence to the DASH diet. The Folsom DASH score comprises of 11 components, including: total grain, whole grain, vegetables, fruit, dairy foods,

meats, poultry and fish, nuts, seeds, and dry beans, % kcal from fat, % kcal from saturated fat, sweets, and sodium (99). Either 1, 0.5, or zero points were awarded based on established cut points for each component of the score (99). A limitation of this score includes not distinguishing between low-fat dairy and regular dairy products, as well as not considering fats that have been shown to benefit cardiovascular health, such as poly- and mono-unsaturated fat. The score also combines meat, poultry, and fish instead of distinguishing between lean meats. For example, an individual would be penalized for consuming 4 daily servings of fish. An additional DASH score included 6 components with a range of scores from 0-6, in which a point value of either 0 or 1 was assigned based on meeting the established cut points for the score (100). These include: ≥5 servings of fruit, ≥4 servings of vegetables, 2–3 servings of low-fat or non-fat dairy products, ≤1/2 serving of sweets and ≥1 serving of whole grains, and consumption of 1–3 servings of lean meat, poultry or fish (100). A limitation of this score is the "all or nothing" approach in which intermediate intakes are not awarded points. For example, participants who consumed 4 fruit servings daily would receive the same number of points as a participant who consumed no fruit daily.

Table 2: Diet Quality Scores Considered

Item	HEI-2010	AHEI-2010	AHA 2020 Impact Goals	DASH score *(Toledo et al, 2010)*	DASH score * *(Fung et al, 2008)*	DASH score *(Folsom et al, 2007)*
Vegetables (s/d)	x	x		x	x	x
Fruit (s/d)	x	x		x	x	x
Vegetables and Fruit (s/d)			x			
Whole Fruit	x					
Variety in F&V						
Total grain (s/d)						x
Whole grain (s/d)	x	x	x	x	x	x
Refined grains (s/d)	x					
Oily fish						
Total fat (% kcal/d)						x
Sat fat (% kcal/d)						x
Trans (% kcal/d)		x				
Long-chain FA (% kcal/d)		x				
PUFA (% kcal/d)		x				
MUFA+PUFA	x					
Nuts, seeds, and dry beans					x	x
Low-fat or non-fat dairy				x	x	
Total dairy (s/d)	x					x
Processed meat (oz/d)			x			
Red/processed meat		x			x	
Lean meat, poultry, and fish				x		
Meat, poultry, fish						x
Total protein foods	x					
Seafood and plant-based	x					
Fish and shellfish			x			

Cholesterol (mg/d)						
Sodium (mg/d)	x	x				x
Added sugar (kcal/d)						
SSB and fruit juice		x				
Empty calories	x					
Sweets				x		x
Sweetened beverages			x		x	
Alcohol		x				

Table 3: Adapted AHEI-2010 Score Description

Component	Description	Criteria for minimum score (0)	Criteria for maximum score (10)
Vegetables (servings/d)	All vegetables, except white potatoes and juice	0	≥5
Fruit (servings/d)	Includes all fruit, excluding fruit juice	0	≥4
Whole grain* (% of whole grains of total grains/d)	Includes grams of whole grain in "whole grain" products	0	≥50
Sugar sweetened beverages (servings/d)	Includes soda, fruit juice, and fruit drinks, presweetened iced teas, sports drinks and energy drinks	≥1	0
Nuts, legumes, and vegetable protein* (oz equivalents/d)	Includes nuts and vegetable proteins (i.e., legumes, beans, and tofu)	0	≥1
Red/processed meat (servings/d)	Red and processed meat	≥1.5	0
Long-chain (n=3) fats (EPA+DHA) (mg/d)		0	≥250
PUFA (% kcal/d)		≤2	≥10
Sodium (mg/d)		Highest decile	Lowest decile
Alcohol (drinks/d)	Includes wine, beer, and distilled spirits		
Women		≥2.5	0.5-1.5
Men		≥3.5	0.5-2.0

*Adapted component of the score

Table 4: Fung DASH Score Description*

Component	Description	Scoring Criteria
Vegetables	All vegetables except potatoes and legumes	Q1 = 1 point
Fruit	All fruits and fruit juices	Q2 = 2 points
Whole grain	Brown rice, dark breads, cooked cereal, whole grain cereal, other grains, popcorn, wheat germ, bran	Q3 = 3 points Q4 = 4 points
Nuts and legumes	Nuts and peanut butter, dried beans, peas, tofu	Q5 = 5 points
Low fat dairy**	Low fat, fat free, and non fat milk, yogurt, cottage cheese	
Sodium	Sum of all sodium content of all foods	Reverse scoring Q1 = 5 point
Red and processed meat	Beef, pork, lamb, deli meats, hot dogs, bacon	Q2 = 4 points
Sweetened Beverages	Soft drinks, fruit drink, presweetened iced teas, sports drinks and energy drinks	Q3 = 3 points Q4 = 2 points Q5 = 1 points

*Points awarded based on quintiles of intakes
**Low fat dairy component was excluded due to exceptionally low intakes and inability to create quintiles accurately

3.1.3 Measures

Dependent Variable

The primary outcome variable includes total AHEI-2010 and Fung DASH diet scores, derived from the sum of each component score based on total intakes and quintiles of intakes, for the AHEI-2010 and DASH diet score, respectively. See Table 5 for a description of how the components were derived from variables available in the USDA FPED/MPED and nutrient data files.

Table 5: Description of score components and dietary file variables used to develop components

Component	Description	FPED/MPED/nutrient file variable name	Operationalization
Vegetables (s/d)	All vegetables, except white potatoes and juice	dr1i_v_total dr2i_v_total dr1i_v_starchy_potato dr2i_v_starchy_potato	dr1i_v_total-dr1i_v_starchy_potato
Fruit (s/d)	Excluded fruit juice	dr1i_f_whole dr2i_f_whole	dr1i_f_whole
Whole grain (% whole grain of total grain))	Includes grams of whole grain in "whole grain" products	dr1i_g_whole dr2i_g_whole dr1i_g_total dr2i_g_total	(dr1i_g_whole/ dr1i_g_total)*100
Sugar sweetened beverages	Includes soda, fruit juice, and fruit drinks, presweetened iced teas, sports drinks and energy drinks	dr1i_ssb dr2i_ssb	dr1i_ssb
Nuts, legumes, and vegetable protein (oz equivalents/d)	Includes nuts and vegetable proteins (i.e., legumes, beans, and tofu)	dr1i_pf_nutsds dr2i_pf_nutsds dr1i_pf_legumes dr2i_pf_legumes dr1i_pf_soy dr2i_pf_soy	dr1i_pf_nutsds + dr1i_pf_legumes+ dr1i_pf_soy
Red/processed meat (s/d)	Red and processed meat	dr1i_pf_meat dr2i_pf_meat dr1i_pf_curedmeat dr2i_pf_curedmeat	dr1i_pf_meat+ dr1i_pf_curedmeat
Long-chain (n=3) fats (EPA+DHA) (mg/d)	Sum of all EPA and DHA long chain fats consumed in food	dr1ip205 dr1ip226 dr2ip205 dr2ip226	(dr1ip205+ dr1ip226)*1000
PUFA (% kcal/d)	Percentage of all polyunsaturated fat of total daily caloric intake	dr1ipfat dr2ipfat dr1ikcal dr2ikcal	[(dr1ipfat * 9)/ dr1ikcal] * 100

Sodium (mg/d)	Sum of all sodium content of all foods	dr1isodi dr2isodi	dr1isodi
Alcohol (drinks/d) Women Men	Includes wine, beer, and distilled spirits	dr1i_a_drinks dr2i_a_drinks	dr1i_a_drinks
Components for DASH			
Fruit (s/d)	All fruit and fruit juices	dr1i_f_whole dr2i_f_whole dr1i_f_juice dr2i_f_juice	dr1i_f_whole + dr1i_f_juice
Whole grain (oz-equivalents/d)	Includes grams of whole grain in "whole grain" products	dr1i_g_whole dr2i_g_whole	dr1i_g_whole
Low-fat dairy (s/d)	Low fat dairy (i.e., yogurt, cottage cheese) and low fat dairy used in mixed dishes	dr1i_d_total dr2i_d_total	Inclusion criteria: fat free, low fat, non-fat, no fat in the food description of dairy containing foods

Independent Variable

The predictor variable, place of birth/nativity, was represented categorically as U.S.-born and foreign-born based upon the participants' self-responses to the survey question, "In what country were you born?" (1=foreign born; 0=US born).

3.1.4 Rationale and Operationalization of Covariates

See Table 6

Age: Research suggests that diet quality may differ by age and life stage (62, 101, 102). For example, one study utilizing NHANES data found that older adults (≥65 years) had better diet quality according to the HEI-2005 than young and middle-aged adults (18-64 years) (62). To account for these potential differences in diet quality by age, we controlled for age in all statistical models as a continuous variable (22-79 years).

Sex: Sex has also been shown to influence food choice and diet quality, with women reported to have better diet quality in comparison to men (63). Gender norms and societal perceptions of masculinity and femininity may drive these differences with western societies consistently demonstrating an association between gender and specific food components, for example the association between masculinity and meat (particularly red meat), alcohol, and large portions and the association of vegetables, fruit, fish, dairy products such as a yogurt with femininity (103, 104). Sex was therefore included in all statistical models categorically and based on self-reported information of participants reporting being a male or female (1=female, 0=male).

Education: There is literature indicating an association between higher educational attainment and diet quality (62-64, 105). One study, for example, found that study participants with a college degree or higher had higher scores for whole fruit, total vegetables, and whole grains in comparison to those with less than a high school education, who had higher scores for saturated fat and sodium

(62). We therefore controlled for education level in our analysis given our interest in examining the influence of nativity on diet quality independent of any potential differences in education level or other influencing factors.

Educational level was operationalized as a 4-level categorical variable (0= less than high school, 1=high school diploma or general equivalency diploma; 2=associates degree or some college; 3=college degree or above).

Socioeconomic status: Most studies have reported better diet quality and food purchasing behaviors in accordance with dietary guidelines among those of higher socioeconomic status compared to those of lower socioeconomic status (63, 93, 102, 106, 107). In a recent trend analysis of NHANES data from 1999 to 2010, for example, the data showed a positive association between both income and education level with total AHEI-2010 and an increase in the disparity between low and high socioeconomic during the examined time period (102). Given these observed associations, we controlled for socioeconomic status in our statistical modeling to ensure that we are examining the influence of nativity on diet quality independent of any potential differences in socioeconomic status.

We used income to poverty ratio (IPR) to represent socioeconomic status to account for inflation over the 10-year period of the pooled NHANES data. NHANES defines the IPR as a ratio of family income to the federal poverty level based on family size. IPR values range from 0 to 5 with a IPR value of 1.00 representing 100% of the federal poverty line, a value of 2 indicating 200% of the federal poverty lines, and so forth. Following convention used in other studies, we recoded the variable into 5 categories (0=<1.00, 1=1-1.99; 2=2-2.99, 3=3-

3.99, 4=4-5) for presentation in descriptive tables. IPR was included in all statistical models as a continuous variable.

Smoking: Research suggests that smoking among adults is associated with poorer diet quality and lower intake of nutrients and food components promoted to consume more of, such as polyunsaturated fats, vitamin A, fiber, and fruit (108-111). To account for this observed association, we adjusted for smoking status in our statistical models which included behavioral factors also associated with diet quality.

We categorized smoking status as never, former, and current based on participants' responses to the questions 1) "Have you smoked at least 100 cigarettes in your entire lifetime?" and 2) "Do you now smoke cigarettes?" Study participants answering "no" to both questions were categorized as "never" haven smoked, participants answering "yes" to both questions were considered "current" smokers. Study participants that answered "yes" to "have you smoked at least 100 cigarettes in your entire lifestyle?" and "no" to "Do you now smoke cigarette?" were classified as "former" smokers. The smoking status variable therefore included 3 categories (0=never; 1=former; and 2=current).

Physical Activity: Dependent on the level and intensity of physical activity, energy balance research suggests that increased physical activity influences energy and nutrient requirements (112-114). While the relationship between physical activity, appetite, diet, and diet quality are complex, we controlled for physical activity in the statistical models which included behavioral factors.

Physical activity was operationalized as engaging in moderate or vigorous levels of recreational/leisure activity for at least 10 minutes continuously or not. This operationalization was based on the questions "Over the past 30 days, did you do moderate activities for at least 10 minutes that cause only light sweating or a slight to moderate increase in breathing or heart rate?" and "Over the past 30 days, did you do any vigorous activities for at least 10 minutes that cause heavy sweating or large increases in breathing or heart rate?"

3.1.5 Statistical analysis

Statistical analysis was conducted using STATA IC Version 13.0 (115). To account for the NHANES complex sampling design, first-day survey weights were used for the analyses of individual foods and nutrients so that the results were representative of the noninstitutionalized U.S. population. All available dietary data were used for the analysis given sample size constraints, particularly for the foreign-born non-Hispanic Black length of residency analysis. A 2-sided α level of 0.05 was used to assess significance for all analysis.

Simple descriptive statistics were used to describe the sample population. Chi square analysis and t-tests were used to determine statistical significance of any differences in sociodemographic and lifestyle factors between U.S.-born and foreign-born, non-Hispanic Blacks. Length of residency descriptive statistics were adjusted for age given the trend of increasing age for each increasing length of residency category. Adjusted mean scores were established for each score and its

components. Multivariable-adjusted linear regression was used to investigate the association between nativity and diet quality for both the AHEI-2010 and DASH continuous total scores.

To assess confounding, we evaluated several regression models for the total scores analysis (see Section 3.1.3 for description of covariates). Model 1 included age and sex. Model 2 further included socioeconomic risk factors such as education level and IPR; and Model 3, the behavioral factors that might influence dietary intakes such as smoking status and physical activity. The final model, Model 4, added daily caloric intake. Given the association between education and income level and possible issues of collinearity among other covariates in the model, we ran a diagnostic test to assess for multicollinearity in the full model. The variance inflation factor (VIF) was shown to be less than 10 confirming the stability of the model. The same multivariable models were used to examine the association between length of U.S. residency and diet quality among foreign-born Blacks.

Given the non-normal distribution (See Appendix A) and large percentage of "zero" intakes for many of the components (See Appendix B), we used a multinomial polytomous logistic regression with a three-level dietary intake measure based on tertiles as the dependent variable for most of the component analysis for each score (lower intake group, medium intake group, and higher intake group) as well as the total AHEI-2010 and DASH diet scores (lower scoring group, medium scoring group, and higher scoring group). Multinomial polytomous logistic regression provides a relative risk ratio (RRR) to indicate the

ratio of the probability of being in one outcome category over the probability of being in the baseline category. Given the extremely large percentage of "zero" intakes for the alcohol component (72.4%, respectively), three-level dietary intake measures were created to designate no intakes, intakes below the median, and intakes above the median for those with non-zero intakes. The primary predictor of interest was foreign-born vs. U.S.-born and covariates included the same predictors used in the aforementioned full model. In these analyses, the lowest intake tertile (LI), lowest scoring group (LS), no intake group (NI) were designated as the base comparison categories in the relevant polytomous regression analyses. Adjusted percentages of meeting the recommended component cut points for the AHEI-2010 score were also determined.

3.2 Specific Aim 2: Hypertension

3.2.1 Study Population

We used pooled data from the 2003-2014 National Health and Nutrition Examination Survey to examine the association between nativity and high blood pressure among U.S.-born and foreign-born, non-Hispanic Blacks. See Section 3.1.1 for more information and additional details about NHANES are available elsewhere (81). Similar to Specific Aim 1, inclusion criteria for the study included those self-identified as non-Hispanic Blacks between the ages of 22-79 (see section 3.1.1 for rationale for age criteria). Exclusion criteria included those who were pregnant at the time of assessment and those <22 and ≥80 years for the reasons discussed above. We excluded pregnant participants given the prevalence of hypertension in pregnancy (preeclampsia) and our research focus on primary

hypertension outcomes and not hypertension caused by secondary factors (116, 117).

3.2.2 Measures

Dependent Variable

The primary outcome variable was categorical and defined as mean systolic blood pressure (SBP) ≥140 mm Hg or mean diastolic blood pressure (DBP) ≥90 mm Hg or being told by a doctor and health professional that he/she had high blood pressure and current treatment for hypertension with prescription medication.

In NHANES, all BP determinations (systolic and diastolic) are taken in the mobile examination center (MEC) and participants are asked questions regarding diagnosis and treatment of high blood pressure (118, 119). Upon quietly sitting for 5 minutes and once the participants' maximum inflation level (MIL) has been determined, three consecutive blood pressure readings are obtained (119). A fourth measurement may have been taken if a blood pressure measurement was interrupted or incomplete (119).

The outcome included those diagnosed with hypertension and currently taking medication and those presenting with elevated blood pressure (SBP or DSP) at the time of data collection. All available blood pressure measurements were used in this analysis to determine elevated blood pressure. Sensitivity analysis excluded the first blood pressure measurement.

Secondary outcome variables include systolic and diastolic blood pressures as continuous variables (See Appendix D).

Independent Variable

The predictor variable, place of birth/nativity, was represented categorically as U.S.-born and foreign-born based upon the participants' self-responses to the survey question, "In what country were you born?" (1=foreign born; 0=US born).

3.2.3 Explanation and Operationalization of Covariates

See Table 6

Age: The association between age and the development of hypertension is a well understood phenomenon. Research indicates that increasing age, particularly among the elderly (65 and older), is pathophysiologically associated with factors that influence high blood pressure including significantly lower cardiac output, heart rate, intravascular volume, increased stiffness of large arteries, renal blood flow, and plasma renin activity (34, 120). Additionally, this trend is particularly pronounced by greater increases in SBP in comparison to DBP among middle-aged adults (120-122). Due to the well-documented link between age and risk for hypertension, we included continuous age in years as a covariate in all models. For descriptive statistics, age was also presented in 4 categories (0=22-34 y; 1=35-49 y; 2=50-64 y; 3=65-79 y).

Sex: There are observed sex differences in hypertension outcomes, which exist in both human and animal models (123, 124). For example, research has demonstrated that men younger than 65 consistently have higher levels of hypertension compared to their female counterparts in the same age group, with these discrepancies most pronounced in early adults. One study, for example, found that among 18- to 29-year-olds, 4% of Black women and 10% of Black men reported hypertension (125). After menopause, however, the prevalence of high blood pressure in women surpasses that of men (123). These sex differences may be attributed to both biological and behavioral factors with biological factors such as sex hormones, chromosomal differences playing a role (126). Due to these documented differences, we included sex as a covariate in all statistical models.

Education: Research suggests an important association between education and hypertension, with findings indicating both systolic and diastolic blood pressures being inversely associated with education level, even after controlling for other risk factors (127). These observed differences by education level could be due to a host of related factors, such as neighborhood-based environmental factors, income, and psychosocial stressors. A Harvard University study, in fact, suggested that education levels among Blacks may better explain hypertension rates than genetics and ancestry (128). Considering the strong association between education level and hypertension, we controlled for education

in our statistical models. Educational level was operationalized as it was defined in Specific Aim 1.

Socioeconomic status: There is a well-documented relationship between income and hypertension risk with those of lower socioeconomic status shown to have a greater likelihood of developing high blood pressure than those of higher socioeconomic status (129-131). This association may be mediated by a complex relationship between income and bio-behavioral factors such as physical activity and dietary habits (130). Considering these relationships, we included socioeconomic status as a covariate in our statistical models as IPR as it was operationalized in Specific Aim 1.

Health insurance status: U.S. adults without health insurance have been shown to be less likely to get screened for chronic diseases and conditions such as hypertension and hypercholesterolemia (132, 133). Additionally, research suggests an association between health insurance status and blood pressure control, with the lack of insurance being associated with lower blood pressure control (134). Due to these associations, we controlled for health insurance status as a categorical variable, which was based on the question "Are you covered by health insurance or some kind of health care plan?"

Smoking: Smoking is a known and well-established risk factor for hypertension with research as early as the mid-20th century demonstrating this

association (66, 135). Biologically, smoking contributes to the impairment of endothelial function, leads to stiffening of the arteries, inflammation, and ultimately acceleration of the atherothrombotic process (66, 136). We therefore controlled for smoking status in the statistical model which included behavioral factors. We operationalized smoking status as described for Specific Aim 1.

Physical Activity: Physical activity is a modifiable, behavioral risk factor for hypertension (67). Recent research among African Americans/Blacks in the Jackson Heart Study in particular suggest that regular moderate–vigorous physical activity or sport/exercise-related physical activity may lower hypertension risk among Blacks (16). Considering these associations, we controlled for physical activity in all statistical models including behavioral factors. We operationalized physical activity categorically similar to our definition in Specific Aim 1.

Body Mass Index: Research shows that Body Mass Index (BMI) is independently associated with hypertension as well as other chronic diseases and conditions (127, 137). Specific to BMI and hypertension risk among various ethnic groups, a recent study demonstrated that non-Hispanic Blacks had a higher prevalence of hypertension compared to both non-Hispanic Whites and Mexican Americans at every BMI level (138). We therefore considered BMI in the full statistical models. BMI was included in the analysis as a continuous variable and for the descriptive tables presented categorically as normal (18.5-24.9 kg/m^2), overweight (25-29.9 kg/m^2), and obesity ($\geq$30.0 kg/m^2).

Other considered covariates:

Waist circumference: A broad body of evidence suggests a strong association between waist circumference and hypertension risk independent of obesity and other anthropometric measurements (139-143). Waist circumference has also been shown to be a better predictor of overall cardiovascular disease risk (144). Given this literature, we explored using waist circumference as a covariate in our modeling instead of BMI. After performing sensitivity analysis and seeing no difference in our study result, we decided to use BMI in our models (See Appendix E).

Marital status: An additional possible social predictor of hypertension explored as a covariate in this statistical analysis includes marital status (145-147). Research suggests a relationship in marital status and health outcomes, with married people more likely to experience positive mental and physical health (147). One study, for example, found that men who had never been married had a higher risk for elevated SBP and DBP compared to married men, with the authors concluding differences in psychological status, dietary intake, and economical consideration potentially playing a role in these observed differences (145). The research findings are not as consistent among African Americans—one study found hypertension to be significantly associated with being single for women, however, this association was mitigated once demographic and health status variables were included in the fully adjusted statistical modeling (148).

In a preliminary statistical model, we included marital status in the categories of married, previously married (divorced, separated, widowed), single living with partner, and never married. For parsimony and adequate power of the models, we excluded marital status in the final analysis (See Appendix E).

Alcohol intake: Research has demonstrated a well-established link between heavy alcohol consumption and increased risk for hypertension (149, 150). A recent systematic review confirmed these associations by showing a dose dependent association between lower alcohol and lower blood pressure risk (149). Given the challenges of validly operationalizing alcohol intake, we omitted alcohol as a covariate in our statistical modeling and note this as a limitation of our analysis. Specifically, it is questionable whether the 24-hr recall data represents usual alcohol intake. Additionally, self-reported alcohol use data from the alcohol questionnaire may not accurately reflect actual alcohol intake. Specifically, this self-reported data is subject to recall bias given that participants are asked about alcohol intake over the past 12 months and probed for the number of drinks consumed per day, per week, per month, and per year, which assumes a level of consistency in drinking habit throughout the year. These responses are also subject to social desirability bias, in which subjects respond based on what is perceived as socially desirable (151).

Sodium intake: Sodium intake has been implicated in playing a role in the development of primary hypertension based on research as early as the mid-1950's and research has shown reductions in sodium intake to be associated with

reductions in both SBP and DBP (60, 152, 153). Given this evidence, we considered including sodium as quintiles, however, due to differences in how sodium intake was assessed between the various waves of NHANES, we decided to exclude this as a covariate. Specifically, we would have had to exclude the 2013-2014 cohort of data since the 2013-2014 FPED/MPED files were unavailable which would have comprised the statistical power of our models.

Table 6: Operationalization of Variables

Variable	Specific Aim	Operationalization	NHANES basis
Dependent/Outcome			
AHEI-2010 diet score	1	Continuous variable, max score 100 points	USDA FPED/MPED and nutrient files
DASH diet score	1	Continuous variable, max score 40 points	USDA FPED/MPED and nutrient files
Hypertension risk	2	Binary variable representing having HTN=1 or not having HTN=0 HTN: mean systolic blood pressure (SBP) ≥140 mm Hg or mean diastolic blood pressure (DBP) ≥90 mm Hg or [being told by a doctor or health professional that he/she had high blood pressure and current treatment for hypertension with prescription medication] Continuous variable representing systolic and diastolic BP	SBP and DBP: All available readings (up to four) Have you ever been told by a doctor or health professional that you had hypertension/high blood pressure? Current medication use for high blood pressure
Independent/Predictor			
Nativity	1, 2	Binary variable representing place of birth/nativity; US born=1, foreign born=0	In what country were you born?
Length of residency	1, 2	Categorical variable: <10 years, 10-19 years, 20-29 years, ≥30 years	Length of time in the U.S.
Covariates			
Sex	1, 2	Binary variable to represent a subject's gender;	Gender of the sample person

		1=female, 0=male	
Age	1, 2	Continuous variable, 22-79	Age in years of sample person at the time of screening; individuals 80 and older are top coded at 80
Income:Poverty ratio	1, 2	Continuous variable: 0-5 Categorical variable in descriptive statistics, <1.00=1, 1-1.99=2, ≥3.00=3	A ratio of family income to poverty threshold and based on reported total annual family income
Education Level	1, 2	Categorical variable: less than high school; high school diploma or general equivalency diploma; associates degree or some college; college degree or above	What is the highest grade or level of school you have completed or the highest degree received?
Health insurance	2	Categorical variable, y/n health insurance	Are you covered by health insurance or some kind of health care plan?
Physical activity	1, 2	Categorical variable, y/n engagement in moderate or vigorous physical activity	Over the past 30 days, did you do moderate activities for at least 10 minutes that cause only light sweating or a slight to moderate increase in breathing or heart rate? Over the past 30 days, did you do any vigorous activities for at least 10 minutes that cause heavy sweating or large increases in breathing or heart rate?"

Smoking status	1, 2	Categorical variable; Never smoked=1, Former smoker=2, Current smoker=3	Have you smoked at least 100 cigarettes in your entire lifetime? Do you now smoke cigarettes?
BMI	2	Categorical variable;, Normal (18.5-24.9)=2, Overweight (25-29.9)=3, Obese (≥30.0)=4	Weight and standing height measurements
Other considered covariates			
Sodium intake	1	Quintiles of average daily sodium intake	USDA FPED/MPED and nutrient files
Marital status	2	Categorical variable: married, previously married (divorced, separated, widowed), single living with partner, and never married	Marital status
Waist circumference	2	Continuous variable	Waist circumference measurement

3.2.4 Statistical Analysis

All statistical analysis were conducted using STATA IC Version 13.0, with appropriate adjustments taken for the complex survey design (115). Simple descriptive statistics were used to describe the sample population. Age adjustments were made for the length of residency descriptive statistics. Multivariate logistic regression was used to measure the association between the hypertension (yes/no) and nativity. Progressive multivariate logistic regression models were run including full, reduced, and crude models.

Model 1: Demographic Covariates

Logit HTN_YN = β_o + β_1 placeofbirth + $\beta_2 sex$ + $\beta_3 age$ + u

Model 2: Demographic + Socioeconomic Covariates

Logit HTN_YN = β_o + β_1 placeofbirth + $\beta_2$sex + $\beta_3$age + β_4 *IPratio* + $\beta_5 educ$ + $\beta_6 HealthInsurance$ + u

Model 3: Demographic + Socioeconomic + Health Risk Covariates

Logit HTN_YN = β_o + β_1 placeofbirth + $\beta_2$sex + $\beta_3$age +β_4 IPratio + $\beta_5$educ + $\beta_6 HealthInsurance$ + $\beta_8 PAstatus$ + u

Model 3: Demographic + Socioeconomic + Health Risk Covariates + BMI

Logit HTN_YN = β_o + β_1 placeofbirth + $\beta_2$sex + $\beta_3$age +β_4 IPratio + $\beta_5$educ + $\beta_6 HealthInsurance$ + $\beta_8 PAstatus$ + $\beta_9 BMI$ + u

Model 1 included demographic covariates such as age and sex. Model 2 added the demographic variables as well as the socioeconomic variables, education level, IPR, and health insurance status. Model 3 included demographic, socioeconomic and health risk variables, such as smoking status, and physical activity. The full model, Model 4, added BMI. We confirmed in sensitivity analysis that results were not appreciably different after adjusting for waist circumference (See Appendix E). We additionally evaluated marital status in a preliminary model, but omitted it for parsimony as it did not appreciably alter the findings (See Appendix E).

