Are There Migrant Health Advantages or Negative Immigrant Adaptations in Hypertension Awareness, Treatment, and Control?

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ABSTRACT

Latin American migrants in the U.S. have a lower prevalence of many chronic diseases relative to several race/ethnic groups with higher socioeconomic status (SES). We study whether this (paradoxical) health advantage translates into more effective chronic disease control, or whether poor control is a pathway by which increasing U.S. experience worsens migrant health. We examine race/ethnic/nativity differences in hypertension awareness, intervention, treatment, and control using the 2005-2010 National Health and Nutrition Examination Survey. Mexican immigrants indeed have lower odds (OR=0.60) of being diagnosed with hypertension than non-Hispanic whites after controlling for SES, behavioral, and health care indicators. However, consistent with negative adaptation in health, Mexican immigrants have lower odds of intervention (OR=0.86), treatment (OR=0.74), and control (OR=0.61). Although protective resources could be reducing the disease incidence among migrant populations, we question their role in the so-called Hispanic Health Paradox given that they appear to be less effective in disease control.

INTRODUCTION

It is well-known that Hispanics in the United States appear to have better health than is

"expected" relative to that of other race/ethnic groups with similar or higher socioeconomic

standing (SES). As lower SES is generally associated with worse health, this phenomenon is

commonly known as the Hispanic Health Paradox (HHP). Given that the HHP by and large

"holds" for foreign-born Hispanics (i.e., immigrants from Latin America), it is also oft referred

to as an immigrant or migrant health advantage (MHA).

Much of the research on the HHP and the MHA focuses on examining whether and

understanding why Latinos or immigrants may have a lower *prevalence* of disease or unhealthy

behaviors relative to other race/ethnic groups (Crimmins et al. 2007). The contexts and behaviors

that prevent people from getting sick, however, may not always be similar to those that help

individuals treat and control chronic disease, which is a major element of healthy living other

than disease prevention. Further, an examination of awareness, treatment, and control of chronic

health conditions may be of particular relevance to understand the contributions of different

artifacts and "true" mechanisms of the HHP, such as data problems (Barcellos et al. 2012),

migration selection (Rubalcava et al. 2008; Turra and Elo 2008), or "sociocultural" protection

(Landale et al. 2000, 2006).

Understanding race/ethnic/nativity differences in disease treatment and control can also

contribute to understandings of immigrant adaptation in health. It is well-known that the MHA

appears to "erode" with time spent in the United States due to processes of (negative)

acculturation (Lara et al. 2005) or cumulative disadvantage (Abraído-Lanza et al. 2006). An

examination of individuals with different levels of experience and adaptation to U.S. society is

also useful for understanding whether the erosion of the MHA in the prevalence of disease is

further compounded by worse disease control among more experienced immigrants, and the sources of these additional disadvantages.

We study hypertension awareness, intervention, treatment adherence, and control among Mexican immigrants relative to U.S.-born Mexican Americans as well as U.S.-born non-Hispanic (NH) whites and blacks using data from the National Health and Nutrition Examination Survey (NHANES), a nationally-representative survey that permits the assessment of multiple stages of disease control due to its collection of self-reported data and blood pressure measurements. The control of hypertension has been attributed to a decrease in several forms of cardiovascular disease (CVD, the leading cause of death in the United States) in recent years (CDC 2013a). However, the prevalence of hypertension has increased over the past two decades (Hajjar & Kotchen 2003, Cutler et al. 2008), suggesting that more research is needed to understand the changing composition of the population affected by this disease.

Moreover, hypertension is a major chronic condition for which there is an apparent immigrant advantage relative to U.S.-born Mexican Americans (Barquera et al. 2008) and, likely, NH whites (Riosmena et al. 2013). We examine the extent to which this advantage may be inflated by a disproportionate lack of disease awareness among immigrants. Further, we assess whether the advantage in prevalence translates to better disease treatment and control among the foreign-born, and whether control effectiveness varies according to their levels of prior U.S. experience.

PREVIOUS RESEARCH

The Hypertension Treatment Pathway

Hypertension is defined as having high levels of systolic (maximum) or diastolic (minimum) blood pressure in the veins (NHLBI 2010). The pathway from hypertension prevalence to control

3

involves four steps: diagnosis, intervention, treatment, and control. Hypertension diagnosis implies awareness of the condition through receiving a diagnosis from a health care professional. Receiving an intervention requires a medical visit with a health care professional in which the health care professional advises treatment for hypertension. Treatment of hypertension requires adherence (typically in the form of medication) to the recommended intervention. The last stage of the pathway, hypertension control, implies systolic and diastolic blood pressure levels that have returned to the normal range (see methods for details on blood pressure thresholds). We describe this sequence as the hypertension treatment pathway. Trends in hypertension diagnosis to control reveal that despite increased prevalence rates, diagnosis, treatment, and control have also increased (Cutler et al. 2008, Hajjar et al. 2006, Hajjar et al. 2003). Nonetheless, increased diagnosis does not completely account for the increased prevalence (Hajjar & Kotchen 2003).