Additional sensitivity analysis was conducted by excluding the first blood pressure reading, and the final results and conclusions were shown not to differ from when using all available measurements (See Appendix F). We therefore used all available measurement data in our final analysis given our sample size constraints for the length of residency analysis among foreign-born, non-Hispanic Blacks. Additionally, according to one study, just one BP measurement was adequate to diagnose hypertension since <0.5% were reclassified as hypertensive after the first BP reading (154, 155). The researchers further added the importance of additional measurements to verify the initial elevated readings, which confirms our methodology to use all available blood pressure data (155). Also, post hoc exploratory analysis were conducted to examine potential gender and age influences, in which separate models were performed for each gender and for subjects <65 years and ≥65 years (See Appendix G).

3.3 Specific Aim 3: Qualitative

3.3.1 The Importance of the Qualitative Approach

This qualitative study used in-depth interviews and focus groups (FGs) with a diverse group of Blacks living in Boston Massachusetts, United States. This methodology was chosen because it allowed us to examine study participants' self-described perceptions of how their culture influences their diet and, for those born outside of the U.S., what factors they felt influenced any dietary changes that occurred since migrated to the U.S.

There are many benefits to utilizing qualitative methods alongside quantitative approaches, particularly in research related to human behavior. Qualitative methodology specifically allows for a deeper analysis about individuals' perceptions of their experiences—details that are masked in quantitative methodologies. Specific to our main research question exploring the diversity in the Black population as this relates to diet, qualitative methods can elaborate on why quantitative differences might exist and the potential cultural and social drivers that are not captured in the quantitative data. Use of both quantitative and qualitative methods is therefore an appropriate and comprehensive approach for this dissertation research.

3.3.2 Study Population and Recruitment

Tufts University Health Sciences Institutional Review Board approved all study procedures. A purposive sample was recruited by the placement of

promotional flyers and on-site recruitment at community-based organizations and on-site tabling at community events in Roxbury, South Dorchester, and Mattapan---predominately Black/African American neighborhoods in Boston. According to a 2010 report released in collaboration between Tufts University, Boston NAACP, Urban League of Eastern Massachusetts, and the William Monroe Trotter Institute, these neighborhoods range from having 55% to up to 76% of Black residents (156). Flyers were placed in community libraries (Codman Square Library, Mattapan Public Library, Dudley Street Library), community centers, and institutions serving our target demographic (See flyer in Appendix H). Partnering community organizations that were more integral in the recruitment process (i.e., tabling at center, email blasts, etc.) included:

- Healthworks Community Fitness, http://healthworkscommunityfitness.org/
- Somali Development Center, http://sdcboston.org/
- African Community Health Initiatives, http://africancommunityhealthinitiatives.org/

The research manager screened potential participants who expressed initial interest in the research study by telephone or in-person. Inclusion criteria included: self-identified as Black/African American, age 40-70 years, English-speaking, and born in either the U.S., countries throughout the Caribbean/Latin America, or countries throughout Africa.

Given the influence of children on foods served in the household and the study's major focus on the role culture influences diet, exclusion criteria included those having children under the age of 18 living in the household. In the research literature, there is also limited focus among middle age adults and with the aging population, the diet of this target audience will also be increasingly important.

Initial targets for recruitment included 20 U.S.-born Blacks, 20 Caribbean/Latin American-born Blacks, and 20 African-born Blacks. Participants either participated in a 60-minute in-depth interview by phone or a 90-minute FG for a target of 4 in-depth interviews and 2 FGs for each place of birth category. All participants received a $50 Visa gift card for participation and were either randomly assigned to participate in an in-depth interview or FG. Several (n=4) participants assigned to focus groups had time barriers to participation and were interviewed instead.

3.3.3 Methods

Prior to the in-depth interview or FG, each participant read a research participant information sheet and gave verbal consent to participate in the study. Participants then completed a brief questionnaire, which included questions related to sociodemographic factors, place of birth, year and age of migration, and cooking and eating habits (See Appendix I for Research Participant Information Sheet and Appendix J for initial intake questionnaire). For the in-depth interviews, participants completed the questionnaires via the online Qualtrics survey software.

A semi-structured discussion guide was developed, informed by the Satia-Abouta model of dietary acculturation (12), and then reviewed and revised by the study team. The discussion guide was pilot tested with one focus group and refined to improve clarity and flow (See final facilitator guides in Appendix K). Four focus groups were held at the Codman Square Library in Dorchester and one focus group was held at the Somali Development Center in Jamaica Plain. All focus groups were held in the evenings to accommodate the schedules of the study participants.

3.3.4 Qualitative Analysis

All in-depth interviews and FGs were digitally recorded and preliminary transcription was conducted using an online transcription software, speechmatics (https://www.speechmatics.com) (157). Four graduate research assistants then manually reviewed and finalized the transcripts. Data were analyzed using inductive thematic analysis (158). In qualitative methodology, the data analysis process is typically carried out either deductively or inductively. In thematic analysis, identified themes are based on the data and patterns that emerge from the data (159). Conversely, deductive thematic analysis is more theory driven in which the themes are based on predetermined concepts driven by the theoretical framing (159).

For our analysis, the team first developed the initial codebook based on both the major topics covered in the FGs and in-depth interviews as well as emergent themes and comments that were common among the in-depth interview

and FG transcripts. The codebook was refined based on coding an initial transcript and discussion among study team members (See Appendix L for codebook). Inter-coder reliability was then established by randomly selecting one transcript per type of in-depth interview or FG and comparing codes between the lead analyst (AGB) and the graduate research assistants. For any codes that failed to achieve 80% agreement or better, researchers met to discuss discrepancies and further refined the codebook to clarify code definitions. NVivo 10 software was utilized to assist in the coding and analysis process (QSR International, Australia) (160).

To analyze the data, matrix coding queries were run based on characteristics, such as region of birth, education, income, and among foreign-born participants, length of residency and age of migration. Specifically, the matrix coding queries included:

- Food Components and Region of Birth
- Change in Diet and Region of Birth
- Change in Food Components and Region of Birth
- Influencers of Change and Region of Birth
- Knowledge, Diet, and Disease, and Region of Birth
- Barriers and Region of Birth
- Income (Influences food purchases, adaptations, food program participation) and Region of Birth
- Age of Immigration of Cultural Influences
- Change in Diet and Length of Residency

- Education and Influencers of Change
- Education level and Cultural Influences
- Income and Influencers of Change
- Income and Cultural Influences
- Preferences and Values and Region of Birth

Based on patterns and counts within the matrix coding queries, we finalized the themes that emerged from the data and examined differences by characteristics.

Chapter 4: Diet quality differs based on nativity among U.S. non-Hispanic Blacks: NHANES 2003-2012 data

Abstract

BACKGOUND: Non-Hispanic Blacks in the U.S. are less likely to meet national dietary recommendations than Whites. However, within the non-Hispanic Black population, most studies fail to consider heterogeneity, particularly nativity. *METHODS*: Using the Alternative Healthy Eating Index-2010 (AHEI-2010) and DASH scores, we compared diet quality between U.S.-born (n=3,837) and foreign-born (n=406), non-Hispanic Black adults aged 22-79y, based on pooled nationally representative data (NHANES 2003-2012); as well as by length of U.S. residency among foreign-born Blacks. Multivariable-adjusted regression, controlling for demographic, socioeconomic, and behavior covariates, was used to investigate the association between nativity and total diet quality scores. We performed multinomial (polytomous) logistic regressions predicting three-level dietary intake measures based on tertiles (lower intake group, LI; medium intake group, MI; and higher intake group, HI) of the total scores and their components. *RESULTS*: Foreign-born Blacks had significantly higher AHEI-2010 (β 9.2,95% CI, 7.4,11.0) and DASH diet (β 3.1, 95% CI, 2.4, 3.7) scores compared to U.S-born Blacks, and more favorable intakes for many of the score components. Among foreign-born Blacks, diet quality did not significantly differ by length of residency. Results of the multinomial logistic regression suggest that foreign-born Blacks were more likely to be in the higher intake than the lower intake group for fruits (including and excluding fruit juice; RRR 2.35, 95% CI 1.63, 3.37; RRR 2.82, 95% CI 1.82, 4.39), vegetables (excluding starchy vegetables) (RRR 1.56, 95%CI 1.13, 2.16), % whole grains (RRR 2.31, 95%CI 1.59, 3.36), and omega-3 fatty acids (RRR 1.88, 95%CI 1.31, 2.71). *CONCLUSIONS*: Foreign-born non-Hispanic Blacks have higher diet quality scores compared to their U.S.-born counterparts. Considering nativity among U.S. non-Hispanic Blacks in nutrition research and public health efforts may improve accuracy of characterizing dietary intakes and facilitate development of targeted nutrition interventions to reduce diet-related diseases in the diverse non-Hispanic Black population in the U.S.

Key Words: diet quality, dietary intake, health disparities, immigrants, foreign-born, Blacks/African Americans, place of birth/nativity, length of residency, NHANES, acculturation

4.1 Introduction

In the United States, non-Hispanic Blacks are generally reported to have poor diet quality and not meet national dietary recommendations, such as the Dietary Guidelines for Americans (61-64). For example, studies have shown intakes of total vegetables, whole grains, milk, dietary fiber, potassium, and calcium to be lower than Whites (61-65). Relatedly, Blacks also have among the highest rates of morbidity and mortality from diet-related diseases such as hypertension, heart disease, and stroke in comparison to other racial/ethnic groups in the U.S. (1, 3). However, a major limitation of the epidemiological data is the lack of consideration regarding heterogeneity within the U.S. Black population, particularly accounting for nativity. For example, while some Blacks were born in the U.S. and have roots in the sociopolitical system of slavery in the U.S., others are long-standing or recent immigrants of African descent from places such as Africa and the Caribbean. Specifically, the population of immigrant groups has markedly increased since the passage of the Immigration and Nationality Act of 1965, which lifted the quotas based on country of origin and replaced them with an immigration system based on family re-unification and employment (23, 24). Combined, Caribbean-born and African-born self-identified Black immigrants make up an estimated 8.7% of the U.S. Black population and the Census Bureau projects that by 2060, 16.5% of U.S. Blacks will be foreign born (23-25). Moreover, immigration statistics suggest that the influx of Black immigrants

represent a diverse array of countries of origin (i.e., Nigeria, Ethiopia, Ghana, Jamaica, Trinidad and Tobago), which would deepen the heterogeneity of cultures and lifestyle patterns, particularly food preferences and diet quality (161).

While there is considerable cultural and ethnic diversity based on place of birth in the U.S. Black population, limited nutrition research has explored this topic (74, 76-79, 162-164). One study that compared the diets of African Americans and Haitian Americans with and without type 2 diabetes found Haitian Americans had significantly higher Alternate Healthy Eating Index-2010 (AHEI-2010) scores than the African American participants (74). Another study comparing non-Hispanic Blacks born in the U.S. to Hispanic and non-Hispanics Blacks born outside of the U.S. found that both groups of foreign-born Blacks had lower intakes of total energy and all types of fat, as well as higher intakes of fiber, vitamin C, potassium , and other essential nutrients (163). A limitation of the study, however, is the focus on nutrients instead of food groups, which has wider implications for practical nutrition recommendations. In both studies, authors emphasized the importance of disaggregating ethnicities and considering nativity when assessing diets (74) (163).

Most of the research exploring dietary differences based on place of birth of those of African descent are based in Europe (162). Studies in the U.K. have explored the diets of British Afro-Caribbean populations (76-79). One study of Afro-Caribbean subjects, mostly of Jamaican origin, concluded that dietary modification suggestions for diet-related diseases such as obesity, diabetes, and hypertension need to consider cultural contexts (78). The authors emphasized that

immigrants from the Caribbean were born in different countries, each with unique food habits and dietary patterns that persist in first and later generations after immigration. A similar study described the wide range of dietary habits and foods consumed by British Afro–Caribbean populations. (79). The only known study in the U.S. that qualitatively compared the diets of Afro-Caribbean and African American women identified cultural variations in traditions of food and food preparation between the two different groups (80).

Conversely, considerably more research has examined the health and health behaviors among Asian and Hispanic immigrant groups in the U.S., providing support for the healthy immigrant hypothesis (33, 37). This hypothesis posits that immigrant groups have more favorable health behaviors, risk factors, and family support that are associated with lower risk for a variety of chronic diseases and poor health outcomes (165, 166). There is also evidence that recent immigrant groups are healthier than those residing in the U.S. for longer periods due to acculturation, possibly resulting in the adoption of less unhealthy eating and lifestyle behaviors (167-169). Very few large studies have examined the association between nativity, length of residency, and health outcomes and health behaviors among non-Hispanic Blacks.

The aim of the present study was to compare diet quality between foreign-born and U.S.-born, non-Hispanic Blacks using the AHEI-2010 and DASH diet scores. We hypothesized that foreign-born Blacks would have higher diet quality scores for either index compared to their U.S.-born counterparts; and that among

foreign-born Blacks, longer lengths of residency would be associated with poorer diet quality scores.

4.2 Methods

4.2.1 Data Source, Study Population, Dietary Assessment

This research study used pooled data from the 2003-2012 National Health and Nutrition Examination Survey (NHANES), a nationally representative health and nutrition survey of the non-institutionalized U.S. population (81). The survey includes demographic, socioeconomic, and health- and diet-related questions and is carried out through complex, stratified, multistage probability sampling. NHANES dietary intake data is based on up to two 24-hr recall data, in which the food and beverages consumed during the 24-hour period (midnight to midnight) is assessed to estimate intakes of energy, macronutrients, micronutrients, and food group components from the foods and beverages consumed (88, 89). The first day is collected in the Mobile Examination Center (MEC) and data for the second day is collected by telephone 3 to 10 days later (88, 89). The NHANES protocol was approved by the National Center for Health Statistics Research Ethics Review Board and all participants provided informed consent. Additional details about NHANES are available elsewhere (6-9).

The primary analysis was restricted to those who self-identified as non-Hispanic Black between the ages of 22-79 not known to be pregnant at the time of the examination, and had data necessary to determine diet quality scores from at least one valid 24-hr recall (N=4,243). To account for the average age of college-

level educational attainment the lower age limit was set at ≥22 years. Because the age variable in NHANES is top coded at 80 years, the upper age limit was set at <80 years. Use of all available recall data provided unbiased estimates for population means for our sample. Caloric intakes of ≤600 kcal and ≥ 4800 kcal were excluded from the analysis due to implausibility (n=103 and n=99 subjects excluded, respectively).

4.2.2 Diet Quality

Diet quality scores have been designed based on reducing risk for specific diseases and conditions (i.e., Dietary Approaches to Stop Hypertension, DASH, scores, AHA 2020 Impact Score) and evaluating adherence to diets (MDQI Mediterranean Diet Quality Index) and national dietary recommendations to promote overall health and reduce general disease risk (HEI-2005, HEI-2010, AHEI-2010) (6, 93-96). For this diet quality comparison study, we used the revised AHEI-2010 and revised Fung DASH diet scores given their food-based approach and research demonstrating their association with cardiovascular disease risk---a leading cause of mortality and morbidity among U.S., non-Hispanic Blacks. Additionally, the quintile-based approach of the Fung DASH diet score allowed us to account for low intakes (i.e., skewed intakes) of recommended food groups.

Revised AHEI-2010 Score: The AHEI-2010 was established as an alternative to the Healthy Eating Index-2010, a score developed to measure compliance with nutrition recommendations based on the 2010 Dietary Guideline for Americans (DGA) (93, 94). Research suggests an association between higher

AHEI-2010 scores with a lower risk for a range of chronic diseases—including CVD, diabetes and chronic obstructive pulmonary disease (6-11). Based on available valid dietary data in NHANES, a revised version of the score excluding trans fat and adapted cut offs for whole grains was used. The 10 dietary components of the score include total daily consumption of: fruit (excluding fruit juice) (s/d); vegetables (excluding white potatoes) (s/d); whole grains (oz-equivalents/d); sugar sweetened beverages (s/d); nuts, legumes, and vegetable protein (oz-equivalents/d); red/processed meat (s/d); long-chain omega-3 fats (mg/d); polyunsaturated fats (% kcal/d); sodium (mg/d); and alcohol (drinks/d). USDA definitions were used for whole grains and the nuts, legumes, and vegetable protein components of the score (97). All AHEI-2010 components were scored from 0 (worst) to 10 (best) based on the established criteria (see Table 3) and intermediate values were scored proportionally, with a maximum possible score of 100.

Revised DASH Score: The Fung DASH score is a quintile-, food-based dietary score assessing adherence to the DASH diet, a diet developed as a dietary approach to prevent and treat hypertension (5, 98). Components of the revised score included vegetables, fruit, whole grain, nuts and legumes, sodium, red and processed meat, and sweetened beverages (98). The low-fat dairy component in the original score was eliminated due to exceptionally low intakes among the study cohort (See Figure 2), which has also been documented in other studies (170). Points awarded based on quintiles of intakes and reverse scoring were used

for the sodium, red and processed meat, and sweetened beverages, with a possible maximum score of 35 (See Table 4).

4.2.3 Main Exposure Variable and Covariates

The main exposure of interest was place of birth or nativity, represented categorically as U.S.-born versus foreign-born based upon the participants' self-response to the survey question "In what country were you born?". Naturalized citizens, permanent residents, undocumented immigrants, international students, and guest workers were included in the foreign-born category, and anyone born in the 50 U.S. states and the District of Columbia were considered U.S.-born. Additional information on place of birth among immigrants was not publicly available in NHANES, and risk for disclosure presented as a barrier for use of this data. We additionally examined the potential association of length of residency among foreign-born Blacks and hypertension. The 9-category question on length of residency asked by NHANES was recoded into 4 levels, due to sample size constraints, and following other studies on immigration, acculturation, and health (75, 81, 168, 169, 171, 172).

To minimize confounding by other factors, covariates in the analysis included age (years, continuous), sex (male/female), educational attainment (<high school or general equivalency diploma, associate degree or some college, or ≥college degree), family income to poverty ratio (IPR, 0-5, continuous), smoking status (never, former, current), physical activity (self-reported moderate or vigorous levels of recreational/leisure activity for at least 10 minutes

continuously over the past 30 days, yes/no), and daily energy intake (kcal/d, continuous).

4.2.4 Statistical Analysis

Statistical analysis was conducted using STATA IC Version 13.0, with use of sampling weights for the complex survey design so that the results were representative of the noninstitutionalized U.S. population (115). Chi square analysis and t-tests were used to determine statistical significance of any differences in sociodemographic and lifestyle factors between U.S.-born and foreign-born Blacks. Descriptive statistics by length of residency category were age adjusted.

Multivariable-adjusted linear regression was used to investigate the association between nativity and diet quality for each respective continuous total score. To address possible confounding, we performed several regression models. Model 1 included age and sex. Model 2 further included socioeconomic risk factors such as education level and IPR; and Model 3, the behavioral factors that might influence dietary intakes such as smoking status, physical activity. Model 4, the full model, added daily energy intake. We considered a two-tailed $p<0.05$ for statistical significance in all analyses. The same multivariable-adjusted linear regression models were used to examine the association between length of U.S. residency and total diet quality scores among foreign-born, non-Hispanic Blacks.

Given the non-normal distribution and large percentage of "zero" intakes for many of the components (See Appendices A and B and Figure 2), we used a multinomial polytomous logistic regression with a three-level dietary intake measure based on tertiles as the dependent variable for most of the component analysis for each score (lower intake group, medium intake group, and higher intake group) as well as the total AHEI-2010 and DASH diet scores (lower scoring group, medium scoring group, and higher scoring group). Specifically, the multinomial polytomous logistic regression provides a relative risk ratio (RRR) to indicate the ratio of the probability of being in one outcome category over the probability of being in the baseline category. Given the extremely large percentage of "zero" intakes for the low-fat dairy and alcohol components (78.3% and 72.4%, respectively), three-level dietary intake measures were created to designate no intakes, intakes below the median non-zero intakes, and intakes above the median non-zero intakes. The primary predictor of interest was foreign-born vs. U.S.-born and covariates included the same predictors used in the aforementioned full model. In these analyses, the lowest intake tertile, lowest scoring group, no intake group were designated as the base comparison categories in the relevant polytomous regression analyses. Adjusted percentages of meeting the recommended component cut points for the AHEI-2010 score were also determined.

4.3 Results

4.3.1 Population Characteristics

The study population included 4,243 non-Hispanic Blacks, including 3,837 U.S.-born and 406 foreign-born (Table 7). Compared to non-Hispanic, U.S. born Blacks, more foreign-born Blacks were male ($p<0.05$), attained a higher level of educational ($p<0.001$), were classified as normal and overweight ($p<0.001$), had never been a smoker ($p<0.001$), engaged in physical activity ($p<0.001$) and had lower energy intake ($p<0.001$). For example, 29.0% of foreign-born, non-Hispanic Blacks completed a college degree or higher compared to 15.3% U.S.-born Blacks, 30.1% of foreign-born Blacks were classified as obese compared to 49.5% U.S.-born Blacks, and 76.3% foreign-born Blacks never smoked compared to 54.0% of U.S.-born Blacks. Age-adjusted sociodemographic and health characteristics of foreign-born Blacks by length of residency category are also shown in Table 7. In comparison to those who were in the U.S. for <10 years, a greater percentage of foreign-born Blacks who were in the U.S. for ≥30 years were categorized as current smokers ($p<0.05$; 14.8% vs. 5.0%, respectively), had higher income ($p<0.001$; IPR of 4-5: 43.5% vs 7.9%, respectively), and had a college degree or higher ($p<0.05$; 39.4% vs. 18.3%, respectively). Conversely, more participants residing in the U.S. for <10 years compared to those residing in the U.S. ≥30 years reported having health insurance ($p<0.05$; 45.1% vs. 16.0%). Foreign-born Blacks residing in the U.S. for ≥30 years reported more daily energy intake in comparison to those residing in the U.S. for <10 years (2,091 kcal/d vs. 1,735 kcal//d), however these differences were not statistically significant.

Table 7: Demographic characteristics and health behaviors among non-Hispanic Blacks by nativity and U.S. length of residency among foreign-born, non-Hispanic Blacks, pooled NHANES 2003-2012

	All Non-Hispanic Blacks						
				Foreign-born non-Hispanic Blacks*			
	U.S.-born (n=3,837)	Foreign-born (n=406)	p value	<10 years (n=105)	10-19 years (n=98)	20-29 years (n=88)	≥30 years (n=105)
Female, %	55.3	47.5	0.05	47.9	47.2	51.1	46.3
Age, y mean (SE)	45.3 (0.4)	44.7 (0.8)	0.51	38.6	41.7	48.1	53.5
Educational attainment, %							
< High School	25.1	18.3	<0.001	29.6	16.3*	12.1*	13.3*
High School or equivalent	26.1	21.1		31.3	22.0	16.6	14.0
Some college	33.6	31.5		24.1	29.3	42.5*	36.9
≥ College degree	15.3	29.0		18.3	32.5*	30.5*	39.4*
Income: Poverty Ratio, Mean (SE)	2.4 (0.06)	2.5 (0.1)	0.18	2.0 (0.1)	2.3 (0.2)	3.1 (0.2)**	3.1 (0.2)**
< 1.00, %	24.2	19.0	0.34	21.1	21.2	14.1	17.9
1-1.99, %	26.2	23.9		39.1	25.9	12.2*	15.2*
2-2.99, %	16.3	21.2		23.5	23.2	23.2	14.7
3-3.99, %	12.3	14.0		10.1	14.4	19.7	10.1
4.00-5.00, %	21.1	22.0		7.9	15.6	31.7**	43.5**
Health insurance, %	74.9	72.3	0.54	45.1	23.2*	20.7*	16.0**
Body Mass Index, kg/m^2 Mean (SE)	31.1 (0.2)	28.1(0.4)	<0.001	26.7 (0.4)	27.9 (0.6)	29.4 (0.8)*	28.8 (0.9)*
Normal weight (18.5-24.9), %	20.5	26.2	<0.001	31.2	24.1	22.3	26.6
Overweight (25-29.9), %	28.3	42.5		46.2	44.6	38.9	39.3
Obesity (≥30), %	49.5	30.1		20.3	30.7	38.4*	32.0
Energy intake, kcal/d Mean (SE)	2095 (19)	1898 (41)	<0.001	1735 (80)	1871 (62)	1999 (94)	2091 (122)
Smoking status, %							
Never	54.0	76.3	<0.001	81.4	84.1	75.3	63.7

Former	17.1	15.2		8.1	8.1	13.8	22.0
Current	29.0	8.5		5.0	7.6	11.5	14.8*
Moderate or vigorous physical activity**, %	46.7	53.6	0.01	47.9	54.5	53.2	58.0

*With the exception of age, figures presented were age adjusted; significance presented is for difference from <10 years length of residency reference category; significance presented *p<0.05 **p<0.001

**Based on self-report of engaging in moderate and/or vigorous leisure/recreational physical activity for at least 10 minutes over the

Figure 2: Percentage of no intakes of U.S.-born and foreign-born, non-Hispanic Blacks

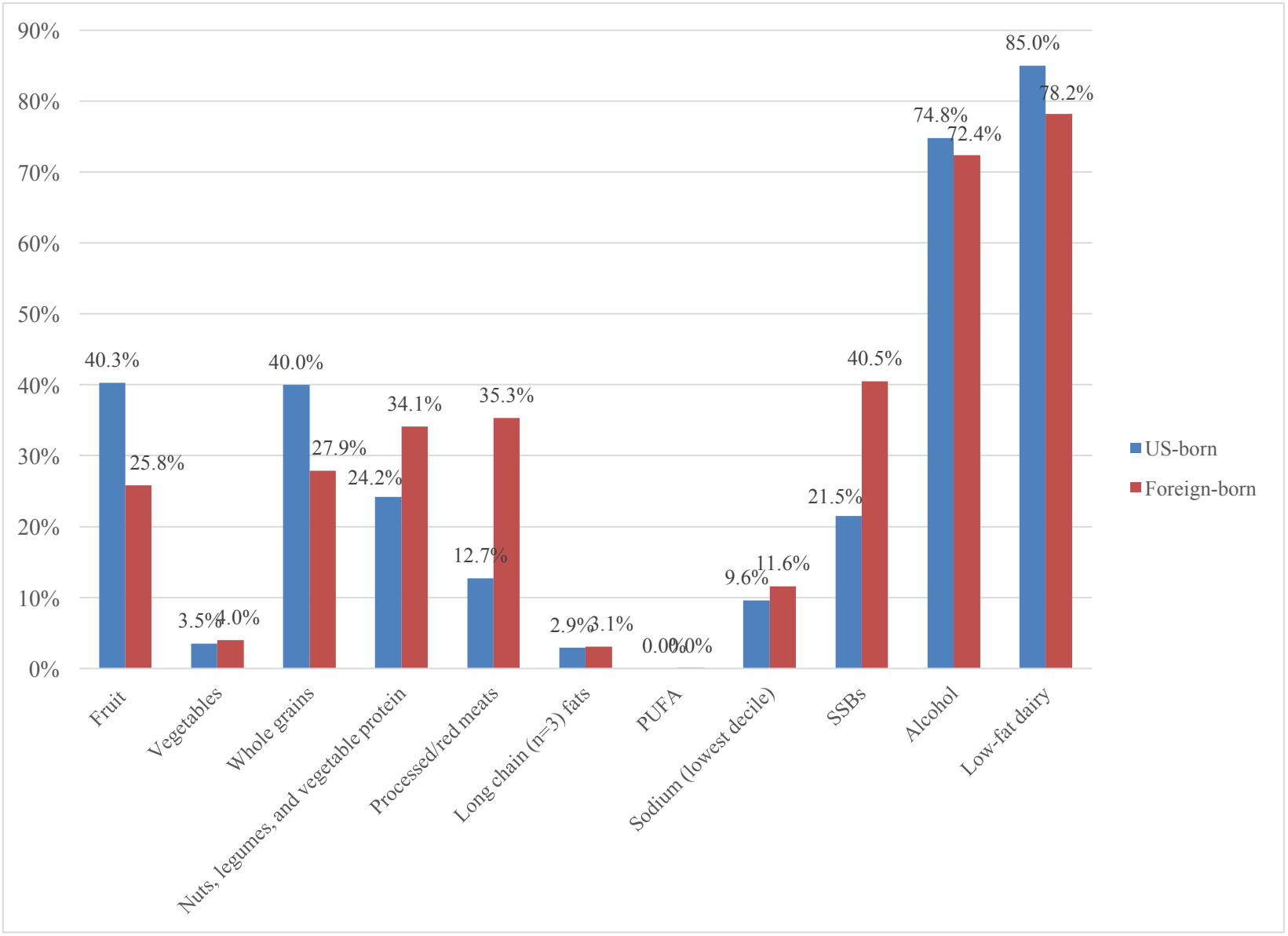


Table 8: Prediction for AHEI-2010 and DASH scores for U.S.-born compared to foreign-born, non-Hispanic Blacks, pooled NHANES 2003-2012