Racial and Nativity Differences in the Hypertension Treatment Pathway

Past research on the hypertension pathway suggests persistent disparities among racial/nativity groups. Blacks are more likely than whites and Mexican Americans to have and be diagnosed with hypertension. Although blacks in most studies are also more likely to adhere to treatment, they are less likely to have their hypertension under control (Hajjar & Kotchen 2003, Cutler et al. 2008, Ostchega et al. 2007). Social, behavioral, and structural factors may help explain some of the variation between blacks and other racial/nativity groups, yet few studies include these factors as covariates (For example, see Hajjar & Kotchen 2003, Cutler et al. 2008, Ostchega et al. 2007). Those who do account for these characteristics often fail to evaluate their contribution to race/nativity differences, and instead conclude that group disparities persist despite controlling for these factors (Borrell et al. 2008). Some studies offer meager explanations for black disadvantage, referencing (at times without citation) common contributors to disparities

4

including discrimination (Borrell et al. 2008), obesity, socioeconomic disadvantage, poor diet, and possible genetic factors (Hajjar et al. 2006). Although a few proxy measures for social, behavioral, and structural factors may not fully account for racial/nativity differences, their significant contributions are worth evaluating.

Work by Morenoff and colleagues (2007) offers a rare assessment of contextual characteristics in shaping hypertension prevalence and the treatment pathway among blacks and whites. They find that adjusting for neighborhood context accounts for black-white disparities in prevalence and awareness. Neighborhood context does not explain differences in treatment adherence or hypertension control, with blacks reporting higher levels of treatment and lower levels of control, consistent with other studies.

Hispanics experience a distinct pattern along the hypertension treatment pathway. Most studies have found that Mexican Americans are about as likely as whites to have hypertension, but are less likely to be aware, treat, or control their hypertension. Inclusion of Hispanic groups in most studies is problematic for several reasons. First, studies that include Hispanics often fail to articulate differences among multiple Hispanic nationalities, which have been documented (Pabon-Nau et al. 2009). This is most often reconciled by sole inclusion of Mexican Americans, the largest of the Hispanic subgroups. Second, many studies fail to account for differences between U.S.- and foreign-born Hispanics. Finally, those studies that examine nativity differences often fail to place U.S.- and foreign-born Hispanics within a broader racial context or evaluate social, behavioral, and structural influences (Pabon-Nau et al. 2009, Salinas 2008, Bersamin 2009).

Evidence from past research on nativity differences in the hypertension to control pathway suggest that U.S.- and foreign-born Hispanics have different experiences throughout the

pathway (Bersamin et al. 2009, Borrell et al. 2008). Mexican immigrants are less likely to be pre-hypertensive and hypertensive than U.S.-born Mexicans and NH blacks when controlling for SES, behavioral, and health access factors. (Borrell 2008, Rodriguez 2012). Mexican immigrants closely resemble NH whites, whereas Mexican Americans most closely resemble NH blacks with the highest rates of hypertension and prehypertension (Borrell 2008). In addition to nativity, acculturation variables are also associated with rates of hypertension. The longer Mexicans are in the United States and the more English that is spoken in the home, the more likely they are to be hypertensive. In this case, factors associated with acculturation are adversely associated with hypertension prevalence (Moran et al. 2007). Theories for the negative health effects of acculturation include adoption of risky behaviors (e.g. smoking and poor diet) associated with low SES in the U.S. and the loss of potentially protective characteristics of immigrant neighborhoods (or barrio effects) (Eschbach 2004, Jasso et al. 2004).

One of the primary limitations of hypertension prevalence studies is their reliance on self-reported measures of hypertension, which fail to catch undiagnosed disease. Multiple studies have found that Mexican immigrants are less likely to be aware of their hypertension (Barcellos et al. 2012, Langellier 2012, Bersamin et al. 2009), with one study finding that speaking primarily Spanish is associated with higher rates of undiagnosed hypertension (Eamranond et al. 2007). Thus, although many studies identify a migrant health advantage in the prevalence of hypertension, some of this advantage may be due to lack of awareness. For example, Barcellos et al. (2012), found that undiagnosed hypertension accounted for approximately 20% of the healthy migrant advantage. In addition to acculturative effects, awareness is also stratified by age and access to health insurance (Bersamin 2009). Younger immigrants and those without insurance are more likely to be aware of their hypertension.

The healthy migrant advantage has not been demonstrated for hypertension treatment. Although Mexican immigrants have lower hypertension prevalence rates than most other racial/ethnic groups, they have one of the lowest rates of treatment (Bersamin 2009). Mexican immigrants are less likely to have basic and consistent access to health care services, making them less likely to receive treatment advice from medical professionals (Estrada 1990). However, there is a dearth of literature exploring the relative effects of nativity, acculturation, and other socioeconomic and behavioral factors in predicting treatment compared to prevalence, awareness, and control for Mexican immigrants and Mexican Americans. This study aims to address that gap.

Similar to other stages of the chronic disease treatment pathway, Mexican immigrants and Mexican Americans demonstrate some of the lowest levels of hypertension control compared to NH whites and blacks (Hajjar 2006). Health insurance and SES are typically the most important factors dictating whether or not hypertension is controlled (Borrell 2008). Few studies have specifically evaluated the effects of nativity in hypertension control for Mexican immigrants and Mexican Americans, so little is known about the extent to which nativity and other associated effects might contribute to hypertension control above and beyond access to health insurance and individual behavioral characteristics.

Although some studies have comprehensively evaluated hypertension awareness, treatment, and control among Mexican Americans, few studies have specifically evaluated the roles that nativity, acculturation, and structural, social, and behavioral factors play throughout the pathway. Instead, these measures are sometimes included as a few of many covariates, and are only discussed when they produce statistically significant associations with one aspect of the pathway. Understanding when and the extent to which these factors impact hypertension

treatment pathways may elucidate the latent effects of the healthy migrant advantage, which continues to be a nuanced yet pervasive protective force for Mexican immigrants.

We evaluate self-reported hypertension diagnosis, intervention, and treatment, as well as clinically measured blood pressure using a merged sample of over 13,000 adults to assess the ways in which NH whites, NH backs, U.S.-born Mexican Americans, and foreign-born Mexican immigrants move through the hypertension treatment pathway. We have three specific aims:

Aim 1: Evaluate the extent to which Mexican immigrants maintain a health advantage throughout the hypertension treatment pathway

Aim 2: Evaluate the extent to which time spent in the U.S. may influence the likelihood of hypertension diagnosis, intervention, treatment and control for Mexican immigrants.

Aim 3: Compare Mexican immigrant outcomes to U.S.-born Mexicans and NH whites and NH blacks to place immigrant outcomes in a broader racial context.

DATA AND METHODS

The NHANES is a nationally representative cross-sectional sample of children and adults in the United States. The survey is conducted biannually by the Centers for Disease Control and Prevention (CDC) and the National Center for Health Statistics (NCHS). Each survey cycle includes a sample of between 5,000 and 10,000 respondents from 15 counties across the United States. It includes questions relating to health and nutrition as well as medical examination and laboratory tests and is best known for combining anthropometric health measures with self-reported indicators of physical and mental health as well as social and behavioral indicators.

We use anthropometric measures of blood pressure to assess prevalence and control and self-report measures of hypertension diagnosis, intervention, and treatment from the pooled 2005-2010 National Health and Nutrition Examination Survey (NHANES) (CDC 2011a). The

8

2005-2010 sample contains the three most recent survey cycles that were publicly available at the time of analysis. NHANES is an ideal dataset for analyzing hypertension treatment pathways for this population due to the survey's inclusion of both self-reported questions and clinically-measured outcomes on hypertension. NHANES also oversamples Mexican immigrants and U.S.-born Mexican Americans, which make up the largest proportion of Hispanics in the United States. Although NHANES does include other Hispanic subgroups, they have not consistently oversampled these groups in each survey cycle and thus do not recommend using Hispanic subgroups to make nationwide generalizations (CDC 2011b).

Due to a limited number of respondents with hypertension within multiple racial groups, the study combines three NHANES cycles, the 2005-2006, 2007-2008, and 2009-2010 data. The combined datasets result in a sample size of over 13,000 adults.[1] Respondents who did not identify as Mexican immigrants, U.S.-born Mexican Americans, whites, or blacks were not included in the analysis.

Dependent Variables – The Hypertension Treatment Pathway

We use four binary outcomes as measures of the hypertension treatment pathway: hypertension diagnosis, intervention from a medical professional, treatment adherence, and, ultimately, hypertension control.

For hypertension diagnosis, NHANES asked respondents the "yes/no" question, "Have you ever been told by a doctor or other health professional that you had hypertension, also called high blood pressure?" If respondents replied that they did not know whether they were hypertensive, they were coded (0), not aware of hypertension or not hypertensive. If they refused

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[1] Final sample size used in the analysis does not reflect this number due to exclusions based on pregnancy or missing data. Additionally, we did not include pregnant women in the analysis due to temporary changes in blood pressure that can occur during pregnancy. These changes during pregnancy may not reflect persistent hypertension and would potentially skew results.

the question they were coded as missing. Respondents who said they were not hypertensive but had a measured systolic or diastolic blood pressure that indicated that they were hypertensive were coded (0) for diagnosis as well as each subsequent question to avoid excluding this hypertensive group from the analysis.

If respondents were aware of their hypertension, NHANES then asked if they have had an intervention, "Because of your high blood pressure/hypertension, have you ever been told to take prescribed medication?" Similarly, respondents were asked to respond "Yes/No" and recoded in the same way as hypertension awareness. Respondents unaware of their hypertension were coded as (0) for intervention.

If respondents had ever been told by a doctor or health professional to take medication for their hypertension, they were then asked whether they adhered to the treatment recommendation. NHANES asked, "Are you now taking prescribed medicine?" All respondents who were aware of their hypertension or diagnosed with hypertension during the NHANES examination but had not had an intervention with a health care professional were coded (0) for treatment adherence.