	Model 1 Age + Sex		Model 2 + Education + Poverty:Income		Model 3 + Smoking Status + Physical Activity		Model 3 + Smoking Status + Physical Activity + Energy intake	
Variables	β	95% CI	β	95% CI	β	95% CI	β	95% CI
AHEI-2010 Score [a]	10.8**	9.1, 12.5	10.1**	8.2, 11.9	9.7**	7.9, 11.6	9.3**	7.5, 11.1
DASH Score [b]	3.9**	3.3, 4.5	3.5**	2.9, 4.2	3.2**	2.6, 3.9	3.1**	2.5, 3.7

[a] Maximum AHEI 2010 Diet score is 100 points
[b] Maximum DASH Diet score is 35 points

*p<0.05, **p<0.001

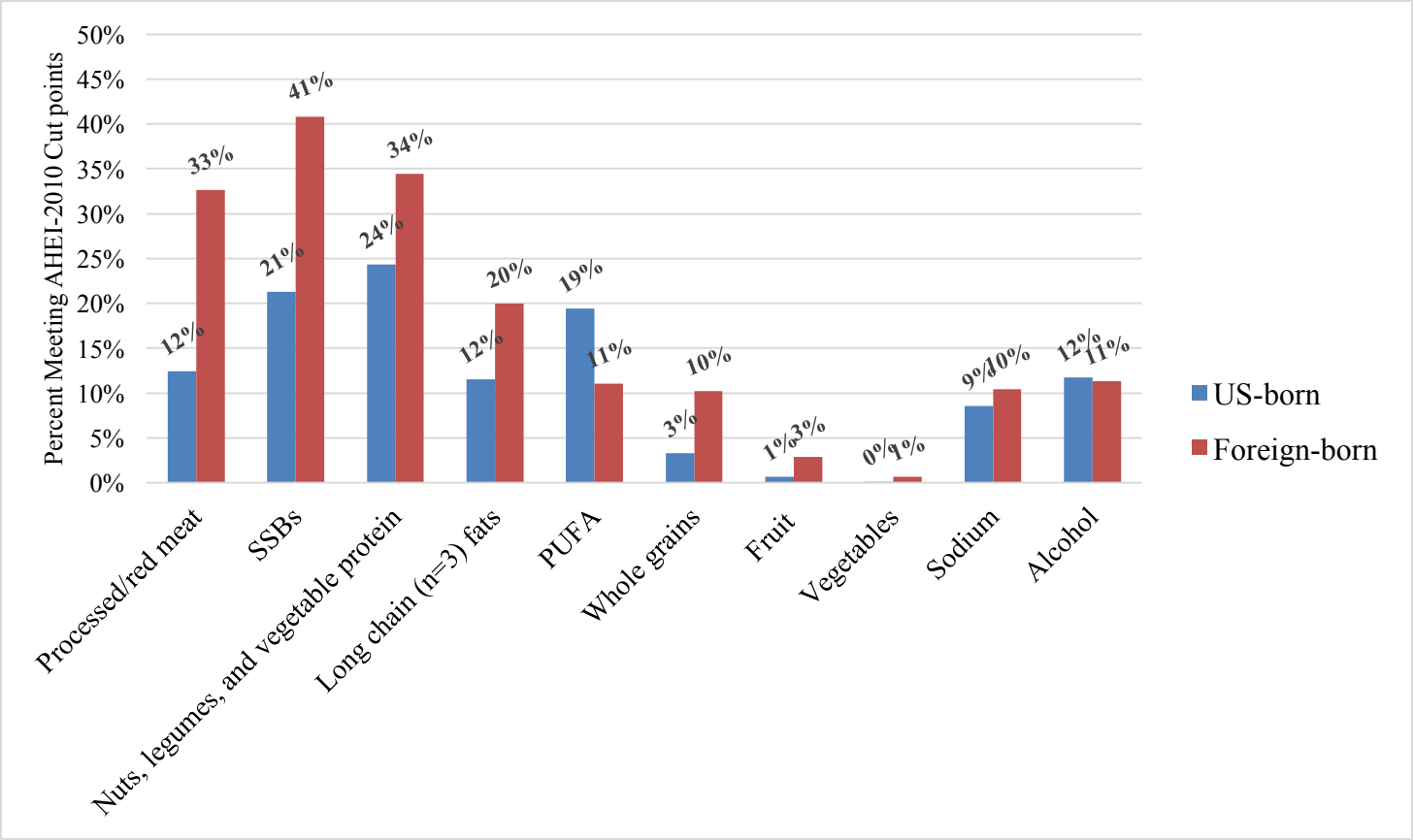
4.3.2 Adapted AHEI-2010 Score

Based on the multivariable-adjusted linear regression (See Table 8), foreign-born, non-Hispanic Blacks on average had AHEI-2010 scores 9.3 points higher (β 9.3,95%CI 7.5,11.1) than their U.S.-born counterparts after controlling for demographic, socioeconomic, and behavioral factors. As shown in Figure 2, many of the study participants had zero intakes for the AHEI-2010 components. See Figure 3 for adjusted percentages of adherence to AHEI-2010 cut points for non-Hispanic, U.S.-born and foreign-born Blacks. Additionally, Supplementary Table 1 includes mean scores and servings for each component of AHEI-2010.

4.3.3 Adapted Fung DASH Score

As shown in Table 8, foreign-born non-Hispanic Blacks scored significantly higher on the DASH diet score in comparison to their U.S.-born counterparts for all models, including the full model (β 3.1, 95% CI, 2.4, 3.7). Additionally, Supplementary Table 1 includes mean scores and servings for each component of the adapted DASH score.

Figure 3: Percent Adherence to AHEI-2010 Cut points of U.S.-born and foreign-born, non-Hispanic Blacks*



*All differences were statistically significant except sodium and alcohol

4.3.4 Multinomial logistic regression models

Foreign-born Blacks were more likely to be in the high scoring tertile than the low tertile for both the AHEI-2010 (RRR 5.75, 95% CI 3.73, 8.86) and DASH (RRR 7.63, 95% CI 4.73, 12.31) scores (Table 9 and see Appendix C for figures). For the DASH scores, foreign-born Blacks were also more likely to be in medium tertile than the low one (RRR 2.86, 95% CI 1.80, 4.53). For the component analyses, foreign-born Blacks were more likely to be in the high tertile for the fruit categories (including fruit juice: RRR 2.35, 95% CI 1.63, 3.37and excluding fruit juice: RRR 2.82, 95% CI 1.82, 4.39), vegetables (RRR 1.56, 95%CI 1.13, 2.16), % whole grains (RRR 2.31, 95%CI 1.59, 3.36), and omega-3 fatty acids (RRR 1.88, 95%CI 1.31, 2.71). U.S.-born Blacks were less likely to be in the high tertile category than the low intake for sugar sweetened beverage (RRR 0.28, 95%CI 0.19, 0.41), red/processed meat (RRR 0.35, 95%CI 0.23, 0.53), and PUFA (RRR 0.36, 95%CI 0.24, 0.53).

Table 9: Multinomial logistic regression of food component intakes among U.S.-born and foreign-born, non-Hispanic Blacks, pooled NHANES 2003-2012

	Medium tertile or intake*		High tertile or intake	
Variables	RRR**	95% CI	RRR	95% CI
AHEI-2010 Score				
U.S.-born	1.00		1.00	
Foreign-born	1.61	0.98, 2.66	**5.75**	**3.73, 8.86**
DASH Score				
U.S.-born	1.00		1.00	
Foreign-born	**2.86**	**1.80, 4.53**	**7.63**	**4.73, 12.31**
Vegetables [a] (servings/d)				
U.S.-born	1.00		1.00	
Foreign-born	1.20	0.85, 1.70	**1.56**	**1.13, 2.16**
Fruit, excluding juice [b] (servings/d)				
U.S.-born	1.00		1.00	
Foreign-born	1.24	0.82, 1.86	**2.35**	**1.63, 3.37**
Fruit, including juice [c] (servings/d)				
U.S.-born	1.00		1.00	
Foreign-born	**1.81**	**1.18, 2.78**	**2.82**	**1.82, 4.39**
Whole grain [d] (oz equivalents/d)				
U.S.-born	1.00		1.00	
Foreign-born	1.52	0.65, 3.54	0.73	0.45, 1.18
Whole grain [d] (% of total grains/d)				
U.S.-born	1.00		1.00	

Foreign-born	1.00	0.66, 1.50	**2.31**	**1.59, 3.36**
Sugar sweetened beverages [e] (servings/d)				
U.S.-born	1.00		1.00	
Foreign-born	**0.41**	**0.30, 0.54**	**0.28**	**0.19, 0.41**
Nuts, legumes, and vegetable protein [d] (oz equivalents/d)				
U.S.-born	1.00		1.00	
Foreign-born	**0.57**	**0.37, 0.90**	1.21	0.91, 1.60
Red/processed meat (servings/d)				
U.S.-born	1.00		1.00	
Foreign-born	**0.44**	**0.32, 0.62**	**0.35**	**0.23, 0.53**
Long-chain (n=3) fats (EPA+DHA) (mg/d)				
U.S.-born	1.00		1.00	
Foreign-born	0.98	0.71, 1.34	**1.88**	**1.31, 2.71**
PUFA (% kcal/d)				
U.S.-born	1.00		1.00	
Foreign-born	**0.53**	**0.37, 0.77**	**0.36**	**0.24, 0.53**
Sodium [f] (mg/d)				
U.S.-born	1.00		1.00	
Foreign-born	0.95	0.69, 1.30	0.69	0.44, 1.06
Alcohol [g] (drinks/d)				
U.S.-born	1.00		1.00	
Foreign-born	1.21	0.87, 1.70	1.08	0.64, 1.84

Total n= 4,243 for each model

*Scores and intakes were categorized into tertiles. The low tertile was designated as the base comparison category

and for the alcohol analyses the ‘no intake’ group was designated as the base comparison category in the polytomous regression analyses.

**Relative risk ratio (RRR) indicates the ratio of the probability of being in one outcome category over the probability of being in the baseline (low tertile or no intake) category

[a] All vegetables, except white potatoes and juice
[b] Includes only whole fruit, excluding fruit juice
[c] Includes only whole fruit, including fruit juice
[d] Based on USDA definition
[e] Includes soda, fruit juice, and fruit drinks, presweetened iced teas, sports drinks and energy drinks
[f] Sum of all sodium content in food
[g] Includes wine, beer, and distilled spirits

4.4 Discussion

Overall, the study demonstrates that foreign-born U.S. Blacks generally have better dietary patterns than their U.S.-born counterparts regardless of whether food intake was evaluated using the AHEI-2010 or Fung DASH scores. Each score contains similar components, however, differed in how they operationalized some of the components. For example, the AHEI-2010 score excluded fruit juice and the DASH score included it; the AHEI-2010 score cut point was based on 50% or more of total grains being whole grains, while the DASH score whole grain component was based on quintiles of total whole grain intake. Additionally, unlike DASH, the AHEI-2010 score also includes components for omega-3 fatty acids and polyunsaturated fat intake. Of note, foreign-born, non-Hispanic Blacks reported having higher intakes of omega-3 fatty acids. These results, as well as the higher intakes of other foods known to reduce cardiovascular disease risk, such as fruit, vegetables and plant based proteins found in nuts and legumes, have important implications for dietitians and other health professionals (173). Dietitians working with those of African descent born outside of the U.S. could encourage the adherence to cultural practices and diet to prevent adverse consequences of acculturation.

These study findings also support existing literature demonstrating the low intakes of fruit and vegetables and other encouraged foods and nutrients among the U.S. Black population, both foreign-born and U.S.-born combined (61, 62, 174). An important consideration, however, is the dietary assessment methodology used, differences in the criteria for recommendation cut points, and how food groups are operationalized for these studies. For example, a study assessing adherence to the recommendations proposed in the 2005 Dietary Guidelines demonstrated that 16.9% of

non-Hispanic Blacks met or exceeded the minimum dietary requirements for fruit. In our study, comparatively, only 1% of U.S.-born Blacks and 3% of foreign-born Blacks were shown to meet the ≥ 5 daily servings cut point for fruit established by the AHEI-2010 in comparison to the energy dependent recommendations established in the 2005 Dietary Guidelines. The 2005 Dietary Guidelines also include fruit juice in their definition for total fruit (175), while the AHEI fruit component excludes fruit juice.

It is worth noting that while foreign-born Blacks in this study scored higher on both respective diet quality scores and have higher intakes for food groups encouraged for a healthy diet, their diet quality is still suboptimal. For the AHEI-2010 diet score components, considerably less than 50% of foreign-born Blacks met the recommended cut points for each component. For example, 43% met the recommendation for SSBs, 34% for nuts, legumes, and vegetable protein, 33% for processed/red meat, 20% for long chain omega-3 fatty acids, and 10% or less met the remaining component recommendations. While the study findings support the healthy immigrant hypothesis, in which the health behaviors of immigrants are shown to generally be better than their U.S.-born counterparts, overall the diet of Black immigrants cannot be considered healthy and support the need for improvements in diet for both U.S.-born and foreign-born, non-Hispanic Blacks in order to meet national dietary recommendations to achieve optimal health.

Another key aspect of these results is whether the statistical differences in intakes have clinical meaning and impacts on biomarkers such as systolic and diastolic blood pressure, blood cholesterol, blood glucose levels, or cardiovascular disease cumulatively. Much of the research exploring the associations between dietary patterns and disease risk

are based on larger serving sizes for food groups promoted to consume. For example, a meta-analysis of prospective cohort studies found that increasing fruit and vegetable intake from less than 3 to more than 5 servings was associated with a 17% risk reduction for coronary heart disease (176). Unaccounted for was what the increased fruit and vegetable intake replaced or whether they were added to the diet.

Our study suggests relatively minor differences in intakes between the two study groups. Foreign-born, non-Hispanic Blacks reported consuming 0.3 servings more vegetables, 0.3 servings more fruit, 9.6% more whole grain, 0.4 ounce equivalents more of nut, legumes and vegetable protein, 0.7 less servings of sugar sweetened beverage, and 0.8 less servings red/processed meat than their U.S.-born counterparts. While most studies are not based on such minimal differences in intakes, future studies could model the potential additive health benefits of these modest differences in intakes between U.S.-born and foreign-born, non-Hispanic Blacks.

An interesting finding of the study is the exceptionally low consumption of low fat dairy and alcohol among both foreign-born and U.S.-born, non-Hispanic Blacks, which necessitated adapting our methodological approach. These low intakes are consistent with other literature suggesting low intakes of total dairy products, particularly low fat dairy among non-Hispanic Blacks (170, 177). For example, a recent study showed non-Hispanics Blacks to have an average daily dairy intake of 0.97 servings and an average consumption of 31.8 grams of low fat milk, and 6.8 g of skim milk (170). The high prevalence of lactose intolerance among Blacks may be a driver of these findings (178). For the alcohol component analyses, we ran additional analyses with a three-level categorical outcome based on the established cut points for alcohol intake based on

gender---no intake (0), 0-1.5 drinks per day for women or 0-2.0 drinks per day for men (1), and >1.5 drinks per day for women or >2.0 drinks per day for men (2). The results were similar, however, with no demonstrated differences in alcohol intake between the two groups. An additional aspect of the analysis to note is how optimal alcohol intake is operationalized in the AHEI score; male and female participants consuming less than 0.5 drinks per day receive less points than those who consume 0.5-2.0 drinks daily and 0.5-1.5 drinks daily, respectively. While alcohol intake has been shown to be beneficial for cardiovascular disease, to our knowledge, literature does not support that not consuming alcohol is harmful to health (179). Future iterations of the AHEI score, should therefore, revise the cut points for alcohol intake.

The estimated intakes of various food component were also inconsistent with data from other studies, highlighting constraints of various dietary assessment approaches and the heterogeneity in how to define various food groups when measuring usual dietary intake. Many nutrition studies use food frequency questionnaires, which are shown to better estimate usual intakes for individuals, yet NHANES uses 24-hr recall in their dietary assessment methodology, which are better at estimating usual intakes for groups. Additionally, how researchers define numerous food groups varies. For example, some studies include starchy vegetables in the vegetable category while other do not, and similar discrepancies are noted in the definitions for fruit.

This research highlights the importance of targeted interventions for Blacks born in the U.S. in order to adequately address health disparities. The cultural influences that might underpin these observed differences are important. For example, the historically-based African American “soul food” diet includes fried foods, refined grains, processed

meats, and few fruit and vegetables. Foreign-born Blacks have different cultural cuisines that vary throughout the Africa diaspora (78, 79, 180). Based on the available flora and fauna in the countries of origin, these cultural diets appear to be those associated with lower chronic disease risk. Diet is shaped not only by culture, however, but also environmental and social factors such as availability and access to healthy affordable foods, time and resource availability, nutrition knowledge and awareness, and socioeconomic status. A noteworthy finding is the difference in socioeconomic factors between the two groups (23, 24). Unlike other comparable immigrant groups, foreign-born Blacks tend to be better educated and have a higher income than their U.S. counterparts (23, 24).

Overall, the data do not show statistical changes in overall diet quality with increased length of residency. However, for some food components, the data provides support for the process of dietary acculturation with unfavorable changes found in red/processed meat and whole grain intake, and an increase in polyunsaturated fats. Studies among foreign-born Hispanic immigrants have shown the adoption of other unhealthy dietary practices with longer residency in the U.S. with significant increases in total fat and lower intakes of fruits and vegetables (168, 181). A possible influence on these findings is the use of length of residency as a proxy measure of acculturation, which is a crude representation. Other studies, for example, have used acculturation scales, language preferences, and other measures to estimate the level of acculturation (27, 182).

While this study is novel in that it is the first large national study comparing diet quality and patterns by nativity among non-Hispanics Blacks in the U.S., there are limitations worth discussing. To examine this research question, we used a large

national dataset, which included dietary data based on 24-hr recall data. Region of birth or specific country of birth, however, are not publicly available in the NHANES data set, therefore we used the crude proxy of place of birth (U.S.-born vs. born outside of the U.S.) to account for the ethnic heterogeneity among Blacks. Additionally, region of settlement in the U.S. is an additional factor to consider given the influence of environment on food availability and specifically culturally appropriate foods. For example, the largest proportion of Caribbean Black immigrants are heavily concentrated in New York and Florida, and while African Black immigrants are more geographically dispersed, a large concentration settle in New York, Texas, California, Florida, and Illinois in comparison to other parts of the country (23, 24). The dietary collection methodology used in NHANES also poses as a limitation. While 24-hr recall data are considered the "gold standard" in assessing diet, the validity of these data to represent typical diet is of concern, especially considering the seasonality of foods and variations in dietary habits throughout the year (183, 184). Food frequency questionnaires may therefore be a more appropriate instrument in exploring related research questions in this area.

Overall, this study underscores the need for public health and nutrition research to consider the differences in nativity and ethnicity among the non-Hispanic Black population in the U.S. and explore the underlying cultural, behavioral, and environmental factors contributing to these differences. Since diet quality was shown to differ even after controlling for a variety of factors, further exploration is needed to determine the drivers of these differences. For example, it is well documented that relative to more healthful foods, food companies disproportionately market high-calorie foods and behaviors and

beverages to ethnic minority populations (185, 186), but no study has examined whether there are differences in the influence of this marketing on food purchases by country of birth. Potential variations in disease outcomes and disease risk, such as cardiometabolic and cardiovascular diseases, within the ethnically diverse U.S. Black population is also understudied. While not assessed in NHANES, future studies could examine the diets of second and third generation immigrants to explore the role of biculturism among this demographic. Research could also explore the region of settlement in the U.S. as well as food experiences during the formative childhood years and how this might play a role in dietary patterns and the dietary acculturation process among foreign-born Blacks. The lack of research in this area as well as the findings from this novel study collectively reinforce the need to investigate potential heterogeneity in the diet and diet quality, and potentially other underlying contributing factors, within the non-Hispanic Black U.S. population based on place of birth.

Supplementary Table 1: Adjusted[a] component and total scores of AHEI-2010 and DASH diet scores by nativity and length of residency among non-Hispanic Blacks, pooled NHANES 2003-2012

	Non-Hispanic Blacks						
				Foreign-born			
	U.S.-born (n=3,837)	Foreign-born (n=406)	P value	<10 years (n=105)	10-19 years (n=98)	20-29 years (n=88)	≥30 years (n=105)
Energy intake (kcal/d)	2097 (18)	1871 (48)	<0.001	1774 (75)	1891 (62)	1973 (83)	2043 (108)
Total AHEI-2010 Score[b]	32.7 (0.3)	41.2 (0.9)	<0.001	43.4 (1.8)	39.7 (1.7)	42.1 (1.7)	42.4 (1.9)
Mean AHEI vegetable score[c]	1.8 (0.03)	2.3 (0.1)	<0.001	2.3 (0.2)	2.4 (0.2)	2.2 (0.3)	2.5 (0.3)
Mean AHEI fruit score[d]	1.2 (0.04)	2.0 (0.2)	<0.001	2.7 (0.5)	1.9 (0.3)	1.7 (0.3)	2.1 (0.4)
Mean whole grain score[e]	2.0 (0.06)	3.6 (0.3)	<0.001	4.4 (0.5)	3.5 (0.4)	3.3 (0.4)	3.3 (0.5)
Mean sugar sweetened beverages[f] score	2.8 (0.1)	4.8 (0.3)	<0.001	5.1 (0.6)	5.1 (0.5)	5.4 (0.6)	4.5 (0.5)
Mean red/processed meat score	2.7 (0.1)	4.8 (0.3)	<0.001	6.3 (0.5)	4.1 (0.5)*	5.1 (0.5)	4.4 (0.5)*
Mean Nuts, legumes, and vegetable protein[e] score	3.6 (0.1)	4.3 (0.3)	0.017	3.9 (0.6)	4.1 (0.5)	4.7 (0.6)	5.6 (0.7)
Mean Long-chain (n=3) fats (EPA+DHA) score	3.3 (0.1)	4.3 (0.2)	<0.001	4.5 (0.5)	4.6 (0.4)	4.0 (0.6)	3.8 (0.3)
Mean PUFA score	6.8 (0.7)	5.5 (0.2)	<0.001	4.7 (0.2)	5.5 (0.2)*	6.0 (0.3)**	6.5 (0.3)**
Mean sodium[g] score	4.9 (0.06)	5.3 (0.2)	0.054	5.7 (0.3)	5.0 (0.3)	5.5 (0.3)	6.1 (0.4)
Mean alcohol[h] score	3.5 (0.05)	3.7 (0.1)	0.362	3.5 (0.3)	3.4 (0.3)	4.4 (0.3)	3.8 (0.4)
Total DASH Diet Score[i]	20.3 (0.1)	23.4 (0.3)	<0.001	24.7 (0.5)	23.6 (0.5)	23.4 (0.5)	23.8 (0.6)
Mean vegetable[J] DASH score	2.9 (0.03)	3.2 (0.1)	0.001	3.3 (0.1)	3.4 (0.1)	3.1 (0.2)	3.2 (0.2)
Mean fruit[k] DASH score	2.9 (0.02)	3.5 (0.1)	<0.001	3.8 (0.1)	3.7 (0.2)	3.4 (0.2)	3.4 (0.3)
Mean whole grain[e] DASH score	2.7 (0.04)	3.4 (0.1)	<0.001	3.7 (0.2)	3.4 (0.2)	3.1 (0.2)*	3.2 (0.2)
Mean Nuts, legumes, and vegetable	2.8 (0.03)	2.9 (0.1)	0.191	2.7 (0.2)	2.8 (0.2)	3.1 (0.2)	3.4 (0.3)

protein [e] DASH score							
Mean sodium [g] DASH score	3.0 (0.03)	3.1 (0.1)	0.084	3.3 (0.1)	3.0 (0.1)	3.2 (0.1)	3.5 (0.1)
Mean SSB [f] score	3.0 (0.03)	3.6 (0.1)	<0.001	3.7 (0.2)	3.8 (0.1)	3.8 (0.2)	3.6 (0.1)
Mean red/processed meat score	2.9 (0.04)	3.6 (0.1)	<0.001	4.0 (0.1)	3.5 (0.2)*	3.6 (0.2)	3.6 (0.2)*

Data presented, mean (SE)

[a] Adjusted for age, sex, education level, PIR, smoking status, physical activity status, and energy intake
[b] Maximum AHEI-2010 score is 100 points
[c] All vegetables, except white potatoes and juice [d] Includes only whole fruit, excluding fruit juice [e] Based on USDA definition [f] Includes soda, fruit juice, and fruit drinks, presweetened iced teas, sports drinks and energy drinks [g] Sum of all sodium content of all foods [h] Includes wine, beer, and distilled spirits [i] Maximum DASH Diet score is 35 points, and points for component scores are based on quintiles of intakes
[j] All vegetables, except potatoes, juice, and legumes [k] All fruit and fruit juice

*p<0.05
**p<0.001

Chapter 5: Hypertension among U.S.-born and Foreign-born Non-Hispanic Blacks: NHANES 2003-2014 data

Abstract:

Objectives: Blacks in the U.S. have the highest reported prevalence of hypertension (44%) worldwide. However, this does not consider the heterogeneity of Blacks within the U.S., particularly comparing U.S.-born to long-standing or recent (foreign-born) immigrants. The objective of this study is to compare hypertension risk between U.S.-born and foreign-born Blacks in the U.S. ***Methods*:** We assessed the prevalence of hypertension among U.S.-born (n=4,733) versus foreign-born (n=538), non-Hispanic Black adults aged 22-79y, based on pooled nationally representative data (2003-2014); as well by length of U.S. residency among immigrants. Multivariable-adjusted logistic regression was used to investigate the association between nativity and hypertension risk. ***Results*:** Nearly half (42.8%) of U.S.-born Blacks but only 27.4% of foreign-born Blacks had hypertension. After adjusting for major covariates, foreign-born Blacks were 40.0% less likely (OR 0.60 95% CI 0.48, 0.76) to have hypertension than their U.S.-born counterparts. Among foreign-born Blacks, length of U.S. residency was not significantly associated with risk of hypertension. ***Conclusions*:** Foreign-born versus U.S.-born non-Hispanic Blacks have substantially lower prevalence of hypertension. Considering nativity among U.S. Blacks in clinical research and public health efforts may improve accuracy of characterizing health disparities and facilitate development of targeted interventions to reduce hypertension in this diverse population.

Key Words: hypertension, health disparities, immigrants, Blacks/African Americans, place of birth/nativity, length of residency, NHANES

5.1 Introduction

Blacks in the U.S. experience among the highest reported rate of hypertension (44%) worldwide (1). For example, Nigeria has an age-adjusted hypertension prevalence of 13.5%; and Jamaica, 28.6% (39). Compared to their White counterparts, Blacks in the U.S. are 40% more likely to be diagnosed with hypertension and 30% more likely to die from heart disease (1). A major limitation of this evidence is the lack of consideration of the heterogeneity within the U.S. Black population, for example based on immigration trends over the past 50 years. While some Blacks have been in the U.S. for many generations, others are long-standing or recent immigrants of African descent from places such as Africa and the Caribbean. Indeed, the population of immigrant groups has markedly increased since the passage of the Immigration and Nationality Act of 1965, which lifted the quotas based on country of origin and replaced them with an immigration system based on family re-unification and employment (23). Combined, Caribbean-born and African-born self-identified Black immigrants make up an estimated 8.7% of the U.S. Black population and the Census Bureau projects that by 2060, 16.5% of U.S. Blacks will be foreign born (23, 25). Moreover, immigration statistics suggest that the influx of Black immigrants represent a diverse array of countries of origin (i.e., Nigeria, Ethiopia, Ghana, Jamaica, Trinidad and Tobago), which would deepen the heterogeneity of cultures, social realities, and lifestyle patterns, particularly, food preferences and physical activity habits, which are important modifiable risk factors for hypertension and related disease outcomes (161).