The final step in the hypertension treatment pathway is to assess whether hypertension is currently under control. This study defines high blood pressure according to the National Heart Lung and Blood Institute (NHLBI) guidelines as systolic blood pressure reading of $\geq$140 mm Hg or a diastolic blood pressure reading of $\geq$90 mm Hg (NHLBI 2010). To gauge hypertension control, we utilized the clinically-measured blood pressure readings for each respondent. NHANES respondents who had a physical examination were given between one and four blood pressure readings. We used the NHANES' Integrated Survey Information System (ISIS) protocol to calculate average blood across readings for participants. Respondents were coded as either (0)

still having hypertension or (1) having their hypertension under control. All respondents who were unaware of their hypertension were coded as (0).

Independent Variables

To evaluate the effects of demographic factors, SES, health behaviors and health care access/utilization we included the following independent variables in the analysis. Race/ethnicity/nativity variables were combined into four main categories: NH whites, NH blacks, U.S. born Mexican Americans, and Mexican immigrants (foreign born). Within Mexican immigrants, we created four additional categories based on the length of time the immigrants have lived in the U.S. The categories include immigrants who have lived in the U.S. for less than 5 years, 5-14 years, 15-19 years, and 20 or more years. We constructed a single variable to include NH whites as a referent compared to blacks, U.S. born Mexican Americans, and each category of Mexican immigrant depending on duration of stay in the U.S. Including duration of stay within the racial/ethnic variable allows us to evaluate potential effects negative/positive adaptation within the Mexican immigrant population.

We included three demographic characteristics as control variables: gender (male/female), age (18 and older), and marital status (married/living with a partner or not married).

We included three measures of SES to understand sociostructural influences: education level (categorically coded from less than high school education to college graduate and above), employment (employed or unemployed), and home-ownership status (homeowner/those with a mortgage and renters).[2]

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[2] Originally we included income as one of the socioeconomic variables. However, 522 people were missing income data and it was not significant in any of the logistic regression models. Additionally, because it was correlated with education at .43, We removed income from the analysis to avoid multicolinearity.

We included three risk behaviors in the analysis to capture social/behavioral characteristics: smoking, drinking, and diet quality. We coded each of the risk behaviors as binary variables. For smoking, respondents were asked if they currently smoked cigarettes and we coded them as non smoker (0) or current smoker (1). We coded high alcohol consumption as (1) if women had two or more drinks per night over the last week and if men had three or more drinks per night, which is above the recommended daily alcohol intake per CDC recommendations (CDC 2012), and (0) if they did not. We used a self-reported measure of diet due to lack of consistency in the nutrition/diet modules across NHANES cycles. Respondents were asked to rate the healthiness of their diet on a scale of 1-5, with 1 being an "excellent diet" and 5 being a "poor diet." We categorized diet dichotomously, with fair/poor diets as unhealthy (1), and excellent/good diets as healthy (0).

We include three additional individual covariates for access to health care and utilization. First, whether the respondent had healthcare (yes/no). Second, whether they had a regular place to go for healthcare (yes/no). Third, the number of times received health care over the past year, on a scale of (0) no visits, to (5) 13 or more visits.

We included two final covariates, survey year and pre-screening consumption, which may account for some of the association between race/ethnicity/nativity and progression through the hypertension treatment pathway. Consumption of coffee, alcohol, or cigarettes less than 30 minutes before the blood pressure reading for the final outcome (hypertension control) may have had an effect on respondents' blood pressure readings, although it is not shown to have an effect in all cases. For this reason, respondents who had consumed one of these substances were not excluded from the analysis and instead the variable was used as a control.

Analysis

12

Each step of the hypertension treatment pathway is a binary dependent variable, requiring four separate logistic regression models. The reference group for race/nativity will be NH whites. Race is the primary independent variable of interest, and other demographic, SES, health care, behavioral, and acculturation factors will be included as covariates. Logistic regression produces odds ratios for each group compared to a reference group.

We used time lived in the U.S. as a proxy for acculturation for the Mexican immigrant population. NHANES also asks all respondents about citizenship status and foreign-born respondents about language preference. We first examine how citizenship and language preference are distributed among Mexican immigrants depending on low long they have lived in the U.S.

For each step of the diagnosis to treatment pathway, we calculated nested models, with the final model including demographic factors, indicators for SES, health behaviors and health care access and utilization. Model 1, the basic demographic model, assesses the effect of race/nativity on each step of the treatment pathway, controlling for essential demographic characteristics, including age, gender and marital status. Model 2, the SES model, adds SES variables, including education, employment, and home ownership, to assess the explanatory power of SES in the hypertension treatment pathway. Model 3, the behavioral risk model., adds four behavioral risk factors – high alcohol consumption, poor diet, and regular cigarette smoking – that have been shown to increase the risk of hypertension. This model includes a control for pre-test consumption for the hypertension control outcome to evaluate whether consuming coffee, alcohol, or cigarettes 30 minutes before the blood pressure test impacts results. Model 4, the health care mode, adds health care variables that may explain some of the ability each racial group to access diagnosis and treatment services. This model includes access to health care,

13

having a regular place to go for health care services, and number of times received health care within the last year. We applied full sample weights constructed by NHANES for the each analysis. We analyzed all data using STATA v.12 (Statacorps 2011).

RESULTS

Table 1 describes the sample of adults in the NHANES 2005-2010 survey cycles for each of the steps of the hypertension treatment pathway. The samples of adults for the intervention, treatment, and control outcomes are among those who had reported ever being diagnosed with hypertension. The table demonstrates racial/ethnic/nativity disparities within the sample. For example, within the Mexican immigrant population, 21% of migrants reported being diagnosed with hypertension, and among those who were diagnosed, they had the lowest proportion of control among all racial/ethnic/nativity groups. When the Mexican immigrant population is broken down by duration of stay, there are gradated relationships for each of the outcomes. A greater proportion of migrants living in the U.S. the longest (20+ years) report being diagnosed with hypertension, yet this group also has the greatest proportion of respondents who have obtained hypertension control. This pattern is reversed for the newest Mexican immigrants. Younger respondents and those with some college had lower rates of diagnoses and higher rates of intervention, treatment, and control compared to older adults and those with no college. Additionally, those who went to the doctor more than four times in a year had a higher rate of diagnosis but also had higher rates of intervention, treatment, and control.

-TABLE 1 ABOUT HERE-

Table 2 presents the odds ratios from the logistic regression analyses for hypertension diagnosis, intervention, treatment and control. Blacks were more likely than whites to be diagnosed for hypertension. Controlling for demographic, SES, risk behavior, and health care

14

factors decreased the likelihood of diagnosis by about 12%, with SES having the most prominent effect on this decrease. Nonetheless, blacks were still almost twice as likely as whites to be diagnosed with hypertension (OR=1.88). Although blacks had a higher likelihood of diagnosis they were also more likely than all other racial groups to have an intervention with a health care professional and adhere to treatment. Controlling for other covariates did not substantively change the odds of receiving an intervention or adhering to treatment. Despite being more likely than whites to have an intervention and adhere to treatment, blacks were about as likely as whites to have their hypertension under control. Controlling for social, structural, and behavioral characteristics played the largest role in hypertension diagnosis but had a much more minimal effect throughout the remainder of the hypertension treatment pathway.

<div align="center">-TABLE 2 ABOUT HERE-</div>

U.S.-born Mexican Americans were about as likely as whites to have been diagnosed with hypertension. Mexican Americans were less likely than whites to receive an intervention and adhere to treatment, and controlling for access to health care explained the largest proportion of the difference. Nonetheless, the differences between Mexican Americans and whites were only statistically significant in the case of hypertension control, in which Mexican Americans have roughly 25% lower odds of having their hypertension under control after accounting for demographic, social, structural, and behavioral factors.

Mexican immigrants overall were less likely than whites to be diagnosed with hypertension, receive an intervention, adhere to treatment, and obtain control. In the cases of hypertension intervention, treatment, and control, accounting for differences in health care access and utilization made differences between Mexican immigrants and whites borderline significant

15

to non-significant. Health care access and utilization did not account for the disparity in the likelihood of hypertension diagnosis.

By dividing Mexican immigrants into four groups based on duration of stay, we can evaluate the ways in which movement through the hypertension treatment pathway may differ among immigrants who have spent varying amounts of time in the United States. Mexican immigrants who had been in the U.S. for less than five years were the least likely to be diagnosed with hypertension. After controlling for other covariates, this group had roughly 50% lower odds of being diagnosed with hypertension. It is worth noting that Mexican immigrants in the less than five year cohort also had the highest proportion of unaware hypertensives among those who were clinically measured as having hypertension (see Table 1). This group also had the lowest likelihood of receiving an intervention, treatment, and control compared to whites until controlling for health care access and utilization.

Mexican immigrants living in the U.S. for 5-14 years had lower odds of diagnosis than immigrants living in the U.S. for less than five years and than immigrants living in the U.S. for 15-19 years. The 5-14 year cohort was less likely to have an intervention than the two groups living in the U.S. for 15 or more years. However, immigrants living in the U.S. for 5-14 years were the least likely to adhere to treatment, and maintained about 45% lower odds of adhering to treatment than whites after controlling for health care access and utilization (with borderline significance of $p < 0.10$). Adding health care covariates eliminated the significant differences between the 5-14 year cohort and whites for hypertension control.

Immigrants living in the U.S. for 15-19 years had higher odds of diagnoses than immigrants living in the U.S. for less than 5 years but lower odds than those living in the U.S. for 5-14 years. Consistent with the other immigrant cohorts the 15-19 year cohort also had lower

16

odds of being diagnosed than whites. After controlling for health care access there were not significant differences between whites and the 15-19 year immigrant cohort for receiving an intervention or adhering to treatment. However, immigrants living in the U.S. for 15-19 years were significantly less likely to have their hypertension under control than whites by almost 50 percent.