The healthy immigrant hypothesis posits that immigrant groups have favorable health behaviors, risk factors, and family support that reduce risk for a variety of diseases

and poor health outcomes (165, 166). There is also evidence that recent immigrant groups are healthier than those residing in the United States for longer periods, possibly due to adopting unhealthy eating and lifestyle habits through the acculturation process (167-169). Most of this research, however, has been conducted among Mexican Americans and Asian immigrants (33, 37), and few large studies have examined the association between nativity, length of residency, and hypertension among non-Hispanic Blacks. While some previous research suggests that foreign-born Blacks from Africa and the Caribbean have more favorable health outcomes (i.e., overall mortality, perinatal health, cancer obesity, cardiovascular disease, allostatic load) than their U.S.-born counterparts, these studies have been small and limited to specific sites, and recent national-level data remains understudied (70-73). More research is consequently needed to elucidate how these dynamics influence differences identified among foreign-born versus U.S.-born Blacks. Understanding these potential influences is also timely and relevant given potential for changes in our immigration policies with changing political perspectives.

To address this important gap in knowledge, the present study aimed to assess the association between nativity and risk of hypertension among non-Hispanic Blacks in the U.S. We hypothesized that foreign-born Blacks would be less likely to have hypertension than their U.S.-born counterparts; and that among foreign-born Blacks, longer lengths of residency in the U.S. would be associated with increased risk of hypertension.

5.2 Methods

5.2.1 Sample Description

We used pooled data from the 2003-2014 National Health and Nutrition Examination Survey (NHANES), a nationally representative health and nutrition survey of the non-institutionalized U.S. population (81). The survey includes demographic, socioeconomic, and health- and diet-related questions and is carried out through complex, stratified, multistage probability sampling. The NHANES protocol was approved by the National Center for Health Statistics Research Ethics Review Board and all participants provided informed consent. Additional details about NHANES are available elsewhere (81). The primary analysis was restricted to those who self-identified as non-Hispanic Black, were between the ages of 22-79, were not known to be pregnant at the time of the examination, and who had data necessary to determine hypertension status (N=5,033).

5.2.2 Measures

The main exposure of interest was place of birth or nativity, represented categorically as U.S.-born versus foreign-born based upon the participants' self-response to the survey question "In what country were you born?". Naturalized citizens, permanent residents, undocumented immigrants, international students, and guest workers were included in the foreign-born category, and anyone born in the 50 U.S. states and the District of Columbia were considered U.S.-born. Additional information on place of birth among immigrants was not evaluated in NHANES. We additionally examined the potential association of length of residency among foreign-born Blacks and hypertension. The 9-category question on length of residency asked by NHANES was recoded into 4 levels, due to sample size constraints, and following other studies on immigration, acculturation, and health (75, 81, 168, 169, 171, 172).

Participants were asked questions regarding medical diagnoses and current medication use. Additionally, for the blood pressure measurements, each participant resting quietly in a seated position for 5 minutes and once the participant's maximum inflation level was determined, the trained professionals obtained three consecutive blood pressure readings using sphygmomanometry and an appropriately sized arm cuff (119). If a blood pressure measurement was interrupted or incomplete, a fourth attempt was made (119).

An average of all available readings of both the SBP and DBP was used to best determine usual resting blood pressure. To test for robustness, we also ran the analysis excluding the first blood pressure reading (See Appendix F). The primary outcome was prevalence of hypertension, defined as a self-reported physician diagnosis of hypertension plus current treatment for hypertension with prescription medication; or having a directly measured mean systolic blood pressure (SBP) ≥140 mmHg or mean diastolic blood pressure (DBP) ≥90 mmHg (187).

To minimize confounding by other factors, covariates in the analysis included age (years, continuous, 22-79 y), sex (male/female), educational attainment (<high school or general equivalency diploma, associate degree or some college, or ≥college degree), family income to poverty ratio (IPR, 0-5, continuous), health insurance status (self-reported, yes/no), smoking status (never, former, current), physical activity (self-reported moderate or vigorous levels of recreational/leisure activity for at least 10 minutes continuously over the past 30 days, yes/no), and body mass index (BMI, kg/m^2, continuous).

5.2.3 Statistical Analysis

Statistical analysis was conducted using STATA IC Version 13.0, with use of sampling weights for the complex survey design so that the results were representative of the noninstitutionalized U.S. population (115). Chi square analysis and t-tests were used to determine statistical significance of any differences in sociodemographic, lifestyle, and hypertension characteristics between U.S.-born and foreign-born Blacks. Multivariable-adjusted logistic regression was used to investigate the association between nativity and hypertension. To assess confounding, we evaluated several logistic regression models. Model 1 included age and sex; including, given the importance of age for risk of hypertension, multiple evaluations of additional transformations for age were considered, none of which fit the model as best as age (continuous in years). Model 2 further included socioeconomic risk factors such as education level, IPR, and health insurance status; and Model 3, the behavioral risk factors of smoking and physical activity. The final model, Model 4, added BMI; and we confirmed in sensitivity analysis that results were not appreciably different adjusting for waist circumference instead (See Appendix E). Secondary analysis included multivariable-adjusted regression modeling with mean systolic and diastolic blood pressure measurements as the outcome variable (See Appendix D). We additionally evaluated marital status in a preliminary model, but omitted it for parsimony as it did not appreciably alter the findings (See Appendix E). Additional post hoc exploratory analysis were conducted to examine potential gender and age influences, in which separate models were performed for each gender and for subjects <65 years and ≥65 years (See Appendix G). We considered a two-tailed $p<0.05$ for statistical significance in all analyses. The same multivariable models were used to

examine the association between length of U.S. residency and risk of hypertension among foreign-born Blacks. P for trend across categories of residency was determined by setting the value for each length of category available in NHANES to its midpoint (for the highest open-ended category of "50 years or more", we used 55 years) and evaluating this as a continuous variable in each regression model.

5.3 Results

5.3.1 Population Characteristics

The study population included 5,033 non-Hispanic Blacks, including 4,511 U.S.-born and 522 foreign-born (Table 10). In general, about half were female (54.9%) and considered obese (47.6%); with another 29.5% being overweight, and engaged in any moderate/vigorous physical activity over the past 30 days (48.0%). About 2 in 5 (41.8%) Black American adults had hypertension; of these, the majority (86.6%) used medication. Compared to U.S.-born Blacks, more foreign-born Blacks were male ($p=0.01$), had higher levels of educational attainment ($p<0.001$), classified as normal and overweight ($p<0.001$), reporting never being a smoker ($p<0.001$), and reporting more engagement in physical activity ($p=0.01$). In crude (unadjusted) comparisons, hypertension was more prevalent among U.S.-born Blacks than foreign-born Blacks (43.5% vs. 27.8%). A large fraction of U.S.-born Blacks (38.4%) were diagnosed with the condition by a clinician compared to foreign-born Blacks (24.0%) and more U.S.-born presented with either elevated systolic blood (20.0% vs. 14.5%) or diastolic blood (8.8% vs. 5.7%) pressure readings. There was a significant difference in the prevalence of having health insurance between the groups (76.2% vs. 70.4%, $p=0.05$).

Table 11 shows age-adjusted sociodemographic and health characteristics of foreign-born Blacks by length of residency category. In comparison to those who were in the U.S. for <10 years, a greater percentage of foreign-born Blacks who were in the U.S. for ≥30 years were categorized as current smokers (13.6% vs. 5.8%, respectively) and were in the highest income bracket (46.9% vs. 10.6%). Conversely, more participants residing in the U.S. for <10 years compared to those residing in the U.S. ≥30 years reported having health insurance (41.4% vs. 17.2%). Even after adjusting for age, hypertension was more prevalent among those living in the U.S. for ≥30 years (32.1%) than for recent immigrants <10 years (25.2%). These results, however, may still be confounded by age since hypertension is more likely to present with increasing age.

Table 10: Demographic characteristics, health behaviors and outcomes by nativity among non-Hispanic Blacks, pooled NHANES 2003-2014

	Non-Hispanic Blacks			
	All (n= 5,033)	U.S.-born (n= 4,511)	Foreign-born (n= 522)	p value
Female, %	54.9	55.6	49.1	0.01
Age, years, Mean (SE)	45.2 (0.3)	45.3 (0.3)	43.9 (0.8)	0.09
22-34, %	28.7	29.0	26.6	<0.001
35-49, %	33.1	32.0	42.5	--
50-64, %	26.7	27.1	23.0	--
65-79, %	11.5	11.9	7.9	--
Educational attainment, %				
< High School	22.8	23.1	20.5	<0.001
High School or equivalent	25.6	26.5	18.1	--
Some college	33.7	33.9	32.0	--
≥ College degree	17.8	16.5	29.4	--
Income:Poverty Ratio, Mean (SE)	2.4 (0.05)	2.39 (0.05)	2.52 (0.10)	0.21
< 1.00, %	22.8	23.3	18.7	0.38
1-1.99, %	25.9	26.0	25.3	--
2-2.99, %	16.7	16.4	19.5	
3-3.99, %	13.0	12.9	14.1	
4.00-5.00, %	21.5	21.4	22.4	--
Body Mass Index, kg/m^2 Mean (SE)	30.8 (0.1)	31.1 (0.2)	27.7 (0.2)	<0.001
Normal weight (18.5-24.9)	21.4	20.3	30.7	<0.001

Overweight (25-29.9)	29.5	28.4	38.7	--
Obesity (≥30)	47.6	49.8	29.0	--
Health insurance, %	75.6	76.2	70.4	0.05
Smoking status, %				
Never	58.3	55.7	81.3	<0.001
Former	15.8	16.4	10.7	--
Current	25.9	27.9	8.0	--
Moderate or vigorous physical activity*, %	48.0	47.5	52.8	0.01
Hypertensive**, %	41.8	43.5	27.8	<0.001
Hypertension diagnosis***	36.9	38.4	24.0	<0.001
SBP ≥ 140 mmHg	19.4	20.0	14.5	0.002
DBP ≥ 90 mmHg	8.6	8.8	5.7	0.03
Medication use if diagnosed (Yes)****	86.6	86.7	85.3	0.69

*Based on self-report of engaging in moderate and/
30 days
**Hypertension status is defined as mean systolic b
Hg (based on mean of all available readings) OR (c
doctor or health professional that he/she had hyper
***Told by a doctor or health professional that he/sh
****Participant currently taking prescribed medicatic
hypertension

Table 11: Age-adjusted demographic characteristics, health behaviors, and outcomes among foreign-born, non-Hispanic Blacks by U.S. length of residency, pooled NHANES 2003-2012

	<10 years (n= 128, 25.1%)	10-19 years (n= 134, 26.3%)	20-29 years (n= 118, 23.1%)	≥30 years (n= 130, 25.5%)
Female, %	42.3	50.9	57.2	50.3
Educational attainment, %				
< High School	31.2	22.5	15.3	14.6
High School or equivalent	22.2	19.9	15.3	16.3
Some college	25.6	29.8	41.4	33.2
≥ College degree	23.3	28.6	29.7	38.7
Income: Poverty Ratio, Mean (SE)	2.12 (0.14)	2.33 (0.15)	2.64 (0.18)	3.11 (0.19)
< 1.00, %	26.4	19.3	12.9	15.3
1-1.99, %	26.8	24.7	17.7	15.8
2-2.99, %	24.7	19.3	19.4	13.8
3-3.99, %	12.8	19.8	17.5	9.2
4.00-5.00, %	10.6	17.0	33.2	46.9
Health insurance, %	41.5	28.6	28.4	17.2
Body Mass Index, kg/m^2 Mean (SE)	26.1 (0.4)	27.8 (0.4)	28.4 (0.6)	28.8 (0.7)
Normal weight (18.5-24.9), %	38.0	26.2	29.7	28.0
Overweight (25-29.9), %	42.8	40.6	37.2	32.8
Obesity (≥30), %	17.0	32.2	32.4	36.6
Smoking status, %				
Never	87.2	87.0	77.6	71.6
Former	6.5	6.5	13.1	15.1
Current	5.8	6.5	9.7	13.6

Moderate or vigorous physical activity*, %	48.8	48.3	55.7	56.8
Hypertensive**, %	25.2	25.9	26.4	32.1
Hypertension diagnosis***	21.7	20.9	21.8	30.8
SBP ≥ 140 mmHg	16.7	14.8	15.6	11.1
DBP ≥ 90 mmHg	4.0	7.0	4.8	7.0
Medication use if diagnosed (Yes)****	67.0	74.6	95.2	94.6

*Based on self-report of engaging in moderate and/or vigorous leisure/recreational physical activity for at least 10 minutes over the past 30 days
**Hypertension status is defined as mean systolic blood pressure (SBP) ≥140 mm Hg or mean diastolic blood pressure (DBP) ≥90 mm Hg (based on mean of all available readings) OR (current treatment for hypertension with prescription medication and was told by a doctor or health professional that he/she had hypertension)
***Told by a doctor or heath professional that he/she had hypertension
****Participant currently taking prescribed medication if s/he was ever told by a doctor or health professional that he/she had hypertension

*p<0.05
**p<0.001

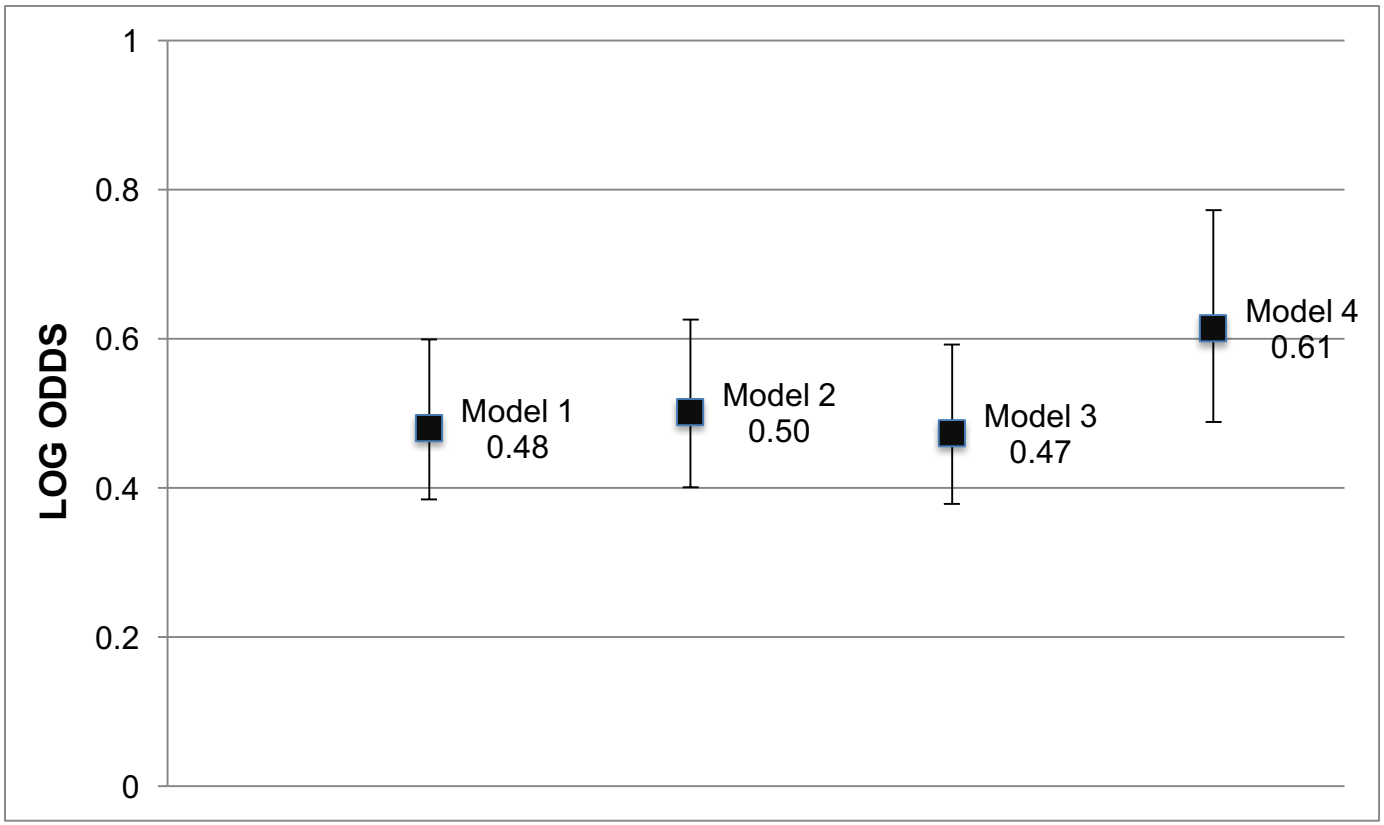
5.3.2 Nativity/Place of Birth and Hypertension

In all models, foreign-born Blacks had significantly lower odds for hypertension than their U.S.-born counterparts (Figure 4 and Appendix M). After adjusting for age, sex, income, education, health insurance status, smoking status, physical activity, and BMI, the strength of the association was attenuated but remained significant, with foreign-born Blacks being 39.0% less likely to have hypertension than their U.S.-born counterparts (OR 0.61 95% CI 0.49, 0.77). The regression models showed that foreign-born, non-Hispanics Blacks on average had systolic blood pressure readings that were 2.3 mmHg significantly lower than U.S.-born Blacks (β -2.3 mmHg, 95% CI -3.8, -0.9) meanwhile these differences were not statistically significant for diastolic blood pressure (β -0.7, 95% CI -2.3, 0.7) (See Appendix D). For the ad hoc analysis by gender, significant associations persisted in the model for females (OR 0.51 95% CI 0.37, 0.71) but not for males (OR 0.76 95% CI 0.53, 1.08), suggesting effect modification by gender (See Appendix G). The ad hoc analysis of running separate models by age (<65 years and ≥65 years) suggested differences by age in which foreign-born Blacks <65 years had a lower risk for hypertension in comparison to their U.S.-born counterparts (OR 0.56 95% CI 0.43 0.72) and there was no significant association between nativity and hypertension risk for those ≥65 years (OR 1.46 95% CI 0.78, 2.73) (See Appendix G).

5.3.3 Length of U.S. Residency and Hypertension

Among foreign-born Blacks (N=510), the central risk estimates suggested potentially higher odds of hypertension with longer length of U.S. residency, but these differences were not significant (Table 12).

Figure 4: Risk of having hypertension for foreign-born, non-Hispanic Blacks compared to U.S.-born Blacks hypertension status, pooled NHANES 2003-2014



Model 1 adjusted for demographic factors of age and sex. Model 2 included the Model 1 variables as well as proxies for socio-economic status such as educational attainment, IPR, and health insurance status. Model 3 also included behavioral factors such as smoking status and physical activity. The final, full Model 4 also included the health risk variable, BMI

All models are significant at the $p<0.001$ level

Table 12: Risk of hypertension among 510 foreign-born, non-Hispanic Blacks by length of residency in the U.S., pooled NHANES 2003-2014

	Model 1 Age + Sex			Model 2 + Education + Poverty:Income + Health Insurance			Model 3 + Smoking Status + Physical Activity			Model 4 + BMI		
Variables	OR	95% CI	p value	OR	95% CI	p value	OR	95% CI	p value	OR	95% CI	p value
Years in U.S.												
<10 (n= 128)	--	--	--	--	--	--	--	--	--	--	--	--
10-19 (n= 134)	1.06	0.60, 1.87	0.84	1.06	0.61, 1.85	0.84	1.07	0.61, 1.88	0.82	0.95	0.53, 1.72	0.88
20-29 (n= 118)	1.10	0.55, 2.18	0.78	1.14	0.58, 2.28	0.70	1.12	0.57, 2.19	0.74	0.96	0.52, 1.79	0.91
≥30 (n= 130)	1.62	0.77, 3.41	0.20	1.69	0.80, 3.58	0.16	1.65	0.79, 3.43	0.18	1.38	0.68, 2.79	0.36
P for trend*	--	--	0.26	--	--	0.19	--	--	0.23	--	--	0.39

Model 1 adjusted for demographic factors of age and sex. Model 2 included the Model 1 variables as well as proxies for socio-economic status such as educational attainment, IPR, and health insurance status. Model 3 added behavioral factors such as smoking status and physical activity. The final, full Model 4 added the health risk variable, BMI.

*evaluated by setting the value for each length of residency category available in NHANES to its midpoint (for the highest open-ended category of "50 years or more", we used 55 years) and evaluating this as a continuous variable in each regression model.

5.4 Discussion

The primary results support our hypothesis suggesting that foreign-born, non-Hispanic Blacks have significantly lower odds for hypertension than their U.S.-born counterparts, even after adjusting for relevant cofounders such as demographic, socioeconomic, behavioral, and health risk variables. The difference was large: 42.8% of U.S.-born Blacks were hypertensive, compared to 27.4% of the foreign-born Blacks, with a multivariable-adjusted risk of 0.61 among foreign-born Blacks. The significant difference in systolic blood pressure readings are also noteworthy considerations given the literature showing elevated systolic blood pressure to be an important risk factor for cardiovascular and renal disease to a greater extent than elevated diastolic blood pressure (120, 188). The 2-mmHg difference in systolic blood pressure between the two groups may not be clinically significant, however. Overall, these results suggest that future research studies and public health programs should consider place of birth when evaluating the health of U.S. Blacks in order to better characterize their risk of hypertension.

Our study results are similar to those observed with some Hispanic groups, particularly older people of Mexican origin, in which foreign-born groups tend to present with better CVD-related health outcomes and lower rates of all-cause mortality (189); outcomes that persist despite greater levels of poverty, lower education levels, and less likelihood of having health insurance (190-193). However, unlike Hispanic immigrant groups, foreign-born Blacks tend to be of higher socioeconomic status and better educated than their U.S.-born counterparts (194). In our study, 16.5% of U.S.-born

Blacks reported having a college degree or higher in comparison to 30.2% of foreign-born Blacks. Foreign-born Blacks also had lower percentages of smoking ($p<0.001$), were more likely to be physically active ($p<0.001$), and had lower BMIs ($p<0.001$), supporting the hypothesis that immigrants tend to follow healthier behaviors than their U.S.-born counterparts. However, while differences in risk of hypertension between foreign-born Blacks and U.S.-born Blacks were partly attenuated they remained after adjusting for these factors, suggesting additional underlying contributors. These potential mediators are not measured consistently or at all in NHANES, causing residual confounding.

One possible explanation for the observed differences between U.S.-born and foreign-born Blacks may be exposure and impact of chronic stress, racial discrimination, and mental health distress. Some evidence suggests that U.S.-born Blacks report greater perceived racism than their foreign-born counterparts (189, 190). Foreign-born Blacks who migrated to the U.S. at an earlier age, however, had similar perceptions of racism (48, 195). A growing body of research also supports the role of persistent chronic stress and the development of chronic diseases such as cardiovascular disease, low birth weight, and other poor health outcomes among Blacks (193). Results are inconsistent, however, warranting future studies exploring perception of racism and stress among the diverse Black population and health outcomes such as hypertension. Specifically, U.S. born Blacks with historical roots in the sociopolitical system of slavery and Jim Crow (U.S. laws enforcing racial segregation from 1865 to mid-1960's) in the U.S. may have different social experiences and perceptions of these experiences in comparison to foreign-born Black immigrant groups.

Potential physiological, genetically based differences are also noteworthy contributors to these research findings. While controversial, there have been numerous historically based hypothesis aiming to explain the genetic causes of the higher prevalence of hypertension among U.S. Blacks (45). One predominant hypothesis is based on historical evidence of the transatlantic slave trade and slavery in the Americas from the 16th century to the 19th century. According to the hypothesis, the conditions of slaves during the middle passage and within the plantation systems created an environment for "natural selection," in which those genetically pre-disposed to conserve and retain salt had a selective advantage for survival (17, 46). Specifically, the major causes of death during this time were thought to be salt-depletive diseases such as dehydration, diarrhea, fevers, and vomiting. Applying Darwin theory, the slaves who were genetically fit for survival were also likely to carry on their genotype to subsequent generations of Western Hemisphere Blacks. While controversial and speculative, this hypothesis may explain the higher incidence of hypertension today among Blacks in the U.S. compared to those from Africa, and to a lesser extend those from the Caribbean/Latin America.

While previous studies among other racial/ethnic groups suggest an increased risk in health outcomes with length of U.S. residency (168, 169, 196-198), this study and other research among Blacks do not provide evidence for this association. Similarly, a 2004 study utilizing National Health Interview data did not find a significant association between years of residency and BMI for foreign-born Blacks, but did find an association for all other racial/ethnic groups (169). On the other hand, the observed risk estimates in

our investigation were suggestive of a potential increased risk with longer length of residency, that could not be confirmed perhaps due to lack of statistical power in this relatively small subgroup (N=510). These findings suggest a need for additional investigation of this important question including the potential role of the acculturation process, which may differ across ethnic immigrant groups.

This study offers an examination of the differences in hypertension among U.S.-born and foreign-born, non-Hispanic Blacks using a large U.S. national dataset at a time when the foreign-born Black population is increasing. However, there are some limitations. First, the study is observational and cannot confirm cause and effect, yet our findings can be considered descriptive in clearly confirming a relevant association between place of birth and hypertension. Although we pooled multiple waves of NHANES datasets to obtain a higher sample of foreign-born Blacks, the sample size for foreign-born Blacks was small, particularly after stratifying by length of residency category, which may have masked the ability to confirm true associations. It is possible that participation in NHANES was differential by both nativity and risk of hypertension however, foreign-born, non-Hispanic Blacks represented 10.2% of the Black population in our study, a figure similar to the 8.7% estimate of the foreign-born Black population based on 2013 American Community Survey data (25). Misclassification when categorizing covariates also cannot be ruled out; and better assessments of certain covariates (including education, income, and lifestyle) might have shown these to explain a greater proportion of the observed difference in risk of hypertension. While NHANES was an appropriate dataset to use given its objective health and nutrition data and large sample sizes, NHANES does not make place of birth or ethnicity data among foreign-

born Blacks publicly available, so we were unable to evaluate nativity by country of origin or region (i.e., Caribbean-born Blacks, African-born Blacks). Finally, length of residency was used as a proxy for acculturation due to limitations of the dataset. Similarly, we were unable to consider age of migration, which would impact the process of acculturation and health behaviors during formative years, nor reasons for migration or migration patterns that may include extended periods of stay in one's home country. Based on recent evidence there is percipience that these factors may have implications for blood pressure and other health outcomes. For example, a recent study among African immigrants found younger age of migration and family reunification to be linked with decreased allostatic load (199). It should also be noted that the adjustment of length of residency by age is somewhat artificial given that it is not possible for someone who has been in the U.S. for 30 years or more to be 25 years old. Future research could therefore attempt to better examine this research question by studying different length of residency cohorts among similar age subjects.

Overall, this study validates the need for future studies to consider nativity and place of birth when evaluating the health of the U.S. Black population, as well as research to understand potential underlying mechanisms including genetic and biological factors, modifiable lifestyle factors and social conditions that may contribute to the differences in hypertension risk between U.S.-born Blacks and foreign-born Blacks. For example, future studies should compare diet quality and leisure-time and work-related physical activity between the two groups, as well as exposure to and perception of racism. An additional interesting finding of the ad hoc analysis worth further study is the effect modification of both gender and age. U.S.-born Blacks were shown to have a higher risk

for hypertension when <65 years, but not ≥65 suggesting that U.S.-born Blacks are diagnosed at an earlier age than their foreign-born counterparts. Meanwhile, foreign-born, Black women also had a lower risk for hypertension compared to their U.S.-born counterpart, but this association was not consistent for foreign-born, Black men. Acquiring a better understanding of the reasons for differences in risk of hypertension among the ethnically diverse U.S. Black population, including the influence of age and gender, will help better characterize health disparities more accurately and develop more targeted interventions to effectively address them.

5.5 Conclusions

Nativity and/or ethnicity among U.S. Blacks are not commonly considered in most research studies and clinical and public health interventions. These study findings, however, suggest that the health disparities in hypertension outcomes differ by nativity, with greater risk for U.S.-born Blacks compared to foreign-born Blacks. Our study, therefore, supports accounting for the diversity of nativity among U.S. Blacks to advance clinical services and public health science and knowledge about health disparities and develop targeted ways to address them.

Chapter 6: Qualitative exploration of cultural factors influencing diet among ethnically-diverse urban Blacks living in the northeast U.S.