Immigrants living in the U.S. for twenty or more years had the greatest likelihood of diagnosis compared to other immigrant groups, but also had the highest likelihood of receiving an intervention, adhering to treatment, and having their hypertension under control. For each outcome, adding health care access and utilization variables accounted for the disparity between the 20 or more year cohort and whites (although for hypertension control the difference was borderline significant at $p<0.10$).

DISCUSSION

Results from the logistic regression models suggest that there are significant and substantive race/ethnic/nativity differences in hypertension diagnosis, intervention, treatment, and control. However, these differences are not consistent throughout the hypertension treatment pathway. NH blacks were more than twice as likely as NH whites to be diagnosed with hypertension (OR=2.02), those who were diagnosed had similar odds as NH whites of receiving an intervention from a health care professional (OR=.92), much greater odds of adhering to treatment (OR=1.64), and similar odds of controlling their hypertension (OR=1.00) after controlling for demographic factors, SES, health behaviors and health care access/utilization. This pattern corroborates previous findings that NH blacks have higher odds of becoming hypertensive than NH whites, but our results indicate that once they are diagnosed the disadvantage seen in prevalence rates may disappear or even reverse throughout the hypertension

17

treatment process. It's possible that recent interventions that specifically target hypertensive NH blacks may have had an impact in hypertension in the context of interactions within the medical system. Yet these interventions do not appear to ameliorate the social and structural barriers that make NH blacks more likely to become hypertensive in the first place.

It is informative to include NH blacks when evaluating the effects and scope of the Hispanic health paradox because the inclusion of blacks helps to place Hispanic advantage and disadvantage in context. Our findings suggest that NH blacks face the largest negative disparity in hypertension diagnosis but all Mexican groups (native and foreign born) have the lowest odds of obtaining hypertension control compared to whites. Although it is beyond the scope of this paper to explicitly compare black/Hispanic differences, it is important to observe that different racial groups may face greater disadvantage at different points along the hypertension treatment pathway.

Consistent with the Hispanic health paradox theory, migrants do seem to have a healthy migrant advantage for likelihood of being diagnosed with hypertension, and this advantage is the most pronounced for those who most recently arrived. Available data do not allow us to explicitly examine whether lower odds of diagnosis may be due to a biased sample of immigrants, so we must rely on studies that have explicitly tested for potential data artifacts and sample biases and found that migrant advantages persist for a number of health outcomes (not including hypertension). In one study that examined rates of undiagnosed hypertension and diabetes, Barcellos (2009) concluded that undiagnosed hypertension did not account for Mexican immigrant advantage, even in the 0-4 year immigrant cohort (also using NHANES data).

Our findings suggest, however, that the migrant health advantage does not persist throughout the hypertension treatment pathway. The advantage diminishes the likelihood of

18

receiving an intervention, adhering to medication, and obtaining control for each of the Mexican immigrant cohorts. It is possible that the cultural, social, and structural buffers that protect immigrants from developing hypertension in the first place may not have the same benefits in helping them access medical care and treat their hypertension. Our study does not include contextual effects in the models, but we may hypothesize that factors such as social support may decrease stress and potentially blood pressure for some immigrants. Those immigrants that become hypertensive may not have social support or other buffering mechanisms in place and thus cannot harness their benefits in the treatment and control process.

Based on the HHP theory we would have expected that as immigrants lived for longer periods of time in the U.S. their health would decline in a gradated manner. Instead, length of time in the U.S. does not produce this pattern within the hypertension treatment pathway. Although immigrants who lived in the U.S. the longest (for 19 or more years) were the most likely to be diagnosed with hypertension they were also the most likely to receive an intervention, adhere to treatment, and obtain control before controlling for access to health care (after which the disparities diminished).

For Mexican immigrants, social, behavioral, and structural factors played a bigger role in decreasing disparities. Specifically, having health insurance, having a regular provider, and having frequent visits to the doctor were all associated with diminishing differences between Mexican immigrants and whites beyond statistical significance. If immigrants had better access to health care rather than the nuanced cultural and social buffers discussed in HHP literature, they would most likely have better rates of hypertension control. Sensitivity tests (not shown here) indicated that the odds ratios were similar when having health insurance was removed from

19

the regression analysis, suggesting that immigrants may benefit from having a regular place to go for health care and frequent visits even if they are uninsured.

Out findings encourage distinguishing between Mexicans by nativity. U.S.-born Mexicans were not significantly different than whites in their likelihood of being diagnosed with hypertension, receiving an intervention, or adhering to treatment. If Mexican immigrants had been grouped with U.S.-born Mexican Americans, it's possible that distinctions among immigrants and non-immigrants might have been lost. This would have implied that immigrants move through the hypertension treatment to control pathway comparably to whites. Likewise, the inclusion of Mexican immigrants could have changed the odds ratios to reflect disadvantage for U.S.-born Mexicans that was not present when this group was isolated. We should be wary of studies that group all Mexicans together and do not control for nativity, as there may be a binary or abnormal distribution within this group.