Abstract

Background: Blacks in the United States (U.S.) are generally reported to have poor diet quality and are less likely to meet national dietary recommendations. A limitation of this research is the failure to account for the ethnic and cultural diversity among the U.S. Black population, and how this ethnic diversity influences dietary intake. The purpose of this qualitative study is to 1) explore the influence of culture, place of birth, and ethnicity on the diet of an ethnically-diverse Black population, specifically U.S.-born, African-born, and Caribbean-born Blacks and 2) explore a model of dietary acculturation among the African-born and Caribbean-born Black subsample. **Methods:** The purposive sample included 22 U.S.-born, 15 Caribbean/Latin America-born, and 10 African-born Blacks (n=47) who participated in either a key informant interview (n=12) or a focus groups (5 groups, size 5-9). Satia-Abouta's model of dietary acculturation informed the interview and focus group questions, which assessed for the influence of culture, reasons and age of migration, education, income, language, and preferences and values on diet and dietary changes. NVivo 10 software was utilized to assist with coding and analysis. **Results:** Caribbean/Latin-born and African-born Blacks expressed an important role of their cultural identity in influencing their dietary preferences, while U.S.-born Blacks demonstrated a variation of preferences for traditionally African American foods. In comparison to U.S.-born subjects, Caribbean/Latin American-born and African-born Blacks indicated a prominent place for a variety of fruit, vegetables, fish, and spices in their diet. Themes around availability, accessibility, and cost of culturally appropriate foods varied by place of birth. Among foreign-born Blacks, themes related to dietary preferences and values also varied somewhat by age of migration, length of residency, and income. **Conclusions:** These qualitative findings suggest that culture, ethnicity, and other demographic factors play an important role in the diet of the ethnically-diverse U.S. Black population and emphasizes the importance of dietitians and practitioners to consider these differences when providing dietary and nutrition counseling guidance.

6.1 Background

Blacks in the U.S. are generally reported to have poor diet quality and to not meet national dietary recommendations (61-64). For example, studies have shown intakes of total vegetables, whole grains, milk, dietary fiber, potassium, and calcium to be lower than Whites (61-65). A limitation of this research is the failure to account for the ethnic diversity among the U.S. Black population, and how this ethnic diversity may influence dietary intake. While some Blacks have been in the U.S. for many generations, others are recent immigrants from Africa, the Caribbean, or Latin America, or first and second generation descendants. The Black immigrant population has grown since the 1960s, with Caribbean-born and African-born self-identified Black immigrants making up an estimated 8.7% of the U.S. Black population and projections increasing to 16.5% by 2060 (23, 25). This ethnic diversity among Blacks includes heterogeneity of cultures and social realities that would potentially influences food and taste preferences and dietary patterns. Understanding this diversity will allow for more effective tailoring of nutrition interventions and provide evidence for considering ethnic diversity among Blacks in future intervention studies and national datasets.

Limited research has explored the diversity in diets among Blacks, and most of the research on this topic has been conducted outside the U.S. (74, 77-80). Particularly, most studies have been based in the United Kingdom and explored the diets of British Afro-Caribbean populations. (77, 78). One study examined the diets of Afro-Caribbean individuals and concluded that dietary modification

suggestions for diet-related diseases need to consider cultural contexts because Caribbean countries have unique food habits and dietary patterns that persist in first and later generations after immigration (77). In the U.S., one study quantitatively compared the quality of diets of African Americans and Haitian Americans with and without type 2 diabetes, showing that Haitian Americans had significantly higher diet quality than the African American study participants (74). The one qualitative study comparing the diets of Afro-Caribbean and African American women indicated cultural variations in traditions of food and food preparation between the two groups (80).

Related to the cultural influences of diet is the process of acculturation and changes in habits of immigrant groups. To date, most of the research related to acculturation has been conducted among Hispanic and Asian immigrant groups, for which, migration and acculturation are mostly associated with changes in lifestyle behaviors and dietary composition with increased length of residency (168, 196, 200-202). While various conceptual models have been proposed to explain the general process of acculturation (27), the Satia-Abouta model of dietary acculturation (Figure 5) specifically posits several key contributors to changes in diet among immigrant groups, including socioeconomic, demographic, and cultural factors (12). These factors are thought to predict the process of changes in psychosocial factors, such as attitudes and beliefs about food, taste preferences, and food availability and preparation (12). This model is particularly relevant given the limited research among this demographic (196, 200, 202).

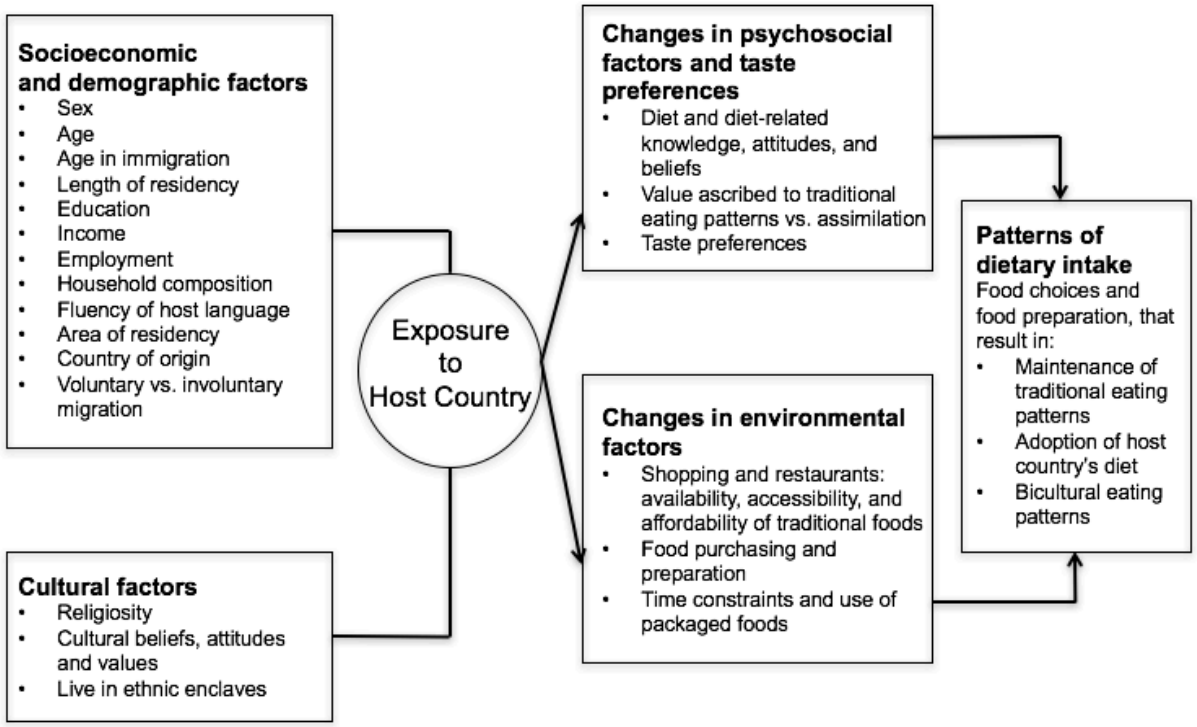


Figure 5: Model of Dietary Acculturation Adapted from Satia-Abouta's model

Thus, we designed a qualitative study with the goal of 1) exploring the influence of culture and ethnicity on the diet of an ethnically-diverse Black population, specifically U.S.-born, African-born, and Caribbean-born Blacks and 2) exploring the Satia-Abouta model of dietary acculturation among the African-born and Caribbean-born Black subsamples. Using this model, we hypothesize that cultural, socioeconomic and demographic, environmental, and psychosocial factors will shape the diet of ethnically-diverse Blacks living in the U.S.

6.2 Methods

This qualitative study used semi-structured key informant interviews and focus groups with a diverse group of Blacks living in Boston Massachusetts, United States. This methodology was chosen because it allowed us to explore various aspects of the Satia-Abouta model and examine study participants' self-described perceptions of how they felt their culture influences their diet and, for those born outside of the U.S., what factors they felt influenced any dietary changes.

Tufts University Health Sciences Institutional Review Board approved all study procedures. A purposive sample was recruited by the placement of promotional flyers (See Appendix H) and on-site recruitment at community-based organizations and on-site tabling at community events in predominately Black/African American neighborhoods in Boston. The research manager screened potential participants who expressed initial interest in the research study by telephone or in-person. Inclusion criteria were self-identifying as

Black/African American; age 40-70 years; English-speaking; being born in either the U.S., countries throughout the Caribbean/Latin American, or countries throughout Africa. Exclusion criteria included having children under the age of 18 living in the household, given the influence of children on foods served in the household and the limited focus of research on middle-aged adults (203). Initial targets for recruitment included 20 U.S.-born Blacks, 20 Caribbean/Latin American-born Blacks, and 20 African-born Blacks. Participants were randomly assigned to participate in either a 60-minute in-depth interview by phone or a 90-minute focus group (FG); for a target of 4 in-depth interviews and 2 FGs for each place of birth category. All participants received a $50 Visa gift card for participation. Several (n=4) participants assigned to focus groups had time barriers to participation and were interviewed instead. Prior to the in-depth interview or FG, each participant read an informed consent agreement (See Appendix I) form and completed a brief questionnaire (See Appendix J), which included questions related to sociodemographic factors, place of birth, year and age of migration, and cooking and eating habits. For the in-depth interviews, participants completed the questionnaires via the online Qualtrics survey software. A semi-structured discussion guide (used for both the in-depth interviews and FGs) was developed, informed by the Satia-Abouta model of dietary acculturation (See Appendix K) (12), and then reviewed and revised by the study team. The discussion guide was pilot-tested with one focus group and one in-depth interview and refined to improve clarity and flow.(Table 13).

Table 13: Major topics from Satia-Abouta's model, discussion guide, and questions

Topic	Questions
Cultural factors	How does the culture of your ethnic group influence the way you eat?
	Can you share any particular foods/dishes that you eat from your culture?
	In what ways has your diet changed since you've moved to the U.S.?*
	In what ways has your diet stayed the same since you've moved to the U.S.?*
Socioeconomic and demographic factors	In what ways do you think your age of migration might have influences your diet today?*
	In what ways did your personal circumstances of moving to the U.S. (i.e., more educational opportunities and for other economic opportunities) contribute to your diet when you came to the U.S.?*
	Do you think your education or income had an impact on the way that you ate when you first came to this country?* Has this changed at all today? And if so, how?
	In what ways do you think the other people who currently live with you influence your eating? (For example, older adults in the household)
Environmental factors	In what way has living in Boston influenced your eating of traditional foods from your culture?
	Describe the availability of traditional/culturally appropriate foods in your community.
	If traditional/culturally appropriate foods are available, how would you describe their prices? Affordable? Not affordable?
	If traditional/culturally appropriate foods are available, describe your travel time to get these foods
	Describe the time that you have to devote to preparing foods from your home country or culture.
	Describe the availability of restaurants that serve the food or similar food from your home country.
	In what way does time availability play a role in your preparation of foods from your home country?
Psychosocial factors and taste preferences	In what ways is your preference for foods influenced by your culture?
	In what ways has your preference for foods changed (if at all) since you moved to the U.S.? *
	In what ways has your beliefs about diet-related disease such as heart disease, diabetes, and obesity

	changed since you moved to the U.S.? *
	How have these beliefs influenced the way you eat?
	What are your thoughts on African Americans' (or people in your country of birth's) perception about diseases such as high blood pressure, diabetes (sugar), and heart disease?
	How have these beliefs influenced the way you eat?

*Question asked to Caribbean/Latin American-born and African-born

All in-depth interviews and FGs were digitally recorded and preliminary transcription was conducted using an online transcription software, speechmatics (https://www.speechmatics.com) (157). Graduate research assistants then manually reviewed and finalized the transcripts. Data were analyzed using inductive thematic analysis (158). First, the team developed the initial codebook based on emergent themes from the in-depth interview and FG transcripts. The codebook was refined based on coding an initial transcript and discussion among study team members. Inter-coder reliability was then established by randomly selecting one transcript per type of in-depth interview or FG and comparing codes between the lead analyst (AGB) and the graduate research assistants. For any codes that failed to achieve 80% agreement or better, researchers met to discuss discrepancies and further refined the codebook to clarify code definitions. NVivo 10 software was utilized to assist in the coding and analysis process (QSR International, Australia) (160). To analyze the data, we conducted matrix coding queries based on characteristics, such as region of birth, education, income, and among foreign-born participants, length of residency, and age of migration.

Based on patterns and counts within the matrix coding queries, we identified themes that emerged from the data.

6.3 Results

6.3.1 Sample Characteristics

Demographic characteristics of the sample by region of birth are summarized in Table 14. The sample (n=47) included 22 U.S.-born Blacks, 15 Caribbean/Latin America-born Blacks, and 10 African-born Blacks. Initial target numbers for the study sample were not met due to recruitment challenges and time constraints of interested participants. For the U.S.-born study participants, we facilitated two focus groups (n=9 each) and conducted four phone interviews. For the Caribbean/Latin-born participants, we held two focus groups (n=5, n=6), and conducted four interviews. For the African-born participants, we held one focus group (n=6) and conducted four interviews. Among the U.S.-born Black participants, 13.6% (n=3) were considered first generation and 1 participant was considered second generation. Some of the countries represented in the foreign-born sample include: Honduras, Jamaica, Barbados, Trinidad and Tobago, Puerto Rico, Somalia, Ethiopia, Cape Verde, and Nigeria.

The mean (SD) age was similar for U.S.-, Caribbean/Latin- and African-born, (57.6 (SD) y, 55.5 (SD) y, and 56.8 (SD) y, respectively). A greater percentage of both Caribbean/Latin-born and African-born Blacks obtained a college degree or higher, 53.3% and 70.0% respectively, in comparison to 27.3%

of their U.S.-born counterparts. Similarly, more foreign-born Blacks had an income of ≥$50,000 or higher (13.6%, 33.3%, and 50.0%, for U.S.-, Caribbean- and African-born, respectively).

Among the foreign-born study participants, most of both the Caribbean/Latin American-born (86.7%) and African-born (60.0%) study participants had been in the U.S. for ≥ 30 years. The average age of migration was 19.0 years for Caribbean/Latin America-born and 28.2 years for African-born Blacks, with 60.0% of the Caribbean-born sample migrating before they were 18, compared to only 10% of the African-born subsample. Reasons for migration varied between region of birth, with most African-born migrating in search of education and employment opportunities and most Caribbean/Latin America-born seeking education or to reunite with family.

In terms of eating patterns, most Caribbean/Latin America-born (60.0%) and African- born (40.0%) Blacks indicated eating equal amounts of U.S.-American food and food from their country of birth. Most indicated being mainly responsible for the cooking and grocery shopping in their household, regardless of country of origin.

Table 14: Sociodemographic characteristics and food-related behaviors of ethnically-diverse U.S. Blacks living in the northeast U.S.

	U.S.-born (n= 22)	Caribbean/ Latin-born (n=15)	African-born (n=10)
Mean age, y (SE)	57.6 (1.6)	55.5 (2.1)	56.8 (2.4)
Female, n (%)	15 (68.2)	12 (80.0)	4 (40.0)
Educational attainment, n (%)			
High School or less	11 (50.0)	4 (26.7)	1 (10.0)
Some college	5 (22.7)	3 (20.0)	2 (20.0)
≥College degree	6 (27.3)	8 (53.3)	7 (70.0)
Marital status, n (%)			
Never married	13 (59.1)	11 (73.3)	6 (60.0)
Married	2 (9.1)	0 (0.0)	1 (10.0)
Divorced, Separated, Widowed	7 (31.8)	4 (26.7)	3 (30.0)
Annual income, %			
Less than $24,999	14 (63.6)	1 (6.7)	2 (20.0)
$25,000-$49,999	4 (18.2)	5 (33.3)	3 (30.0)
≥$50,000	3 (13.6)	5 (33.3)	5 (50.0)
Prefer not to reply	1 (4.6)	4 (26.7)	0 (0.0)
Mean length of residency, y (SD)	--		
<10 y, n (%)	--	1 (6.7)	1 (10.0)
10-29 y, n (%)	--	1 (6.7)	3 (30.0)
≥ 30 y, n (%)	--	13 (86.7)	6 (60.0)
Mean age of migration, y (SD)	--	19 (3.9)	28.2 (3.1)
Younger than 18 y	--	9 (60.0)	1 (10.0)
Older than 18 y	--	6 (40.0)	9 (90.0)
Reasons for Migration, n (%)*	--		
Education	--	6 (40.0)	4 (40.0)
Work/employment	--	5 (33.3)	10 (66.7)
Unite with family	--	10 (66.7)	1 (10.0)
Conflict/natural disaster in home country	--	0 (0.0)	3 (30.0)
Other	--	4 (26.7)	2 (20.0)
Cooking responsibilities, n (%)			
Mainly responsible	16 (72.7)	11 (73.3)	8 (80.0)
Shared responsibility or someone else's responsibility	6 (27.3)	4 (26.7)	2 (20.0)
Grocery shopping responsibilities, n			
Mainly responsible	18 (81.8)	12 (80.0)	7 (70.0)
Shared responsibility or someone	4 (18.2)	3 (20.0)	3 (30.0)

else's responsibility			
Food intake, n (%)	--		
Mainly food from my country of birth	--	1 (6.7)	2 (20.0)
Mostly food from my country of birth and some American food	--	3 (20.0)	3 (30.0)
Equal amounts of both food from my country of birth and American foods	--	9 (60.0)	4 (40.0)
Mostly American foods and some food from my country of birth	--	2 (13.3)	1 (10.0)

*Participants had the option to choose more than one reason for migration

6.3.2 Qualitative Data

See Table 15 for excerpts by emergent theme

Differences in food preferences based on region of birth

An emergent theme included differences in dietary preferences based on region of birth of the study participants. In comparison to U.S.-born subjects, Caribbean/Latin American-born and African-born Blacks indicated a prominent place for a variety of fruit, vegetables, fish, and spices and seasonings in their diet. Spicy peppers and fresh herbs, for example, were commonly mentioned among Caribbean/Latin American-born and African-born Blacks. Meanwhile, U.S.-born Blacks mentioned more about fried food, especially chicken, other meat such as pork, and specific vegetables and starches such as collard greens and sweet potatoes as being cultural foods. Rice was commonly mentioned among all three groups.

Value, preference, and influence of cultural factors

Caribbean/Latin American-born and African-born Blacks expressed a strong preference for cultural foods, which they linked with their identity. U.S.-born Blacks had a more mixed response to cultural foods preferences, with some U.S.-born Blacks stating that culture had a major influence on their diet and others stating a minor influence. Meanwhile, many of the U.S.-born Blacks indicated a greater influence of a value for health on their eating habits. A theme that emerged from all three groups included the cultural and deeper meaning of food as symbolic of love and connection. Gatherings with family and friends were also noted as fostering adherence to cultural diets.

Availability, quality, and cost of cultural foods

Differences in availability and cost of culturally appropriate foods was an additional theme that emerged. Poor quality and limited affordability and restaurant availability of cultural foods were noted concerns for U.S.-born Blacks. Conversely, Caribbean/Latin American-born Blacks indicated wide-scale availability of Caribbean foods, but expressed some tropical fruits as difficult to find. Meanwhile, the African-born Black participants suggested varying availability, costliness, and quality of culturally appropriate foods. Both Caribbean/Latin American-born and African-born participants indicated finding similar foods and products at other local ethnic stores given commonalities with other ethnic cuisines. Meanwhile, availability of culturally-appropriate foods at family functions was a common theme among all groups.

Barriers of transportation, time constraints, and work environments

There was a major theme around time constraints as a barrier to adhere to cultural diet among Caribbean/Latin American-born and African-born Blacks. To a smaller extent, the strong smell of cultural foods in the work environment presented as a barrier for consuming cultural diets among Caribbean/Latin American-born and African-born Blacks. Conversely, U.S.-born participants indicated concerns with transportation and affordability as key barriers.

Adaptive strategies

There was a theme across participants regarding adaptive strategies in response to resource availability (time and food) and gained knowledge. The foreign-born study participants expressed adaptations in when and how they cooked their meals as well as their preparation methods and portion sizes. For example, adaptive strategies included cooking in bulk on the weekends, using more easily accessible ingredients or canned versions of products instead of fresh options, and bringing food products from their home country when traveling. Conversely, U.S.-born participants expressed changes in preparation and ingredients from their traditional "African American/soul food" diet for health reasons and a value for health.

Influence of age of migration

Blacks born outside of the U.S expressed that age of migration influenced their dietary habits, with cultural diets shaping taste preferences during both youth and adulthood. Those who migrated in adulthood indicated having a strong preference and knowledge for their cultural style of cooking and use of food ingredients.

Influence of length of residency

Participants residing in the U.S. for 30 years or more generally indicated more changes in their diet in comparison to those living in the U.S. for less time,

with common mention of changes in meal choices and preparation, from using more processed foods to including healthier adaptations.

Influence of Education and Income

Formal education level did not present as a major influence on food preferences and dietary changes, with a mention of the widespread availability of nutrition information in U.S. media outlets. Meanwhile, responses by income varied among foreign-born participants, with some of higher socioeconomic status still indicating cost as a barrier to eating culturally-appropriate foods.

Table 15: Emergent themes, summary of and qualitative data, and representative quotes regarding cultural aspects of diet among ethnically-diverse U.S. Blacks living in the northeast U.S.

	US-born	Caribbean/Latin American-born	African-born
1) ***Differences in food preferences based on region of birth*** -In comparison to U.S-born participants, African-born and Caribbean/Latin-born Blacks expressed eating more fish, fruit, vegetables, and using more spices and seasonings as well as variety of these foods	" …I believe the food I myself was brought up on was fried chicken. Chicken. Bone. I love chicken bone. I know where it comes from. And pork and all that. I'm used to eating fried food is my biggest problem. I don't bake notin. I fry it."	"Well I think it looks like breakfast for us. And it's actually fresh stuff. It's spinach and green bananas and ackee stuff like that. I guess it can be heavy but I feel like it's healthy it's from the earth. It's bananas, it's potatoes, it's not like eating French toast with syrup poured on top of it. Not to say there's anything wrong with that, but on Sundays you'll make green bananas, spinach with toast or eggs or whatever. To kind of switch it up a little bit." "I would use more curry and turmeric, and I make my own seasoning like with onions and garlic and peppers. A mixture of sweet marjoram and all that kind of stuff together and make own seasoning, so I would use too much of the salty stuff."	"But mostly from my part of Nigeria, we ate mostly fish, mostly fresh fish and some smoked. But you don't find the smoked fish that is smoked like the way we smoke it in Nigeria…So fish is our major, in fact, I make it a point to make sure we eat fish at least twice a week. And beef we still eat, not sparingly but more fish than beef and more chicken than beef too." "Vegetables are the same as here. We eat spinach, we eat greens all green leaves, we eat carrots, potatoes. Cauliflower. All kinds of vegetables, we have them back home but like I said it ate limited when I was back home but here my portion has gone up"
2) Value, preference, and influence of cultural foods -Strong preference for cultural foods among Caribbean-born and African-born Blacks -Mixed preference for U.S.-born Blacks, with influence of value for health	"I do value it I mean you know it's tradition. It's a flavor, but you must remember at lot of these things that they say is soul food, things that are necessities, kept these people alive…But the value of it, well let's see. You know I enjoy the flavor of it but not as an every day diet...I also know that there are other things that could be healthier" "I'm getting tired of African American food	"Because it's part of my culture, it's my background, you know I grew up before I came here I grew up on eating that type of food, so it plays a great value in my life, just to keep my culture going into the next generation of my grandkids and just to influence them in what certain foods we eat at certain times throughout the year, celebrating different holidays and stuff like that."	"Well I can't live without it I have to have it so it's important because I grew up with it. Also you just get used to it. I cannot not eat it at least for a couple of days. So it has value, it's important, that's how I identify." "Food is so important in our culture. Like I said I just went back and I got to the point I had to tell my family, I'm tired of eating [laughter]. Because food is the way we show

	myself because I've eaten so much."	"So I think that it sort of set it in stone what I would like to eat.... Those things become much more important to me so that even going forward I always try to keep an element of that ethnic food and traditional you know kitchen cooking."	appreciation, food is the way we show our love. And I felt bad."
3) Variations in availability, quality, and cost of cultural foods -Poor quality and limited affordability for U.S.-born Blacks -Wide-scale availability for Caribbean foods, but not all, particularly fruit -Varying availability and costliness for African foods	"When you say availability for us to be African Americans and to be living in a certain area, you're also talking about quality of food. Like you said, it's expensive, it's not really what I want, and the meat is not fresh and sometimes the vegetables." "You know, finances have a lot to do with where you shop. Star market, Shaws, Brothers... what's available, what can I get to in terms of transportation? And like you said, sometimes even saying 'oh I got a deal.' You buy a two dollar bag of vegetables, and they still rotten or has a poor shelf life." "When you say availability for us to be African Americans and to be living in a certain area, you're also talking about quality of food. Like you said, it's expensive, it's not really what I want, and the meat is not fresh and sometimes the vegetables."	"I can't say everything is available. But most things are." "Caribbean food is sold everywhere around Boston. You can find different places that sell different Caribbean food…And then, you'd find Chinese with something similar to the Trinidadian. You may find, you know, Vincentian, with their breads. It's on a different corner, but you can find cultural food for us."	Yes, that's one other thing. Some of the vegetables we use I can't find here. For instance, to make the fish soup, we always have to use what they call bitterleaf. When I do find the bitterleaf here they are not fresh, they are either frozen or dried up…The spinach they have here is not the kind we have in Nigeria." "There's a lot of things that we get, where that get imported. So there's a lot of Cape Verdean food that I could still have living in Boston because either my family members will bring it from Cape Verde or you can buy anything" "It's expensive but it's available. There's [name of store] and they have all the foods from Ethiopia, but it's expensive, pricewise it's expensive."

4) Barriers of transportation, time constraints, and work environments -Caribbean-born and African-born Blacks expressed time as the primary barrier to eating cultural diets -US-born participants indicate concerns with transportation and cost as a barrier -African-born Blacks indicated cost as a barrier	"A lot of people don't have transportation, access." "Once again, which requires transportation. [Indecipherable] You can't bring nine bags on no bus." "A lot of times you have to cherry pick, you know what I mean? You have to go the one store to get this, you go to another store to get that. You have to watch your budget."	"I say most of my time is on the weekend. I feel like I have a little bit more time. Because if you get home at five, who's gonna whip up a huge meal that's gonna take a couple hours. Unless you stay in your home on a Saturday, you can put in all the slow cooking thing in your house and do your laundry."	"No, no, I'm saying now I have very little time to even look around for it anymore. So I'm just succumbing to whatever, for instance, Thanksgiving is coming. Every thanksgiving, I prepare the usual American meal for my family because that's what they expect. I will throw in one or two Nigerian meals in the middle of it, but the main thing is still turkey and you know all those, with the trimmings" -- "You don't have time to make that delicious food. We don't have time. We make it once a week, Injera and something, otherwise we don't have no time. We are eager to eat when we see it."
5) Adaptive strategies -Change in ingredients based on resources -Bulk meal preparation -Change in preparation methods and ingredients for health reasons -Portion size -Home country travel	"I still eat some of the stuff I was grown upon now. My mother cooked a lot of chitterlings and pig feet, stuff like that. I don't eat them anymore…Today I am trying practicing eating more healthy…I'm trying to change my eating habits, not eat a lot of fried food. Try to eat more baked. Eat a little less." "Because my mother came from the south, and there were certain foods she wouldn't allow in her house. We didn't eat pork. She wouldn't allow it because overtime…her education influenced the type of food we ate in the house…The same thing applies to me as well with certain foods. Like collard greens, I'm going to put some smoked turkey in there to	"We still eat the same cultural food, but we might just cut back on the portion…We don't eat much—Some things we don't get, but what we get here, we eat it. Just cut back the portions. The fish, the salt fish, the callalou. We will cook it probably occasionally, but we just cut back on portion. Not the big plate we have in front of us [laughs] . The pig's tail, we eat still." "We try not to do the Crisco oil any more. We only use it in frying, but we would use the olive oil more." "Yes I do get mauby if I go down to the	"It's now at home, so I choose to cook outside in the garage because it's a lot of onion, so smelly, so spicy, so I use Saturday, I cook Eritrean or Ethiopian food and then save it for a week. So in between Thursday and Friday we can have any Ethiopian dish like pasta." "But it's so hard to find the Teff…So you mix it up. Quarter of Teff, quarter of barley, and a little rice and you mix it up and make it as injera." "So, you see, even the substitutes we were using are getting off our radar, for one reason or the other, we don't need those substitutes anymore. So we are now more inclined to eat American food than the regular home food

	make it more healthy…because all that stuff can pretty much clog your arteries…"	Caribbean I get it in a syrup form and I would bring that back and I would make my own."	that we used to. Not that if we found the home food we would not, but I am not going out of my way to look for them anymore."
6) Influence of age of migration	N/A	"It's just that you know I think that because again I coming here as an adult that I was basically schooled in one way of preparing food and that is what I have just continued to do. I have not really changed my style of cooking. Maybe I changed." "So I think that it sort of set it in stone what I would like to eat...Those things become much more important to me so that even going forward I always try to keep an element of that ethnic food and traditional you know kitchen cooking."	"Well, when I came here. Actually when I came here I did not like the food I didn't like the meat, it was too fatty for me. So as soon as I came, I was not eating that much so I lost a lot of weight I was almost 90 lbs. But eventually I got used to, learn how to shop the meat that has very lean meat, bread that does, back home bread we make it at home, so the ones that I buy at the shop was very spongy I didn't like them, so eventually I start learning about nutrition..So I was young then and it was the right time to come here and learn things, so maybe that influenced me I don't know. But from the beginning I was a healthy eater." "Yes, coming to the States as an adult has influenced how I eat in the sense that what I, like I just explained to you, no matter all the food that they have in the shop, more than 80% of those foods, I've never seen them, and the way they are prepared, the way they are cooked, they are never prepared the way--what I'm used to, but over time, as I say, every day, and I meet more Nigerians…So they begin to show me where to get the items, where to get the recipes and how to make them. So I'm better off now than the time I came"
7) Influence of length of residency			

Less than 10 years	N/A	"I eat spaghetti with chicken cooked all together. Just the spaghetti cooked up with chicken or something. Beef. Anything." "We try not to do the Crisco oil any more. We only use it in frying, but we would use the olive oil more."	"For instance, I go to any fast food or eatery, when people are talking about they need hamburger, they need chicken, with sauce, so I didn't quite understand what those things meant and the kind of food to expect, even if I do buy." "It depends like when you're born you get with certain food and certain taste flavor. So it's like when you come up here you don't know what the other food or other things will taste. So still you will depend on what you have since you were a kid. But it's like…OK what can I taste, what is it, what is it made of. So you ask yourself…that pushes you to stay out of them and stay in the same things that you have back home."
10-29 years	N/A	"We still eat the same cultural food, but we might just cut back on the portion. We still eat everything as we used to back at home. We don't eat much— Some things we don't get, but what we get here, we eat it. Just cut back the portions." "I don't have kids in my family but we cook every other day. We cook every other day. We hardly buy junk food. We hardly buy food we didn't cook."	"The difference between what's available here and what we're used to have back home is everything down there was organic natural, no pesticides. You were sure what you are eating, but we are trying to eat the same thing which is totally different. So, that isn't natural or organic"
30 years or more	N/A	"Different from home to here and back home is the chemicals in the food, which back home it's not as processed	" I eat less traditional food because it's very hard to make them. My sauce they take time, but I try to eat that at least once a week,

		as it is here. So you know they inject a lot into the meats. Unless you go organic and not everybody can afford organic all the time. So unless you grow your own garden, you don't know what you're getting in these stores." "Junk food. Very much, junk food. The food is--when you're here, you work so much. Like families, they're always out just to make that dollar to pay the bills and stuff. So families cannot cook as much as in the island. Because it takes them time" "Yes, the can versus the fresh. And I being lazy, I go to the can because I don't want to cook no coconut."	traditional food. So the traditional food is you make a chicken stew but with the hot spicy stuff. You make a if I do beef. I make it with beef but it is like hot and spicy beef stew. And we eat it with a spongey called injera. So that one I buy it, so I don't know what they put in it because they say, we have this grain called teff back home that's 100% that's what the sponge bread was made of, but here I think they probably mix it with other kinds of flours, so I try to eat less of that because I'm not sure what they mix in it." "Well I'm eating more of less food than I used to when I first came here. When I first came here I made every effort to find the types of foods we used to eat in Nigeria. But now I just eat more of US food than Nigerian food."
8) *Influence of Education and Income*	"But I think I'm pretty worldly….cultured for someone of my educational background, the only furthering education I have is in the cosmetology field and that's about it. So I don't think my education plays a big role I think I eat a lot better than, for my income I eat a lot better than a lot of people."	"My diet hasn't stayed the same. It's not bad, but what I'm saying is I experiment a lot. I love watching cooking shows because there are things that I know I want to do, and so I watch the shows, and I learn how to do them, and then I'll try them. And if I try it, and I like it, I incorporate into my diet. And it's not anything outrageous, or it's not anything super sweet or super salty or bad, but it's something not from my culture necessarily because I experiment with food."	"Well there is more information, there is so much information in this country. About diet, dieting. About what kind of food you should eat. What kind of things can make your heart stronger or give you heart attack. So I do read, I do listen. So there is so much information that also is one way of influencing my eating habits." "I don't go out of my way to look for things anymore like I said I'm comfortable with doing them sparingly, you know, they're really expensive"

6.4 Discussion

The purpose of the study was to use Satia-Abouta's model of dietary acculturation as a framework to explore the influence of culture and ethnicity on the diet of ethnically-diverse Blacks living in the Northeast U.S. The results identified cultural assets and their importance in influencing diet among Caribbean/Latin American-born and African-born Blacks, who expressed a strong value for cultural food preferences as an important part of their identity. Prominence was placed on including a variety of fruit and fish among Caribbean/Latin American-born Blacks, while spices and seasonings were commonly mentioned among both Caribbean/Latin American-born and African–born Blacks, underscoring some commonalities of cuisines throughout the African diaspora. Given research supporting the benefits of fruit and fish intake for chronic disease prevention (204), these findings suggest an opportunity of promoting these healthy culturally-familiar foods among Black immigrants in programs and nutritional messages aiming to prevent diet-related chronic diseases in this demographic. Meanwhile, although the traditional African American/"soul food" cuisine such as fried chicken, collard greens, and macaroni and cheese were discussed among U.S.-born Blacks, many participants discounted the influence of this cultural diet on their current dietary habits. This finding could be attributed to the study location in the northeastern U.S. Barriers around food access and affordability to culturally-appropriate foods, and limited restaurant choices, were also emphasized among U.S.-born Blacks, suggesting possible larger socioeconomic influencers. These findings support the work of prominent

nutrition researcher, Dr. Shiriki Kumanyika, who has done nutrition intervention and epidemiological studies among African Americans in the U.S. In a 2007 article introducing a research paradigm for working with African American communities, the study concluded that to effectively address health disparities among Blacks in the U.S., particularly as it related to obesogenic related diseases, there needs to be a greater focus on cultural and psychosocial processes, social and historical contexts, and the physical and economic environments (205). Additionally, the researchers highlighted the need to explore within-group differences and address the misconception of African Americans as a homogenous group (205).

The study demonstrated that demographic, environmental, and psychosocial factors influence the acculturation process among foreign-born Blacks, as posited in Satia-Abouta's model of dietary acculturation. Demographic factors such as age of migration and length of residency were reported to influence diet and dietary changes. Changes with increased length of residency ranged from both unhealthy adaptation such as increased processed foods to healthy changes such as healthier adaptations to cultural foods. Identified social and environmental factors included family and friend gatherings as opportunities for eating cultural foods, and the work environment as a barrier because of the strong smell of spices in ethnic foods.

While income and education are noted in the literature as influencing dietary purchases and related lifestyle behaviors, these factors were not shown to be major influencers of dietary preferences among foreign-born Blacks in our

study. One possible explanation is the application of intersectionality theory (61, 62). This theory suggests the non-additive effects of social identities such as sex/gender, race/ethnicity, class, immigration status, etc. and as it relates to the study of behavior, health, and disease, how these different intersections of identity contribute or protect against health inequalities (206, 207). For example, the meaningful influence of education on health among non-Hispanic White, college educated men may differ from college educated Black women or college educated Hispanic men due to the intersection and non-additive effects of their respective social identities beyond being college educated. Additionally, while there has been a focus on culture and acculturation in describing immigrant health, some researchers note the importance of considering the socio-historical contexts and the different social experiences of diverse immigrant groups (207). It is possible that the intersectionality of these sociodemographic factors might differentially shape the acculturation process among Black immigrant groups in comparison to other immigrant groups. However, more research with larger sample sizes of foreign-born Blacks with higher levels of educational attainment should be pursued.

In terms of environmental influencers, a major theme was the widespread availability of cultural foods in both restaurants and grocery store outlets among foreign-born study participants, with the ethnic diversity and prevalence of ethnic enclaves in Boston potentially contributing to this availability. According to a 2015 report, 32.8% of the Massachusetts Black population is foreign-born, with Boston including the largest Black community (208). Based on sociology

research, ethnic enclaves may foster less acculturation, reinforce norms and health behaviors, and contribute to resource sharing based on social networks, which ultimately facilitates adherence to culturally appropriate diets (209). Additionally, when cultural foods were not available, participants utilized adaptive strategies to adhere to their diets, such as using different ingredients, or seeking grocery store outlets of different ethnic groups with similar foods (i.e., Chinese or Arab markets). For East African-born study participants, for example, revisions were made to recipes for injera bread based on grains available and affordable in the Boston community. While culturally-appropriate foods were noted as available, African-born participants noted affordability as a concern and an influence on changes in their diets. The fast-paced "American lifestyle" of the U.S. and consequent time constraints was a consistent challenge for all study participants, with some adaptive strategies such as cooking in bulk during the weekends.

While this is one of the first studies in the U.S. to qualitatively apply the dietary acculturation model to the U.S. Black population, there are limitations worth noting. Firstly, due to challenges in recruitment, we only conducted one focus group for the African-born subsample. Although we collaborated with a community-based organization whose main clients were African immigrants, logistical concerns and leadership transitions within the organization presented a roadblock for facilitating an additional focus group. Time constraints also posed a concern for many participants who expressed initial interest, but could not commit to full participation. Future studies could recruit more study participants and consider additional incentives and strategies to address the issue of time

constraints in this demographic (i.e., providing transportation, child care services, etc.). Additionally, in our analyses we did not account for potential cultural differences of study participants who identify as Black racially but who are also ethnically Hispanic (i.e., participants from Honduras, Puerto Rico, etc.). Future studies could therefore explore these potential influences.

Given the geographic limitation of this research, future studies should examine Blacks in other cities throughout the U.S. The cultural influences on diet among U.S.-born Blacks in the South, for example, may differ from U.S.-born Blacks in other parts of the U.S. Additionally, as mentioned above, Boston includes an ethnically-diverse Black population, and the formation of ethnic enclaves has contributed to a demand for cultural foods. The dietary acculturation process and adaptive strategies may vary across region, however. Additionally, with the growing proportion of second and third generation Caribbean/Latin American-born and African-born people (i.e. children and grandchildren of immigrants), future studies could explore the impact of biculturism on dietary preferences and diet-related disease risk among this demographic. The application of intersectionality theory among Black immigrants as it relates to dietary and other lifestyle behaviors is also worth further exploration. While most of the literature exploring acculturation has focused on Asian and Hispanic populations (196, 200, 202), more literature is needed to understand the Black immigrant experience with the consideration of the differences in the U.S. sociopolitical and historical contexts and racialization of these groups.

Overall, this study suggests the importance of considering the ethnic diversity in the U.S. Black population and the potential value of applying such diversity when giving dietary advice rather than using a 'one size fits all' approach. With the growing Black immigrant population in the U.S., these research findings will be important for dietitians and nutrition practitioners working in communities with large Black immigrant populations and highlight some of the cultural assets and dietary strengths of various ethnic groups which should be considered in dietary counseling. Practitioners should account for the place of birth of their Black clients/patients, and consider the acculturation process when delivering culturally-appropriate dietary advice. This study also informs possible differences in diet that might underlie diet-related diseases among the U.S. Black population having important implications for future nutrition and health disparities research.

6.5 Conclusions

This novel study demonstrates the influence of culture and ethnicity on the diet of an ethnically-diverse Black population living in the Northeast U.S. and supports the influencers of change outlined in the model of dietary acculturation. Socioeconomic and demographic, environmental, and psychosocial factors contribute to dietary changes among Blacks who migrate to the U.S. and consequently the diet diversity in the U.S. Black population. For nutrition practitioners and dieticians, this diversity in culture among Blacks should be

considered when giving dietary advice in order to reduce the diet-related diseases that we see in this demographic.

Chapter 7: Conclusions

Overall, this dissertation research provides evidence for the importance of considering nativity among the U.S. non-Hispanic Black population in public health nutrition research, large national health and nutrition-related studies, and interventions designed for this demographic. Quantitatively, the results suggest a difference by nativity in hypertension risk and overall diet quality, with foreign-born Blacks demonstrating generally more favorable outcomes. The qualitative analysis likewise suggests variations in diet and cultural influences on dietary choice among U.S.-born, Caribbean/Latin-born, and African-born Blacks. Validating existing literature in this area, our study also showed that foreign-born, non-Hispanic Blacks, unlike Hispanic immigrants, are more likely to be educated and of higher socioeconomic status, than their U.S.-born counterparts. Like other Hispanic immigrants, however, Black immigrants have more favorable health behaviors such as smoking and physical activity habits. Additionally, length of residency was not significantly associated with hypertension risk and differences in total diet quality.

While these research findings generally support the healthy immigrant hypothesis among non-Hispanic Blacks, collectively, these findings reinforce there is no "one size fits all" approach for the immigrant experience, and suggest that the intersection of race/ethnicity and sociodemographic factors as well as the socio-historical context might differentially shape the acculturation process among foreign-born Blacks. Consequently, more comparative research exploring health outcomes between different immigrant groups in the U.S. is an area of

research worth further exploration. While culture and the acculturation process are important in describing immigrant health, social experiences of diverse immigrant groups are likewise importance to consider in health disparities research (207).

Additionally, although foreign-born Blacks were generally shown to have higher total diet quality and component scores than their U.S.-born counterparts, intakes of total fruit, vegetables, whole grains, and long chain omega-3 fatty acids, were still considerably lower than the national dietary recommendations. While the data show that U.S.-born Blacks have poorer diet quality than their foreign-born counterparts, these findings also suggest that nutrition interventions are generally needed for all non-Hispanic Blacks in the U.S. not just U.S.-born Blacks.

While there are strengths and novelty of this research, there are limitations worth recognition. Due to restrictions on publicly available data in NHANES and the risk for participant disclosure, we were unable to conduct the analysis with the consideration of specific country or region of birth (African-born, Caribbean-born), and thereby not able to consider the full extent of the heterogeneity within the foreign-born Black population. We were also unable to account for the data collection site or region of settlement in the analysis, which may have an impact on diet quality and ultimately disease risk among the foreign-born Black population. The dietary acculturation process, for example, may differ depending on the region of settlement in the U.S. and the availability and affordability of culturally appropriate foods. Despite these limitations, however, the NHANES

dataset was appropriate to use given the availability of objective health and nutrition data with a large cohort of both foreign-born and U.S.-born, non-Hispanic Blacks. For the qualitative aim, the small sample size and the geographic restriction to an urban setting in the northeast U.S. is also a limitation worth noting.

This dissertation research highlights areas of future research as it relates to the consideration of the ethnic diversity among the U.S. Black population in public health research. For future studies among Blacks, associations between nativity could be can also be considered for other disease outcomes beyond hypertension, such as kidney disease, diabetes and other cardiometabolic diseases. Additionally, the underlying factors underscoring the differences in hypertension and diet quality between foreign-born and U.S.-born Blacks is worth further exploration. We know, for example, that unhealthy food products are heavily marketed to Blacks and other racial minority groups, yet no study has examined the potential differential impacts of marketing on foreign-born and U.S.-born Blacks. Other factors such as potential differences in social supports and neighborhood-level characteristics should also be further explored.

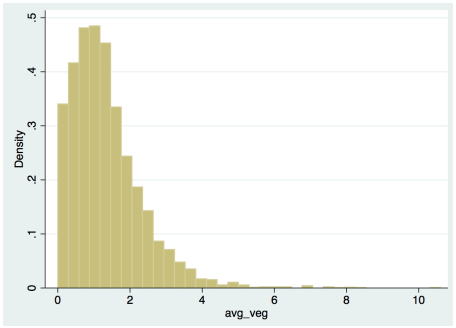
Overall, these study results suggest the importance of accounting for place of birth and ethnicity among Blacks in the U.S. in public health research. The Black immigrant experience is unique given the social and historical context in the U.S., and the experience and health outcomes of this group---particularly in relation to their U.S.-born counterparts---is understudied and worth further

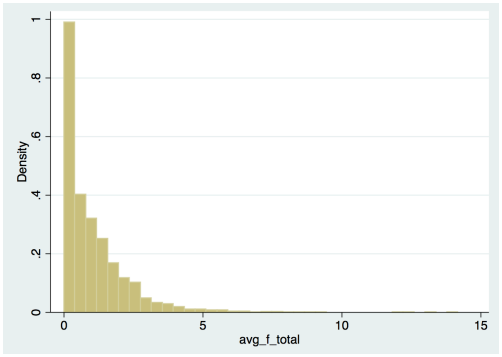
exploration in public health research. While it is well accepted that race is a social construct and ethnicity is an attribute related to language, culture and/or national origin, historically, definitions of race and ethnicity have evolved. The results of this study, therefore, provide support for further evolution of these definitions for use in research and large national surveillance studies to better evaluate and understand diet-related and other health disparities in the U.S. This expansion would not only help research among Blacks, but other racial groups, which are likewise heterogeneous. Ultimately, this delineation of disease outcomes and diet quality can be used in the design and development of culturally appropriate and targeted nutrition interventions to more effectively address these disparities in the future.

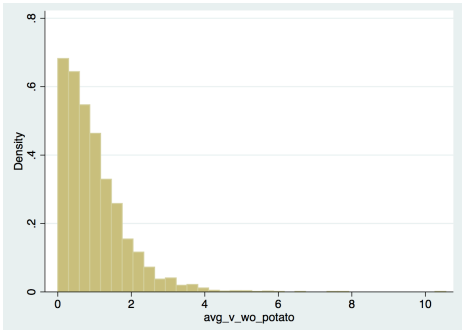
Appendices

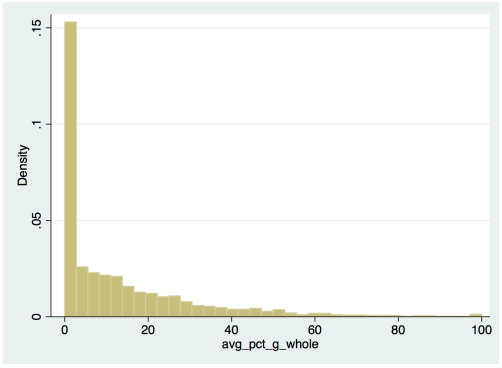
For all non-Hispanic Blacks

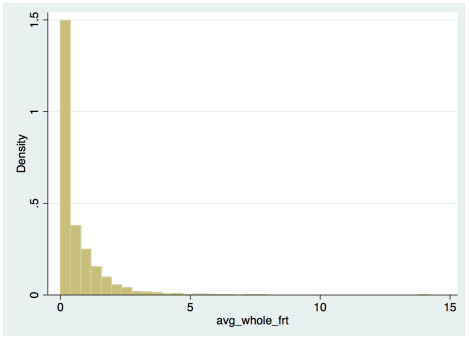
Appendix A: Frequency distributions of food component intakes

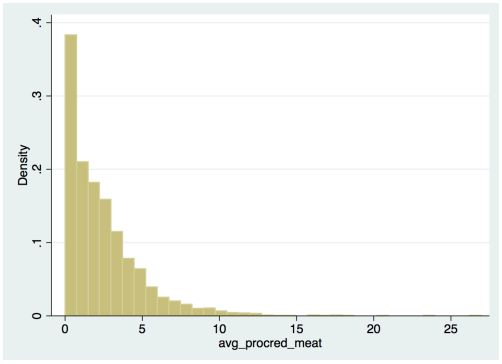


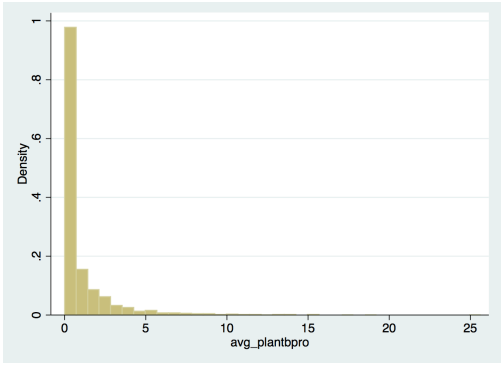








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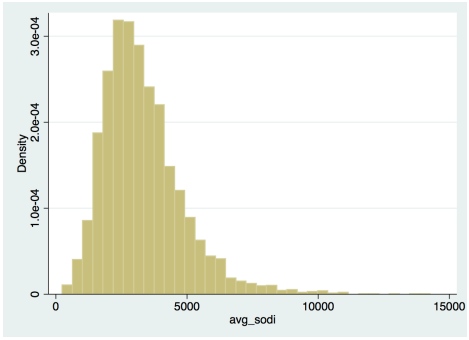
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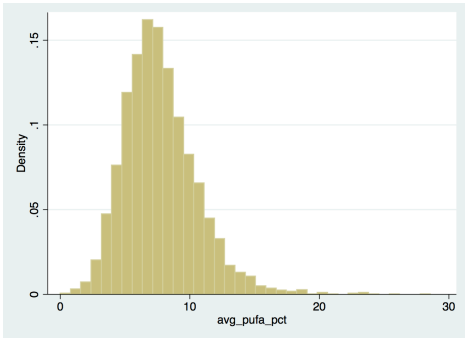
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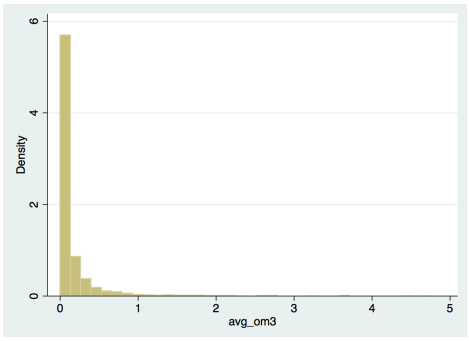
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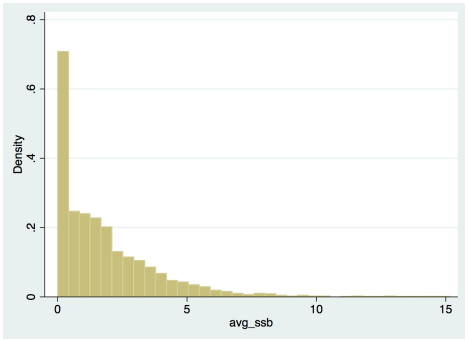
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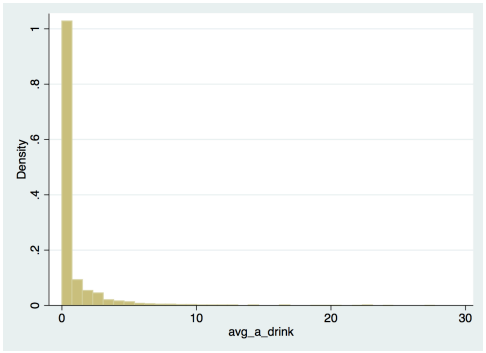
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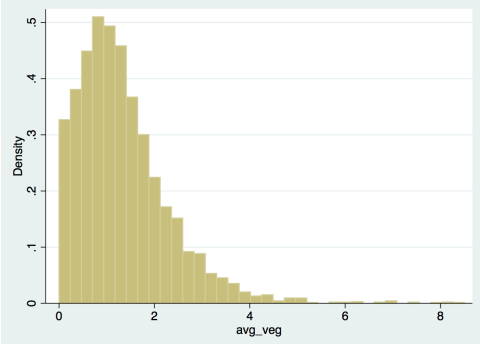