An essential outcome of this study is to question the Hispanic health paradox as a ubiquitous force throughout chronic disease trajectories. Despite immigrants health advantages in prevalence rates for a specific disease these advantages may not persist for those who already have the disease. This finding should discourage viewing Mexican immigrants as having a general health advantage and should encourage future research to continue to extrapolate the presence and limitations of the Hispanic health paradox.

Limitations

This study has several limitations, the first of which is small sample size. Although the study combines three NHANES cycles from 2005-2010, there are still a relatively small number of Mexican immigrants and U.S.-born Mexican-Americans throughout the hypertension diagnosis to treatment pathway. Because the dependent variables are conditional hypertension

diagnosis, three of the four regression analysis include less than 6,000 of the over 13,000 respondents. These small sample sizes likely impact the size of the standard errors and reduce statistical significance of the findings.

Furthermore, blood pressure measurements can be inconsistent and sensitive to acute life events. Temporary stress, some medications (such as Sudafed or other stimulant-based drugs, caffeine, and alcohol) can produce acute high blood pressure but may not reflect a chronic condition. Although controlling for pre-test consumption, NHANES does not allow for examination of acute stress or some other types of drug use. In these cases, measures of cumulative biological risk (such as allostatic load) may be better indicators of chronic disease because they comprise multiple factors and are less sensitive to short-term changes.

Final Remarks

Results from our study on the hypertension treatment pathway are not generalizable to other chronic disease outcomes. Future research should continue to examine the extent to which racial/ethnic/nativity groups experience distinct trajectories throughout chronic disease diagnosis, intervention, treatment, and control. Our study suggests a healthy migrant advantage in hypertension prevalence but negative adaptation processes once migrants are diagnosed. Future studies should work to unpack the social and cultural buffers that may protect immigrants from developing chronic diseases and how these protective factors may deteriorate once immigrants have chronic disease. This requires examination of individual and contextual effects (such as the barrio effect) to help continue to disentangle the Hispanic health paradox.

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22

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Table 1: Characteristics of Study Sample by Hypertension Diagnosis, Intervention, Treatment, and Control in NHANES 2005-2010

Individual Characteristics	Diagnosis (n= 13,456)	Intervention (n= 5,803)	Treatment (n= 5,803)	Control (n= 5,511)
Total Population	36%	75%	67%	42%
Demographic Factors				
Race/Ethnicity				
Non-Hispanic White	37%	75%	68%	45%
Non-Hispanic Black	46%	80%	71%	42%
U.S. Born Mexican	32%	70%	62%	39%
Mexican Immigrant	21%	60%	50%	28%
Lived in U.S. <5 years	11%	50%	38%	20%
Lived in U.S. 5-14 years	15%	51%	37%	24%
Lived in U.S. 15-19 years	21%	59%	51%	27%
Lived in U.S. 19+ years	41%	68%	59%	33%
Female	35%	71%	63%	41%
Male	38%	78%	70%	44%
Age: 20-39	11%	44%	27%	18%
40-59	34%	72%	61%	41%
60-85	60%	82%	77%	48%
Married or with a partner	35%	74%	67%	44%
Socioeconomic Status				
Education: Less than HS	40%	74%	66%	40%
HS graduate	38%	76%	69%	44%
Some college or more	33%	74%	66%	43%
Employed	25%	66%	55%	37%
Homeowner	40%	76%	69%	45%
Health Care				
Have health insurance	41%	78%	71%	46%
Regular place for health care	40%	78%	70%	45%
# of times/year received health care:				
0 times	11%	28%	11%	6%
1-3 times	31%	70%	61%	39%
4+ times	53%	85%	79%	51%
Health Behaviors				
Alcohol Consumption	29%	67%	58%	40%
Unhealthy Diet	35%	74%	64%	41%
Smoke	30%	66%	54%	35%

Table 2: Predictors of Hypertension Diagnosis, Intervention, Treatment, and Control among Racial/Nativity Groups from NHANES 2005-2010 (Odds Ratios)

A. Hypertension Diagnosis (N=13,456)

Race/Nativity	Model 1	Model 2	Model 3	Model 4
NH White (referent)				
NH Black	2.02***	1.90***	1.85***	1.88***
U.S. Born Mexican	1.06	0.99	0.96	1.02
All Mexican Immigrant	0.61***	0.51***	0.47***	0.60***
Lived in U.S. <5 years	0.45***	0.37***	0.34***	0.49***
Lived in U.S. 5-14 years	0.61**	0.50***	0.47***	0.63*
Lived in U.S. 15-19 years	0.58***	0.49***	0.45***	0.53***
Lived in U.S. 20+ years	0.92	0.77*	0.72*	0.83
Demographic Factors				
Age	1.06***	1.06***	1.06***	1.06***
Sex (Male referent)	0.97	0.96	0.95	.85**
Married/ with a partner	1.04	1.08	1.09	1.08
Socioeconomic Status				
Education		0.91***	0.93***	0.90***
Employed		0.85**	0.84**	0.97**
Homeowner		0.97	0.97	0.96
Risk Behaviors				
Alcohol Consumption			0.98	1.00
Smoke			0.91	0.95
Unhealthy Diet			1.48***	1.44***
Health Care				
Have health insurance				0.98
Regular place health care				1.51***
Number of medical visits past year				1.33***
Year	0.99	0.99	0.98	0.99
Constant	0.02***	0.04***	0.03***	0.02***