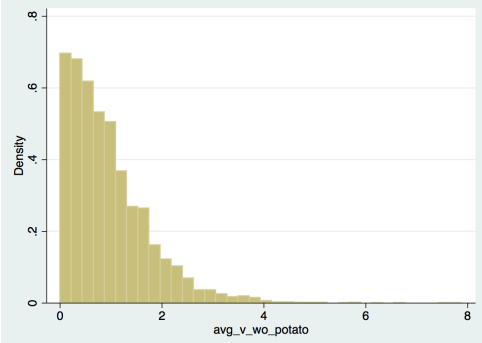

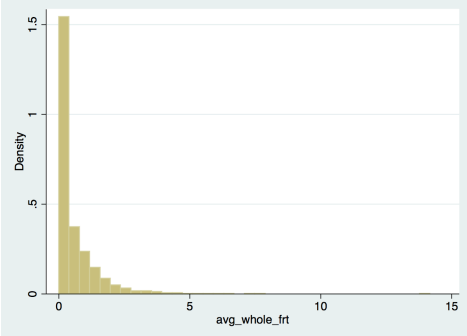

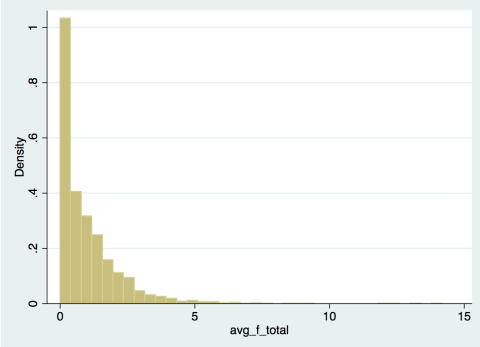

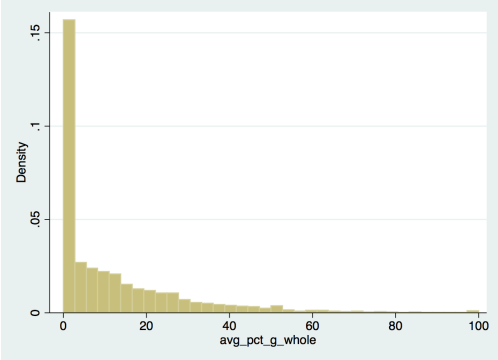

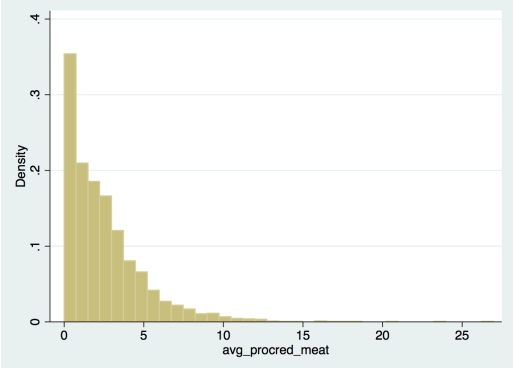

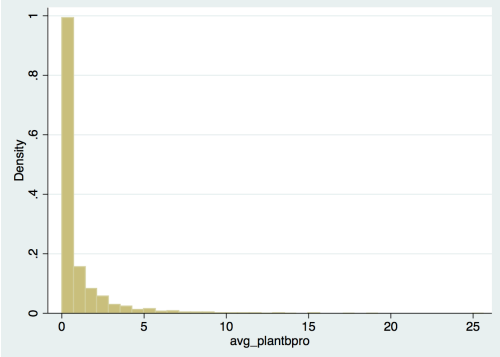

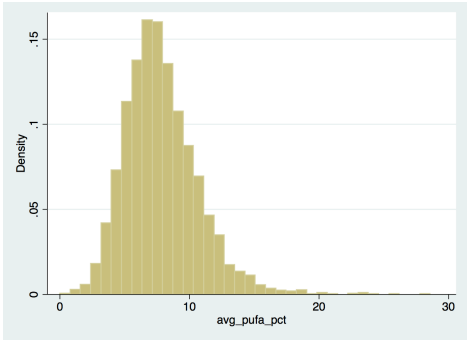
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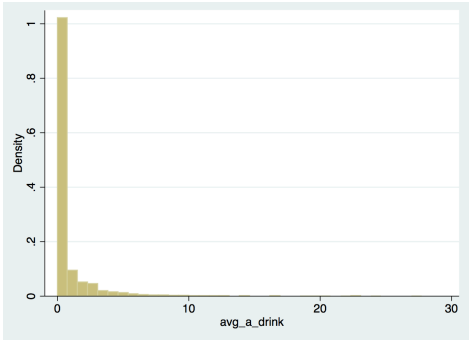
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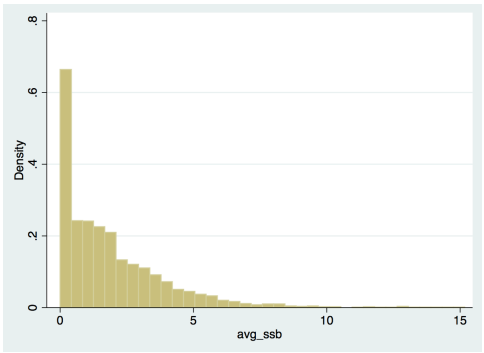
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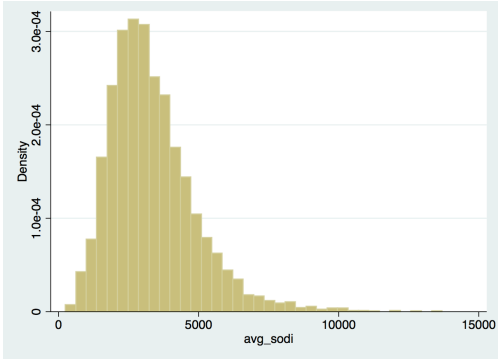
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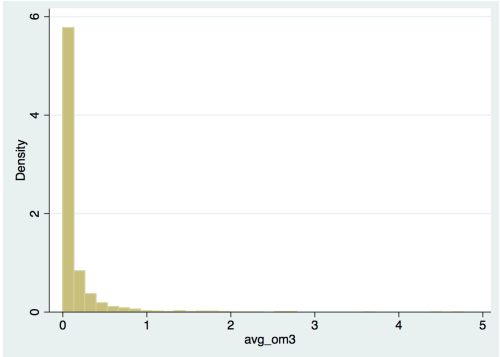
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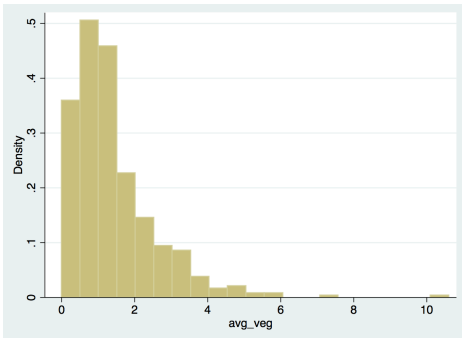
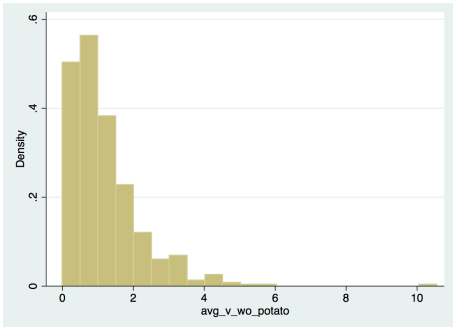
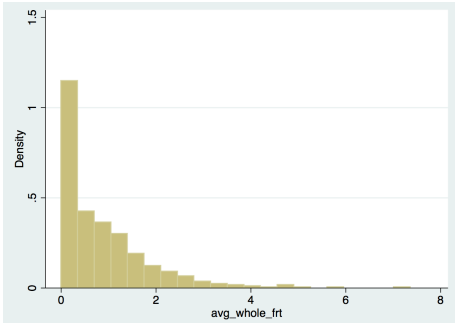
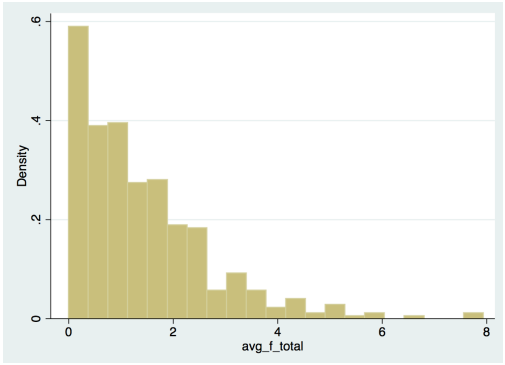
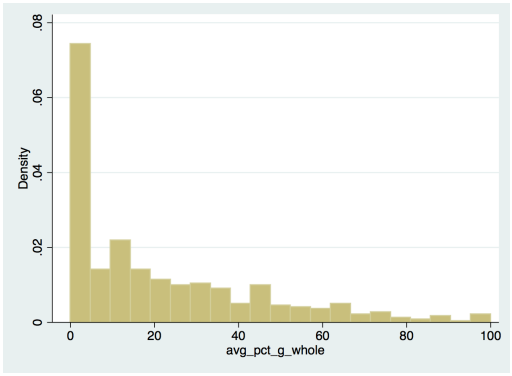
Frequency distributions for variables (For foreign-born, non-Hispanic Blacks)

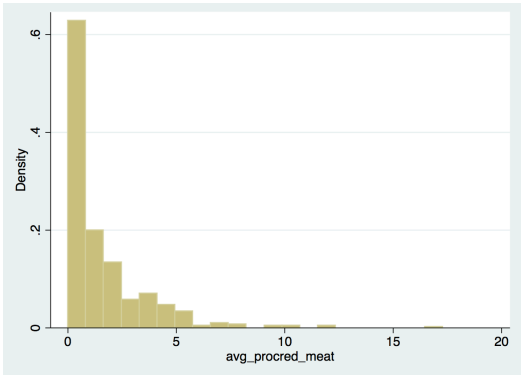


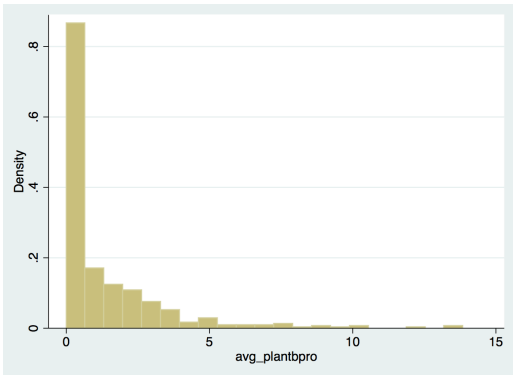


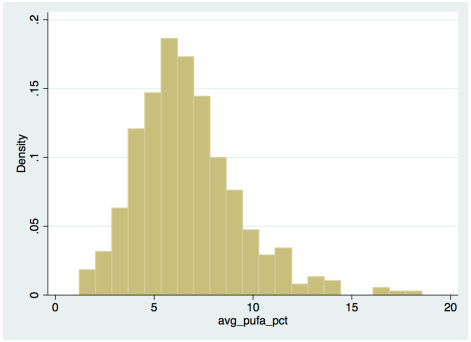








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20
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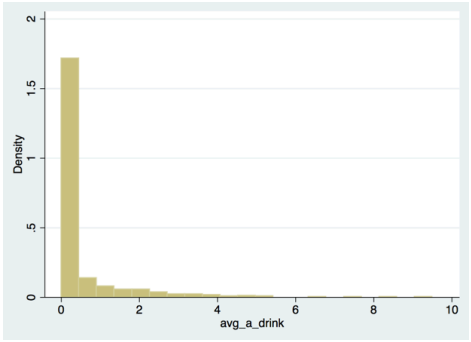
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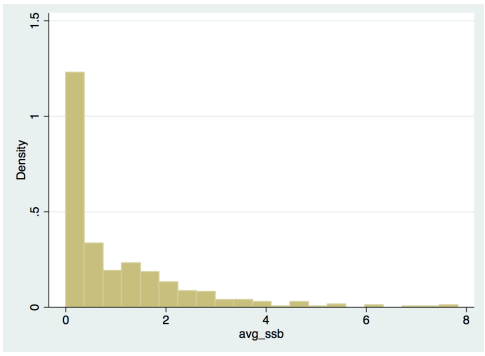
1.5
2
0
2
4
6
8
10
avg_a_drink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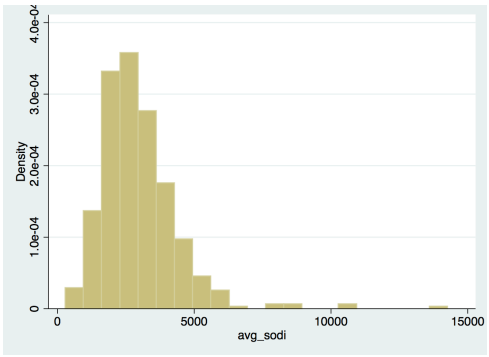
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4.0e-04
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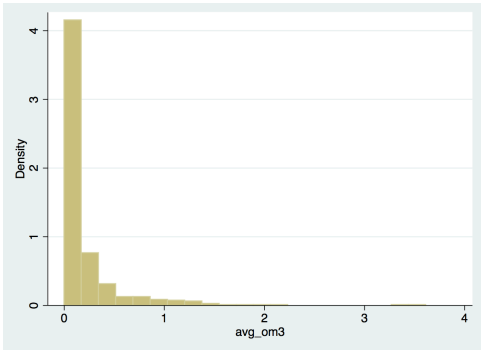
10000
15000
avg_sodi


Density
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2
3
4
0
1
2
3
4
avg_om3

Appendix B: Table of adherence to cut points and lack of any intake

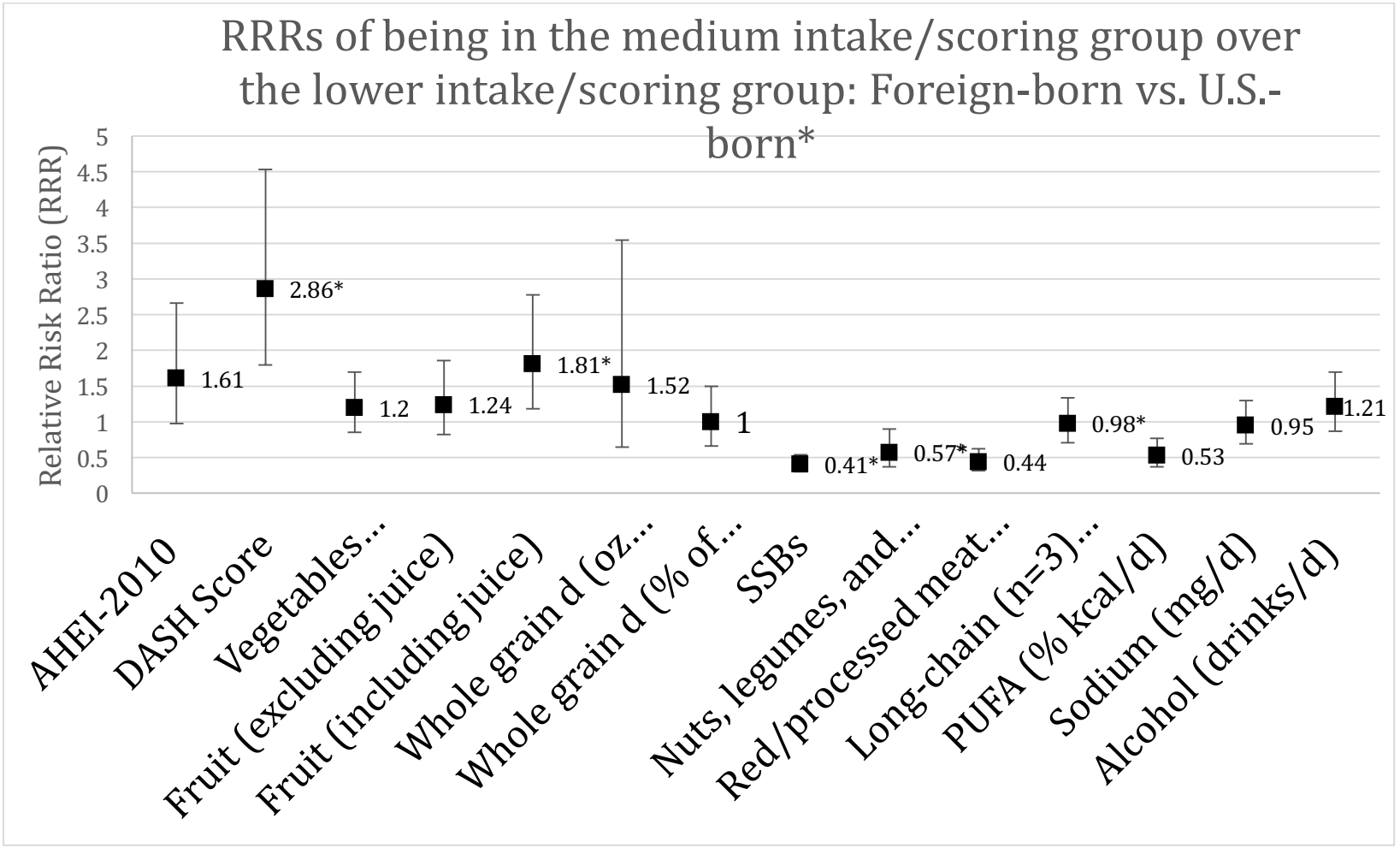
Unadjusted percent adherence to cut points and lack of any intake by U.S.-born and Foreign-born non-Hispanic Blacks, pooled NHANES 2003-2012

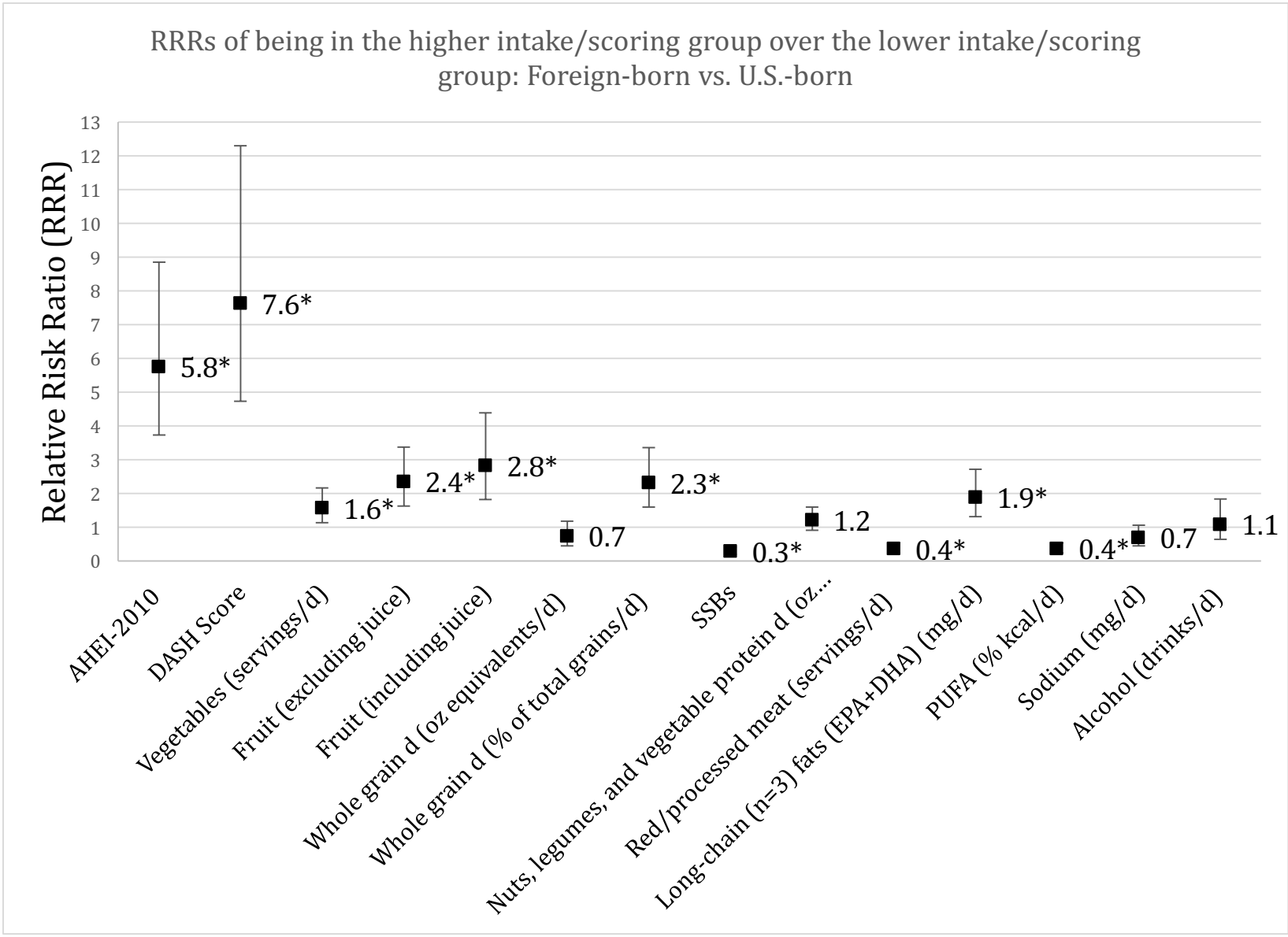
	All Blacks	All U.S.-born	All foreign-born		Foreign-born				
	n = 4,243	n=3,837	n=406	P value	<10 years (n=96)	10-19 years (n=93)	20-29 years (n=83)	≥30 years (n=100)	P value
Fruit									
Meets cut points (≥4 servings/d)	**0.86**	**0.68**	**2.64**	**0.03**	7.3	0.76	0.92	0	0.06
No intake at all	**39.0**	**40.3**	**25.8**	**0.00**	28.4	29.3	23.7	18.9	0.50
Vegetable									
Meets cut points (≥5 servings/d)	**0.16**	**0.11**	**0.63**	**0.05**	0.31	0	0.34	2.0	0.16
No intake at all	3.6	3.5	4.0	0.8	8.3	0	5.2	0.8	0.16
Whole grains									
Meets cut points (≥50% of total grains)	**3.8**	**3.0**	**12.5**	**0.00**	17.8	13.0	8.3	9.4	0.31
No intake at all	**38.9**	**40.0**	**27.9**	**0.001**	25.1	28.1	33.8	26.2	0.72
SSBs									
Meets cut points (no intake at all)	**23.2**	**21.5**	**40.5**	**0.00**	36.9	41.1	41.5	41.9	0.85
Processed meats									
Meets cut points (no intake at all)	**14.7**	**12.7**	**35.3**	**0.00**	44.2	26.5	36.2	30.7	0.14
Nuts, legumes, and vegetable protein									
Meets cut points (≥1oz equiv/d)	**25.1**	**24.2**	**34.1**	**0.0003**	30.9	29.6	35.4	44.3	0.43
No intake at all	39.3	39.2	40.4	0.69	50.2	44.8	31.7	31.4	0.23
Long-chain (n=3) fats (EPA+DHA)									
Meets cut points (≥250 mg/d)	**12.5**	**11.9**	**19.0**	**0.001**	17.4	19.2	18.3	23.8	0.76

No intake at all	2.9	2.9	3.1	0.86	0.94	5.3	3.9	3.5	0.44
PUFA									
Meets cut points (≥10% kcal/d)	**18.6**	**19.4**	**11.1**	**0.001**	**2.8**	**7.9**	**14.5**	**21.1**	**0.002**
No intake at all	0.0061	0	0.0067	0.76	0	0	0	0	
Sodium									
Lowest decile	**9.8**	**9.6**	**11.6**	**0.05**	16.5	6.1	9.2	14.1	0.24
Highest decile	**9.9**	**10.3**	**5.1**		4.5	7.2	7.7	5.3	
Alcohol									
Meets cut points (0.5-1.5 drinks/d for women, 0.5-2.0 for men)	11.6	11.6	11.8	0.91	8.4	8.5	20.3	13.2	0.13
No intake at all	72.6	74.8	72.4	0.34	78.0	79.8	65.1	72.4	0.21
Low fat dairy*									
No intake at all	84.4	85.0	78.2	0.004	83.4	79.6	70.6	75.4	0.28

*Low fat dairy excluded from DASH score given the high percentage of no intakes

Appendix C: Multinomial logistic regression figures




RRRs of being in the higher intake/scoring group over the lower intake/scoring group: Foreign-born vs. U.S.-born
Relative Risk Ratio (RRR)
13
12
11
10
9
8
7
6
5
4
3
2
1
0
5.8*
7.6*
1.6*
2.4*
2.8*
0.7
2.3*
0.3*
1.2
0.4*
1.9*
0.4*
0.7
1.1
AHEI-2010
DASH Score
Vegetables (servings/d)
Fruit (excluding juice)
Fruit (including juice)
Whole grain d (oz equivalents/d)
Whole grain d (% of total grains/d)
SSBs
Nuts, legumes, and vegetable protein d (oz…
Red/processed meat (servings/d)
Long-chain (n=3) fats (EPA+DHA) (mg/d)
PUFA (% kcal/d)
Sodium (mg/d)
Alcohol (drinks/d)

Appendix D: Secondary analysis with systolic and diastolic blood pressure

	Model 1 Age + Sex		Model 2 + Education + Poverty:Income + Health Insurance		Model 3 + Smoking Status + Physical Activity		Model 4 + BMI	
	β	95% CI	β	95% CI	β	95% CI	β	95% CI
SBP (n=5,304)								
US-born	--	--	--	--	--	--	--	--
Foreign-born	**-3.2**	**-4.8, -1.6**	**-2.9**	**-4.5, -1.37**	**-3.2**	**-4.8, -1.7**	**-2.3**	**-3.8, -0.9**
DBP (n=3,989)								
US-born	--	--	--	--	--	--	--	--
Foreign-born	-1.3	-2.8, 0.2	-1.4	-2.9, 0.2	-1.5	-3.1, 0.06	-0.7	-2.3, 0.7

Appendix E: Sensitivity analysis for waist circumference and marital status

	OR	95% CI	P value
Full model with BMI (n=5.033)			
US-born	--	--	--
Foreign-born	0.61	0.49, 0.77	<0.001
Full model with waist circumference (n=4,853)			
US-born	--	--	
Foreign-born	0.61	0.49, 0.77	<0.001

*Reference category is U.S.-born

	OR	95% CI	P value
Full model without marital status (n=5.033)			
US-born	--	--	--
Foreign-born	0.61	0.49, 0.77	<0.001
Full model with marital status (n=5,030)			
US-born	--	--	
Foreign-born	0.61	0.49, 0.77	<0.001

Appendix F: Sensitivity analysis results with 1st blood pressure measurement excluded

	Model 1 Age + Sex		Model 2 + Education + Poverty:Income + Health Insurance		Model 3 + Smoking Status + Physical Activity		Model 4 + BMI	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Hypertension w/ all available BP measurements (n=5,033)								
Place of birth								
US-born	--	--	--	--	--	--	--	--
Foreign-born	0.48	0.39, 0.60	0.50	0.40, 0.63	0.47	0.38, 0.59	0.61	0.49, 0.77
Hypertension excluding 1st BP measurement (n=4,927)								
Place of birth								
US-born	--	--	--	--	--	--	--	--
Foreign-born	0.50	0.40, 0.63	0.52	0.42, 0.65	0.49	0.39, 0.61	0.64	0.51, 0.80

Reference category is U.S. born

Model 1 adjusted for demographic factors of age and sex. Model 2 included the Model 1 variables as well as proxies for socio-economic status such as educational attainment, IPR, and health insurance status. Model 3 added behavioral factors such as smoking status, and physical activity. The final, full Model 4 added the health risk variable, BMI.

Appendix G: Ad hoc analysis data by gender and age (full model data shown)*

	OR	95% CI	P value
Full model by gender			
Male (n=2,471)			
U.S.-born	--	--	--
Foreign-born	0.76	0.53, 1.08	0.130
Female (n=2,562)			
U.S.-born	--	--	--
Foreign-born	0.51	0.37, 0.71	<0.001
Full model by age			
<65 y (n=4,089)			
U.S.-born	--	--	--
Foreign-born	0.56	0.43, 0.72	<0.001
≥65 y (n=944)			
U.S.-born	--	--	--
Foreign-born	1.46	0.78, 2.73	0.235

*Reference category is U.S. born

Appendix H: Recruitment Flyer

Appendix I: Research Participant Information Sheet

Research Participant Information Sheet
Understanding the Role of Ethnicity and Culture in Diet-Related Health Disparities among Blacks: A Qualitative Approach

INTRODUCTION
You are being invited to take part in a research to provide your insights as a self-identified Black/African American on the role culture and ethnicity influences your diet. The ultimate long-term goal of the research is to develop more effective programs to address diet-related diseases among Blacks in Boston and the U.S. Taking part in this research study is totally your choice. You can decide to refuse to participate in this study. If you decide to participate in this study, you can then choose to stop taking part in the study at any time for any reason. If you stop being in this research study, it will not affect how you are treated at Tufts Medical Center/Tufts University.

This research is being conducted as a part of a dissertation project at Tufts University's Friedman School of Nutrition Science and Policy. The PhD student conducting the study is interested in better addressing disparities in health outcomes among Blacks. To better understand the dietary influences of these disparities, the investigator will be hosting focus groups and interviews with community members living in predominately Black neighborhoods of Boston. Particularly, community members will share their insights on the way culture and ethnicity influences diet.
If you have any questions as a result of reading this information sheet, please ask Alison Brown before the study begins.

PROCEDURES
In this study, you will either be asked to participate in one focus group or a phone interview. The focus group discussion will last about 90 minutes and the interview will last no longer than 60 minutes. If you participate in the focus group you are limited to participate in one focus group discussion. We will recruit 21 community members for the interviews and 48 for the focus groups.

BENEFITS
There are no direct benefits to you for participating, however, the research findings will help to gain a better understanding of the cultural influences on diet among Blacks in order to develop more culturally appropriate nutrition interventions. Ultimately, this research will help to better address diet-related racial/ethnic health disparities among Blacks in the U.S.

RISKS

The research study poses minimal to no risk since it includes voluntary disclosure of information. Although there exists a slight risk of loss of confidentiality, this risk is minimized by coding the identifiable data. If you are not comfortable with any question you are free not to answer and can withdraw from the study at any time. In this case, your data will not be included in the study, however your data collected to that point will be included in the study.

CONFIDENTIALITY

The information you give and say in the focus groups or interview will be confidential. This means that only the research team will be able to see it. If you agree to take part in this research study, your personal information will not be given to anyone unless we get your permission in writing. It will only be given if the law requires it. Any recordings made will be destroyed once transcribed.
We will de-identify all information you give us. By "de-identify" we mean that we will remove your name and all other identifying information so that there is no way to link this data with you.
We will make every effort to keep your information private, but it cannot be totally guaranteed. The IRB of Tufts Medical Center and Tufts University Health Sciences or the study sponsor may check records that identify you. This might include your research records and the informed consent form you signed. The records of this study might also be reviewed to make sure all rules and guidelines were followed.

ALTERNATIVES

The alternative is to not participate in this survey.

RESEARCH RELATED INJURY

There are no expected physical risks to participation in this study, therefore research-related injury is not expected.

COST AND COMPENSATION

Participation in this study is at no cost to you. After completion of the focus group or key informant interview in its entirety, you will receive a $50 Visa Gift Card.

FOR FURTHER INFORMATION

Alison Brown will be glad to answer your questions about this study at any time. You may contact her using the contact information below.
Daytime: (617) 636-3686
After-hours: (202) 255-2409
Email address: Alison.brown@tufts.edu

BY COMPLETING THE FOCUS GROUP OR INTERVIEW YOU ARE CONFIRMING YOUR CONSENT TO PARTICIPATE IN THIS STUDY.

Appendix J: Initial Intake Questionnaire

Initial Questionnaire

Thank you again for agreeing to participate in the interview to explore how your culture and ethnicity relate to what you eat. This brief survey must be completed before the phone interview. It should only take 5 minutes or less to complete. The first set of questions ask to provide some information about yourself that will help with the research. The remainder of the survey asks about aspects of your household and upbringing.

Personal Information

1. What is your gender? (CIRCLE ONE) Male Female Other
2. What is your date of birth? _____ / _____ / _____
3. What racial/ethnic group do you most closely identify with? (CHECK ALL THAT APPLY)

   _____Black/African American

   _____Black/Caribbean

   _____Black/African

   _____Black/Latino

   _____Black/Other_____

4. Were you born in the U.S.? (CIRCLE ONE) Yes No

   If yes, skip to question 12.

5. What country were you born?_____

6. What year did you migrate to the U.S.?_____

7. What was the purpose of migrating to the U.S.? (CHECK ALL THAT APPLY)

   _____Education opportunities

   _____Work/employment opportunities

   _____Re-unite with family

   _____Medical reasons

   _____Conflict/natural disaster in home country

   _____Other_____

   _____Don't know

8. Describe how often (and for how long) you have travelled back and forth to your country of birth since moving to the U.S..