B. Intervention from Health Care Professional (N=5,803)

Race/Nativity	Model 1	Model 2	Model 3	Model 4
NH White (referent)				
NH Black	1.73***	1.82***	1.74***	1.79***
U.S. Born Mexican	0.84	0.86	0.85	0.92
Mexican Immigrant	0.59***	0.63**	0.58***	0.86
Lived in U.S. <5 years	0.44***	0.50**	0.45**	0.79
Lived in U.S. 5-14 years	0.55**	0.60*	0.54*	0.90
Lived in U.S. 15-19 years	0.59+	0.63	0.58+	0.73
Lived in U.S. 20+ years	0.75	0.78	0.73	0.99
Demographic Factors				
Age	1.04***	1.04***	1.04***	1.04***
Sex (Male referent)	1.45***	1.45***	1.37***	1.19*
Married/ with a partner	1.19+	1.15	1.14	1.10
Socioeconomic Status				
Education		1.01	1.01	0.99
Employed		0.99	0.99	1.19
Homeowner		1.22**	1.20*	1.21*
Risk Behaviors				
Alcohol Consumption			0.77***	0.78**
Smoke			0.80**	0.88
Unhealthy Diet			1.34***	1.30***
Health Care				
Have health insurance				1.05
Regular place health care				2.32***
Number of medical visits past year				1.17***
Year	1.18**	1.18**	1.17**	1.16**
Constant	0.12***	0.11***	0.13***	0.03***

C. Treatment Adherence (N= 5,803)

Race/Nativity	Model 1	Model 2	Model 3	Model 4
NH White (referent)				
NH Black	1.57***	1.64***	1.59***	1.64***
U.S. Born Mexican	0.84	0.86	0.83	0.91
Mexican Immigrant	0.49***	0.51***	0.46***	0.74+
Lived in U.S. <5 years	0.32***	0.36***	0.31***	0.60
Lived in U.S. 5-14 years	0.33***	0.35***	0.31***	0.55+
Lived in U.S. 15-19 years	0.61+	0.64+	0.58*	0.82
Lived in U.S. 20+ years	0.65*	0.68*	0.61*	0.88
Demographic Factors				
Age	1.05***	1.05***	1.05***	1.04***
Sex (Male referent)	1.33***	1.33***	1.28**	1.1
Married/ with a partner	1.33***	1.27**	1.24**	1.20*
Socioeconomic Status				
Education		1.00	0.99	0.95
Employed		0.97	0.96	1.15
Homeowner		1.26***	1.21***	1.20*
Risk Behaviors				
Alcohol Consumption			0.83*	0.83*
Smoke			0.68***	0.76**
Unhealthy Diet			1.18+	1.14
Health Care				
Have health insurance				1.36**
Regular place health care				3.72***
Number of medical visits past year				
Year	1.22***	1.22***	1.21***	1.22**
Constant	0.05***	0.04***	0.06***	0.01***

D. Hypertension Control (N= 5,511)

Race/Nativity	Model 1	Model 2	Model 3	Model 4
NH White (referent)				
NH Black	0.98	1.03	1.02	1.00
U.S. Born Mexican	0.70**	0.72**	0.70**	0.74*
Mexican Immigrant	0.42***	0.46***	0.43***	0.61**
Lived in U.S. <5 years	0.26***	0.30**	0.27***	0.47+
Lived in U.S. 5-14 years	0.38***	0.42**	0.39***	0.66
Lived in U.S. 15-19 years	0.41**	0.44**	0.41**	0.53+
Lived in U.S. 20+ years	0.59**	0.61*	0.58**	0.71+
Demographic Factors				
Age	1.02***	1.02***	1.02***	1.02***
Sex (Male referent)	1.22**	1.23**	1.23**	1.12*
Married/ with a partner	1.35***	1.28**	1.26**	1.22**
Socioeconomic Status				
Education		1.02	1.00	0.97
Employed		1.09	1.07	1.20*
Homeowner		1.23**	1.19*	1.17+
Risk Behaviors				
Alcohol Consumption			1.03	1.04
Smoke			0.76**	0.83+
Unhealthy Diet			1.08	1.04
Health Care				
Have health insurance				1.43***
Regular place health care				3.25***
Number of medical visits past year				1.33***
Year	1.24***	1.25***	1.24***	1.24***
Constant	0.10***	0.07***	0.09***	0.02***

+ p≤.1; * p≤.05; ** p≤.01; *** p≤.001