9. Of the food from your country of origin and American food, do you usually eat…? (CHECK ONLY ONE)
   _____Mainly food from my country of birth

   _____Mostly food from my country of birth and some American food

   _____Equal amounts of both food from my country of birth and American foods

   _____Mostly American foods and some food from my country of birth

   _____Mainly American food

10. Was you father born in the U.S.? (CIRCLE ONE) Yes No I don't know

If you answered “yes” or “I don’t know,” skip to Question 14.

11. What country was your father born in?

12. Was you mother born in the U.S.? (CIRCLE ONE) Yes No I don’t know

If you answered “yes” or “I don’t know,” skip to Question 16.

13. What country was your mother born in?

14. Were all of your grandparents born in the U.S.? (CIRCLE ONE) Yes No I don’t know

If you answered “yes” or “I don’t know,” skip to Question 18.

15. For your grandparent(s) that was not born in the U.S., please describe the country/countries of birth and relationship (i.e., “my mother’s mother was born in Ethiopia” or “my maternal grandmother was born in Ethiopia”, “my father’s father was born in Trinidad” or “my paternal grandfather was born in Trinidad”).

_____

_____

_____

_____

_____

_____

16. What is the highest level of education that you have completed? (CHECK ONE ONLY)

_____Eighth grade or less

_____Some high school

_____High school graduate or GED certificate

_____Associate's degree or some college

_____Bachelor's degree

_____Master's degree/graduate degree

17. What is your annual household income from all sources? (CHECK ONE ONLY)

_____Less than $24,999

_____$25,000 to $49,999

_____$50,000 to $74,999

_____$75,000 to $99,999

_____$100,000 or more

_____Prefer not to reply

18. What is your marital status? (CHECK ONE ONLY)

_____Now married

_____Widowed

_____Divorced

_____Separated

_____Never married

19. Who in your household does the cooking? (CHECK ONE ONLY)

____I am responsible for the cooking

____Someone else is responsible for the cooking

____I share the responsibility for the cooking

20. Who in your household does the grocery shopping? (CHECK ONE ONLY)

____I am responsible for the grocery shopping

____Someone else is responsible for the grocery shopping

____I share the responsibility for the grocery shopping

21. Was the person who prepared your meals when growing up born in the U.S.? (CIRCLE ONE) Yes No

If yes, thank you for your time. This concludes the survey. The focus group will begin shortly.

22. What country was this person born in?

23. What relationship did you have with this person?

____Mother

____Father

____Grandparents

____Caregiver/guardian

____Other_____

24. What was the purpose of him/her migrating to the U.S.? (CHECK ALL THAT APPLY)

_____Education opportunities

_____Work/employment opportunities

_____Re-unite with family

_____Medical reasons

_____Conflict/natural disaster in home country

_____Other_____

_____Don't know

Thank you for your time. This concludes the survey. The focus group will begin shortly.

Appendix K: Facilitator's Guides

FOCUS GROUP MODERATOR'S GUIDE

Understanding the Role Ethnicity and Culture in Diet-Related Health Disparities among Blacks

Good evening (afternoon) and welcome. Thank you for agreeing to participate in this focus group and taking the time to share your important opinions. I'm Alison Brown and I am PhD student at Tufts University here in Massachusetts. I am interested in learning the role that culture and ethnicity plays in diet in order to better address diet-related diseases among blacks in the U.S. We will be developing a program for African American women that we hope will help reduce their risk of developing heart disease, and would like to get your opinions and reactions to help us best meet the needs of women like you.

There are no right or wrong answers. We expect that you will have differing points of view, so please feel free to share yours even if it's different from what others have said. It is very important, however, that you respect what other group members are saying, even if you disagree with it.

I'm tape-recording this session because I don't want to miss any of your comments. Any reports about this group will include only your first name, so no one can identify who you are. All of your comments are confidential both to us and with each other. Also, please only speak one at a time so that we can get what everyone is saying on the tape. We're interested in hearing from each of you. To make sure of this, if you're talking a lot, I may ask you to give others a chance so that everyone's opinion is heard. If you aren't saying much, I may call on you. We just want to make sure that we hear from all of you.

Feel free to get up and have more refreshments if you like, or go to the bathroom, which is located _____. But please make sure that you leave or get up one at a time. Even if you don't have anything to say, it is important to be present and listen to others, since that might spark some of your opinions.

We also have nametags on to help us remember each other's names. If you want to follow up on something someone has said, or if you want to agree, disagree, or give an example, please feel free to do that. Or I just might call on one of you if it seems like you have something to share with the group.

When I ask a question, you don't have to answer in any particular order. (**Explain popcorn technique**). To get started, please tell us your first name and your favorite food (or memorable experience with food).

Topic 1: Culture and Diet (Dietary Changes)

1. How does the culture of your ethnic group influence the way you eat?

2. Can you share any particular foods/dishes that you eat from your culture?
a. Can you share any particular spices?
b. Can you share any particular meats?
c. Can you share any particular fruit and/or vegetable?

3. *In what ways has your diet changed since you've moved to the U.S.? (asked during the foreign-born Black FGs)*

4. *In what ways has your diet stayed the same since you've moved to the U.S.? (asked during the foreign-born Black FGs)*

Topic 2: Environmental Factors

5. Describe the availability of traditional/culturally appropriate foods in your community.

a. If traditional/culturally appropriate foods are available, how would you describe their prices? Affordable? Not affordable?

b. If traditional/culturally appropriate foods are available, describe your travel time to get these foods

6. Describe the time that you have to devote to preparing foods from your home country or culture.

7. Describe the availability of restaurants that serve the food or similar food from your home country.

8. In what way does time availability play a role in your preparation of foods from your home country?

Topic 3: Psychosocial Factors

1. In what ways has your preference for foods changed (if at all) since you moved to the U.S.? *(asked during the foreign-born Black FGs)*

2. In what ways has your beliefs about diet-related disease such as heart disease, diabetes, and obesity changed since you moved to the U.S.? *(asked during the foreign-born Black FGs)*

a. How have these beliefs influenced the way you eat?

3. In what ways is your preference for foods influenced by your culture?

4. What are your thoughts on African Americans' perception about diseases such as high blood pressure, diabetes (sugar), and heart disease?

a. How have these beliefs influenced the way you eat?

(Summarize). Do you have anything you want to add?

Thank you very much for your time. The information that you've given me will be very helpful and will be used to influence the development of culturally appropriate interventions to help with health disparities among Blacks in Boston and the U.S.

Understanding the Role Ethnicity and Culture in Diet-Related Health Disparities among Blacks

In-depth Interview Guide—U.S.-born

My name is Alison Brown and I'm a PhD student from Tufts University. Thank you for taking the time to participate in today's interview for us to learn more about the ways culture and ethnicity influence eating. I am interviewing 12 people who have expressed interest in being a part of the research. I'd like to ask you about how you think your ethnicity and culture influence the way you eat. You answered some general questions about yourself in the initial questionnaire and I'd like to ask you a little more specific information. This interview will take no more than 1 hour.

Before we begin, it is necessary for me to read you the statement of confidentiality and to also request your permission for this phone conversation to be recorded. I will now read aloud the statement of confidentiality and ask for a verbal agreement from you to record the phone call.

Statement of Confidentiality: Please be assured that your responses to questions in this phone conversation will not be traced back to you in the reporting of this study. If you do not feel comfortable answering any of the questions asked in this interview or do not want to continue this interview, for any reason, please tell me and the interview will end.

If you give us your permission to conduct this interview please say "Yes" now.

Yes →Proceed to next question regarding permission to record.
No → Thank her and end the interview.

We now request your permission to record this phone conversation. Recordings of this phone call will be transcribed into a written document so that we may have an accurate record of the conversation for analysis by Tufts researchers. Recordings of the phone call will be kept confidential by storing the audio file in a password-protected location accessible only to research personnel. The recordings will be deleted as soon as they have been transcribed.

If you give us your permission for this phone call to be recorded, please say "Yes" now.

Yes →Proceed with interview.
No → Ask, "*Are you willing to do the interview without recording it?*"
Indicate the interviewee's response by checking the appropriate box:
□Yes → Proceed with interview.
□No → Thank him/her and end the interview.

If you need to think about a question for a little while before answering, please take the time that you need. Do not feel like you are under any pressure to answer these questions quickly or in a certain way. I am interested in your most thoughtful and honest responses.

KEY TOPIC AREA 1: Perceptions about cultural influences

First, I'm going ask about your culture might influence your eating habits. Culture in this context means any group's language, religion, food, social habits, music and arts, preferences, and beliefs.

1. How do you think the African American culture influences your eating? And when I say eating, this can mean what you eat, how you eat, how often, etc.?

2. How does your religion influence the way you eat?

3. How does the make up of those living in your community influence the way you eat? When I say make-up I mean, who lives there and their background.

KEY TOPIC AREA 2: Personal factors (sociodemographic and demographic factors)

Next, I'm going ask about personal factors and aspects of your upbringing that might influence your eating habits.

1. Do you think the education or income of your parents had an impact on the way that you ate when you were a child?
a. How has this changed, if at all, today?

2. Do you think your education or income has an impact on the way you eat now?

3. In what ways do you think the other people who live with you influence your eating?
a. For example, older adults in the household or spouse.

4. In what way has living in Boston influenced your eating?

KEY TOPIC AREA 3: Perceptions about taste factors, attitudes, and preferences

The final set of questions is about your taste preferences attitudes about traditional African American foods (soul food).

5. How has your taste preferences changed since you were younger?

a. If your eating has changed, what do you think has contributed to these changes?

6. Talk about the importance you place on eating your traditional African American foods.

7. Talk about the importance of an Americanized diet?
b. What are your thoughts on the African American diet (or soul food) compared to the traditional American diet?

8. What are your thoughts on African Americans' perception about diseases such as high blood pressure, diabetes (sugar), and heart disease?
a. What do you think of their understanding of the link between diet and these diseases?
b. How does that differ with other segments of the U.S. population?

CONCLUSION

Summarize what was said. Do you think that accurately reflects what we talked about today?

Is there anything you would have liked to talk about that we didn't cover?

In-depth Interview Guide---Foreign-born

My name is _____ and I'm a PhD student from Tufts University. Thank you for taking the time to participate in today's interview for us to learn more about the ways culture and ethnicity influence eating. I am interviewing 12 people who have expressed interest in being a part of the research. I'd like to ask you about how you think your ethnicity and culture influence the way you eat. You answered some general questions about yourself in the initial questionnaire and I'd like to ask you a little more specific information. This interview will take no more than 1 hour.

Before we begin, it is necessary for me to read you the statement of confidentiality and to also request your permission for this phone conversation to be recorded. I will now read aloud the statement of confidentiality and ask for a verbal agreement from you to record the phone call.

Statement of Confidentiality: Please be assured that your responses to questions in this phone conversation will not be traced back to you in the reporting of this study. If you do not feel comfortable answering any of the questions asked in this interview or do not want to continue this interview, for any reason, please tell me and the interview will end.

If you give us your permission to conduct this interview please say "Yes" now.

Yes →Proceed to next question regarding permission to record.
No → Thank her and end the interview.

We now request your permission to record this phone conversation. Recordings of this phone call will be transcribed into a written document so that we may have an accurate record of the conversation for analysis by Tufts researchers. Recordings of the phone call will be kept confidential by storing the audio file in a password-protected location accessible only to research personnel. The recordings will be deleted as soon as they have been transcribed.

If you give us your permission for this phone call to be recorded, please say "Yes" now.

Yes →Proceed with interview.
No → Ask, "*Are you willing to do the interview without recording it?*"
Indicate the interviewee's response by checking the appropriate box:
□Yes → Proceed with interview.
□No → Thank him/her and end the interview.

If you need to think about a question for a little while before answering, please take the time that you need. Do not feel like you are under any pressure to answer these questions quickly or in a certain way. I am interested in your most thoughtful and honest responses.

KEY TOPIC AREA 1: Personal factors (sociodemographic and demographic factors)

4. Think back to when you first migrated to the U.S. compared to now. How has your eating changed today, if at all?
a. When I say eating, I mean what you ate, how often you eat, etc.
b. Have their been changed in your meat intake?
c. Have their been changed in your fish intake?
d. Have their been changes in your fruit and vegetable intake?
e. Have their been changes in your nut and bean intake?

5. In what ways do you think your age of migration might have influences your diet today?
a. Specifically, consider this influence as it relates to your diet today and when you first migrated to the U.S.

6. People come to the U.S. for many different reasons, for some more educational opportunities and for other economic opportunities in what ways did your personal circumstances contribute to your diet when you came to the U.S.?

Probe for economic and educational circumstances

7. Do you think your education or income had an impact on the way that you ate when you first came to this country?
a. Has this changed at all today? And if so, how?

8. In what ways do you think the other people who currently live with you influence your eating?
a. For example, older adults in the household

9. In what way has living in Boston influenced your eating of traditional foods from your culture?

KEY TOPIC AREA 2: Perceptions about cultural influences
Next, I'm going ask about how things your culture might influence your eating habits.
Culture in this context means any group's language, religion, food, social habits, music and arts, preferences, and beliefs.

10. How do you think the culture of [country of origin] influences your eating and diet? This can include what you eat, how you eat, how often, etc.?

11. How does your religion influence the way you eat?

12. How does the make up of those living in your community influence the way you eat? When I say make-up, I mean who lives there and their background.

KEY TOPIC AREA 3: Perceptions about taste factors, attitudes, and preferences

The final set of questions is about your taste preferences attitudes about traditional eating patterns in your home country.

13. How has your taste preferences changed since you first migrated to the US, if at all?

c. If your eating has changed, what do you think has contributed to these changes?

14. Talk about the importance or value you place on eating the traditional foods from your country of origin.
15. Talk about the importance or value of an Americanized diet?

d. What are your thoughts on your country of origin's way of eating compared to those in the U.S.?

16. What are your thoughts on the country of origin's understanding of about diseases such as high blood pressure, diabetes (sugar), and heart disease?

a. Do you think people know the link between these diseases and diet?
b. How does that differ with the U.S.?

17. In what ways, if any, have your thoughts about diseases such as high blood pressure, diabetes, and heart disease changed since you came to the U.S.?

CONCLUSION

Summarize what was said. Do you think that accurately reflects what we talked about today?

Is there anything you would have liked to talk about that we didn't cover?

Appendix L: Qualitative Analysis Codebook

Node #	Node Name	Definition	Inclusion	Exclusion
1	**Domain 1: Cultural Influences**			
1.1	Food Components			
1.1.1	Meat	Any type of meats eaten influenced by culture	In context of cultural influences on diet	Reference to *change* in diet since moving to the U.S.
1.1.2	Fish	Any type of fish influenced by culture	In context of cultural influences on diet	Reference to *change* in diet since moving to the U.S.
1.1.3	Fruit	Any type of fruit influenced by culture	In context of cultural influences on diet	Reference to *change* in diet since moving to the U.S.
1.1.4	Grains	Any type of grain	Reference to *change* in diet since moving to the U.S.	General reference to cultural influences on diet
1.1.5	Vegetables	Any type of vegetables influenced by culture	In context of cultural influences on diet	Reference to *change* in diet since moving to the U.S.
1.1.6	Nut and beans	Any type of nuts and beans influenced by culture	In context of cultural influences on diet	Reference to *change* in diet since moving to the states
1.1.7	Beverages	Any type of beverage (tea, coffee, SSBs) influenced by culture	In context of cultural influences on diet	Reference to *change* in diet since moving to the states

1.1.8	Spices and seasonings	Any type of spice or seasoning (fresh or dried) influenced by culture	In context of cultural influences on diet	Reference to *change* in diet since moving to the states
1.2	Religious holidays	Influence of religious customs on diet	In context of cultural influences on diet	Reference to *change* in diet since moving to the U.S.
1.3	Portion Size	Description of cultural influence on portion size	In context of cultural influences on diet	Reference to *change* in diet since moving to the U.S.
1.4	Healing Foods	Description of cultural influence on foods used to heal and treat disease	In context of cultural influences on diet	Reference to *change* in diet since moving to the U.S.
1.5	Timing of Meals	Cultural influence on the timing/frequency of meals	In context of cultural influences on diet	Reference to *change* in diet since moving to the U.S.
1.6	Meal Preparation	Cultural influence on meal preparation techniques	In context of cultural influences on diet	Reference to *change* in diet since moving to the U.S.
1.7	Cooking time	Cultural influence on cooking time	In context of cultural influences on diet	Reference to *change* in diet since moving to the U.S.
1.8	Dishes	Specific cultural dishes	In context of cultural influences on diet	Reference to *change* in diet since moving to the U.S.
1.9	Distrust of American Systems	Cultural influence on distrust of American	In context of cultural influences	Reference to *change* in diet since moving to

		systems (medical and food)		the U.S.
2	**Domain 2: Change in Diet**			
2.1	Level of Processing of Foods	Types of processing and form of food (i.e., canned, whole foods, etc)	Reference to *change* in diet since moving to the U.S.	General reference to cultural influences on diet
2.2	Food Components	Components of diet	Reference to *change* in diet since moving to the U.S.	General reference to cultural influences on diet
2.2.1	Meat	Any type of meats eaten	Reference to *change* in diet since moving to the U.S.	General reference to cultural influences on diet
2.2.2	Fish	Any type of fish	Reference to *change* in diet since moving to the U.S.	General reference to cultural influences on diet
2.2.3	Fruit	Any type of fruit	Reference to *change* in diet since moving to the U.S.	General reference to cultural influences on diet
2.2.4	Grains	Any type of grain	Reference to *change* in diet since moving to the U.S.	General reference to cultural influences on diet
2.2.5	Vegetables	Any type of vegetables	Reference to *change* in diet since moving to the U.S.	General reference to cultural influences on diet
2.2.6	Nut and beans	Any type of nuts and beans	Reference to *change* in diet since moving to the U.S.	General reference to cultural influences on diet

2.2.7	Beverages	Any type of beverage (tea, coffee, SSBs)	Reference to *change* in diet since moving to the U.S.	General reference to cultural influences on diet
2.2.8	Spices and seasonings	Any mention of spices or seasonings	Reference to *change* in diet since moving to the U.S.	General reference to cultural influences on diet
2.3	Religious holidays	If mention of specific foods were eaten around a particular religious holiday	Reference to *change* in diet since moving to the U.S.	General reference to cultural influences on diet
2.4	Portion Size	Description of a change in portion size	Reference to *change* in diet since moving to the U.S.	General reference to cultural influences on diet
2.5	Timing of Meals	Description of change in the timing/frequency of meals and snacks	Reference to *change* in diet since moving to the U.S.	General reference to cultural influences on diet
2.6	Size of Meals	Description of change of size of meals (breakfast, lunch and dinner)	Reference to *change* in diet since moving to the U.S.	General reference to cultural influences on diet
2.7	Dishes	Description of specific dishes prepared	Reference to *change* in diet since moving to the U.S.	General reference to cultural influences on diet
2.8	Meal Preparation	Description of changes in meal preparation techniques	Reference to *change* in diet since moving to the U.S.	General reference to cultural influences on diet
2.9	Cooking time	Description of changes in time devoted to	Reference to *change* in diet since moving	General reference to cultural influences on

		cooking since moving to the U.S.	to the U.S.	diet
2.10	Healthy Adaptations	Description of healthy adaptations to cultural foods	Reference to *change* in diet since moving to the U.S.	General reference to cultural influences on diet
2.11	Resource Adaptations	Description of adaptations to cultural foods due to availability of food resources	Reference to *change* in diet since moving to the U.S.	General reference to cultural influences on diet
3	**Domain 3: Influencers of Change**			
3.1	Environmental Influences			
3.1.2	Access to Culturally Appropriate Foods	Descriptions of methods of acquiring culturally appropriate foods	Food retailers, community attributes (includes barriers and facilitators)	
3.1.3	Exposure to Diverse Diets	Descriptions of experiencing various foods outside interviewee's cultural diet	Types of foods, restaurants, community attributes	
3.1.4	Media	Descriptions of exposure to media and its influence on knowledge or perceptions of diet, food, or health	Magazines, TV, radio	
3.1.5	Transportation	Reference to	Different tools of	

		transportation to get culturally appropriate foods	transportation	
3.1.6	American Lifestyle	Reference to fast-paced American lifestyle		
3.1.7	Quality of Foods	Description of quality of food in the participants' neighborhood and how that influences where they purchase their food		
3.2	Social Influences			
3.2.1	Social Groups	Influence of social networks on diet		
3.2.2	Workplace	Description of work place (events, people) influences diet		
3.2.3	Family/Friends	Description of influence of family and friends on diet	Stories surrounding influence of friends and families	
	Children	Particular influence of children on diet		
	Parents / Caretakers	Particular influence of parents/caregivers on diet		
	Spouse	Particular influence of spouses on diet		

	Friends	Particular influence of friends on diet		
3.2.4	Age of Immigration	Influence of age of immigration on diet		
3.2.5	Reasons for Immigration	Influence of circumstances of immigration on diet		
3.3	Education and Knowledge			
3.3.1	Exposure to Nutrition Knowledge	Particular influence of exposure to nutrition knowledge on diet	References to exposure to nutrition knowledge through media, social interaction, and any forms of meetings or conferences	References to professional training, preparation, and experiences in educational programs and institutions
3.3.2	Formal Education	Influence of any involvement in educational programs and institutions on diet	References to professional training, preparation, and experiences in educational programs and institutions	References to exposure to nutrition knowledge through media, social interaction, and any forms of meetings or conferences
3.3.3	Value for Health	Descriptions of good health as a positive outcome and/or desire for good health	References to an idealized (not sure this is the right word - I mean not personal) state of good health	References to personal health status (current or past)

3.3.4	Sharing Knowledge	Description of personal interactions in which knowledge about specific diseases is or is not shared	Mentions of past conversations in which knowledge was shared or intent to share knowledge in the future	Diagnoses, impersonal knowledge dissemination (e.g. media, classes)
3.4	Income			
3.4.1	Influences Food Purchases	Influence of income on historical and current food purchases	In context of income influences on diet	Reference to influences of food programs and social supports on diet
3.4.2	Adaptations	Influence of income on adaptations to current diet	In context of income influences on adaptations to current diet	Reference to influences of food programs and social supports on adaptations
3.4.3	Food Program Participation	Influence of food program participation on food purchases and choices	In context of food program participation influences on diet	In context of income influences on diet
3.5	Disease History			
3.5.1	Family Disease History	Specific disease diagnoses of family members	Disease relating to family members	Disease relating to the interviewee
3.5.2	Personal Diagnosis	Specific disease diagnoses of respondent	Disease relating to the interviewee	Disease relating to family members
3.6	Preference and Values			
3.6.1	Preference for Cultural Foods	Description of a personal preference of	Current preferences	

		foods associated with interviewee's culture and/or home country		
3.6.2	Preference for Agriculture of Foods	Description of preferred agricultural or production system	Methods of growing vegetables, how these preference dictate buying patterns	Food preparation
3.6.3	Change in Taste Preferences	Description of current taste preferences and how they differ from previous preferences	Reference to *change* in diet since moving to the U.S.	General reference to taste preferences
3.6.4	Value for Connection	Descriptions of love or connection as a positive outcome and/or desire for love and connection		
3.7	Language	Any influence of language on diet choice		
4	**Domain 4: Knowledge in Home Country**			
4.1	Knowledge in Home Country	Description of knowledge of diseases in home country	Descriptions of understanding, knowledge; in context of home country	Diagnoses; in context of USA
5	**Domain 5: Diet Disease and Well-Being**			
5.1	Diet's Influence on Disease / Well-being	Description of the impact of diet and food on disease and health outcomes		Discussion of disease unrelated to diet and food

6	**Domain 6: Perceptions of Influence**			
6.1	Barrier	Any factor that interferes with adherence to cultural diets		
6.2	Facilitator	Any factor that facilitates adherence to cultural diets		

*Appendix M: Table of multivariate logistic regression of predictors (full model) of hypertension status among Blacks, pooled NHANES 2003-2004 to NHANES 2013-2014**

N= 3,808	Model 1 Age + sex			Model 2 + education + income + health insurance			Model 3 + smoking status + physical activity + sodium intake			Model 4 + BMI		
Variables**	OR	95% CI	p value	OR	95% CI	p value	OR	95% CI	p value	OR	95% CI	p value
Place of birth												
US-born	--	--	--	--	--	--	--	--	--	--	--	--
Foreign-born	**0.48**	**0.38, 0.60**	**<0.001**	**0.50**	**0.40, 0.63**	**<0.001**	**0.47**	**0.38, 0.59**	**<0.001**	**0.61**	**0.49, 0.77**	**<0.001**
Age (years)	**1.10**	**1.09, 1.11**	**<0.001**	**1.10**	**1.09, 1.11**	**<0.001**	**1.10**	**1.09, 1.11**	**<0.001**	**1.11**	**1.10, 1.11**	**<0.001**
Sex												
Male	--	--	--	--	--	--	--	--	--	--	--	--
Female	**1.16**	**1.01, 1.33**	**0.035**	1.11	0.97, 1.28	0.116	1.08	0.94, 1.24	0.275	**0.87**	**0.75, 1.00**	**0.045**
IPR	--	--	--	0.91	0.86, 0.96	0.002	**0.90**	**0.85, 0.96**	**0.001**	**0.90**	**0.85, 0.96**	**0.001**
Education level												
< High School	--	--	--	--	--	--	--	--	--	--	--	--
High School or equivalent	--	--	--	0.92	0.75, 1.14	0.455	0.91	0.74, 1.13	0.396	0.87	0.71, 1.07	0.192
Some college	--	--	--	1.00	0.83, 1.20	0.989	0.98	0.81, 1.18	0.813	0.91	0.76, 1.08	0.285
≥College degree	--	--	--	0.81	0.63, 1.03	0.089	**0.77**	**0.60, 0.99**	**0.046**	0.75	0.58, 0.97	0.028
Health insurance status												
Yes	--	--	--	--	--	--	--	--	--	--	--	--
No	--	--	--	**0.73**	**0.61, 0.88**	**0.001**	**0.74**	**0.61, 0.89**	**0.002**	**0.76**	**0.63, 0.92**	**0.005**

Smoking status												
Never	--	--	--	--	--	--	--	--	--	--	--	--
Former	--	--	--	--	--	--	**0.80**	**0.65, 0.99**	**0.039**	0.78	0.63, 0.97	0.025
Current	--	--	--	--	--	--	0.80	0.67, 0.94	0.009	0.96	0.80, 1.15	0.625
Physically active***												
Moderate and/or vigorous	--	--	--	--	--	--	--	--	--	--	--	--
No moderate and/or Vigorous	--	--	--	--	--	--	0.98	0.84, 1.14	0.775	1.01	0.87, 1.17	0.878
BMI (kg/m^2)	--	--	--	--	--	--	--	--	--	**1.08**	**1.07, 1.09**	**<0.001**

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[*] Hypertension is defined as mean systolic blood pressure (SBP) ≥140 mm Hg or mean diastolic blood pressure (DBP) ≥90 mm Hg (based on mean of two readings), current treatment for hypertension with prescription medication or was told by a doctor or health professional that he/she had hypertension.
[**] Continuous variable unless otherwise specified
[***] Based on self-report of engaging in moderate and/or vigorous leisure/recreational physical activity for at least 10 minutes over the past 30 days.

Model 1: Demographic variables
Logit HTN_YN = $\beta o + \beta_1$ placeofbirth (main predictor) + $\boldsymbol{\beta_2}$**age +** $\boldsymbol{\beta_3}$ **sex** + u

Model 2: Demographic + socioeconomic variables
Logit HTN_YN = $\beta o + \beta_1$ placeofbirth (main predictor) + $\beta_2$age + β_3 sex + $\boldsymbol{\beta_5}$ **income +** $\boldsymbol{\beta_6}$**educ** + $\boldsymbol{\beta_7}$**healthinsurance +** u

Model 4 (Full model): Demographics + socioeconomic + health risk variables
Logit HTN_YN = $\beta o + \beta_1$ placeofbirth (main predictor) + $\beta_2$age + β_3 sex + β_5 income + $\beta_6$educ + $\boldsymbol{\beta_7}$**healthinsurance** + $\boldsymbol{\beta_8}$**smokingstatus +** $\boldsymbol{\beta_9}$**PAlevel +** $\boldsymbol{\beta_{10}}$ **sodium quintile +** $\boldsymbol{\beta_{11}}$**BMIl**

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