
Is There a Hispanic Epidemiologic Paradox in Later Life? A Closer Look at Chronic Morbidity

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Abstract

This study examined the morbidity patterns of foreign-born Hispanics, U.S.-born Hispanics, Blacks, and Whites aged 53 years and older using seven self-reported physician-diagnosed chronic diseases as well as six biomarkers. Drawing on the 2006 Health and Retirement Study and its biomarker data, the authors found that foreign-born Hispanics had comparable or lower rates of high blood pressure, heart disease, cancer, arthritis, chronic lung disease, and stroke, controlling for age and gender. The health advantages were robust when socioeconomic conditions and health behaviors were controlled. Foreign-born Hispanics were not significantly different from U.S.-born Hispanics except for a lower risk for arthritis. In terms of biomarkers, foreign-born Hispanics were not statistically different from Whites except for having higher risks of high systolic blood pressure and blood glucose. Future research should explore multiple factors contributing to the lower rates of major chronic diseases among older Hispanics who have faced social disadvantages over the life course.

Keywords

aging, epidemiologic paradox, Hispanics, chronic illness, biomarker, race

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In 2007, the estimated foreign-born population reached 38.1 million, accounting for 12.6% of the total U.S. population. Roughly half of the foreign born were from Mexico and other countries in Latin America (Grieco, 2010). Many Hispanic immigrants have low levels of education and limited economic resources. The rapid growth in the population of Hispanic immigrants combined with their low socioeconomic status (SES) has aroused concerns about immigrants' health problems and their need for public assistance such as Medicaid. Immigrants' health problems, should they add disproportionately to the burden of disease in the population, have serious implications for the nation's welfare and health insurance programs.

Contrary to these public concerns, over the past 30 years, a growing body of research indicates that Hispanics, foreign-born Hispanics in particular, have significantly lower mortality rates compared with Whites (Arias, 2010; Arias, Eschbach, Schauman, Backlund, & Sorlie, 2010). In 1986, Markides and Coreil coined the phrase "the epidemiologic paradox" to refer to the finding that in terms of key health indicators such as infant mortality and adult mortality, Hispanics are more similar to Whites than to Blacks, although their SES is closer to that of Blacks than to that of Whites. Additionally, they pointed out that the paradox does not apply to all health outcomes; Hispanics are disadvantaged in diabetes and infectious and parasitic diseases compared to Whites. Despite growing interest in the Hispanic epidemiologic paradox since the 1980s, little is known about whether the mortality advantages of Hispanics map to health advantages in later life.

In this study, we assess the degree to which the Hispanic mortality paradox extends to chronic morbidity among older foreign-born and U.S.-born Hispanics by comparing the prevalence rates for these two groups of seven self-reported physician-diagnosed chronic diseases (high blood pressure, diabetes, heart disease, cancer, arthritis, chronic lung disease, and stroke) to the rates of Blacks and Whites aged 53 years and older ($n = 15,985$) in 2006. Second, we examine racial/ethnic/nativity differences in six biological risk factors, including systolic blood pressure, diastolic blood pressure, pulse rate, total blood cholesterol, high-density lipoprotein (HDL) cholesterol, and glycosylated hemoglobin. This allows us to assess whether reported differences in health mirror biological risk markers for those conditions. This is one of the first studies to explore the Hispanic epidemiologic paradox by looking at both self-reported physician-diagnosed chronic diseases and biomarkers using data from the same sampling frame. Third, we assess the sensitivity of the racial/ethnic/nativity differentials in chronic diseases and biological risk factors to SES and health behaviors in an effort to understand the degree to which these factors contribute, or do not contribute, to those differentials.

Finally, we test whether proxies of acculturation (length of stay in the United States, interview language, and citizenship) are associated with negative health outcomes among older Hispanic immigrants.

Is There a Hispanic Paradox in Chronic Conditions?

Although research consistently documents the Hispanic mortality paradox at older ages, among older Mexican immigrants in particular (Markides & Eschbach, 2005), it is less clear whether the health profiles of Hispanics in later life are equivalent or better compared to Whites or are more similar to those of Blacks. For example, Hispanics had worse self-reported health than Whites (Cho, Frisbie, Hummer, & Rogers, 2004) and higher rates of diabetes (Crimmins, Hayward, & Seeman, 2004). On the other hand, Swallen (1997) found that among immigrants who came to the United States as adults, self-selection for good health was maintained for cancer, heart disease, stroke, and lung disease in old age (70 years and older). In addition, Cho et al. (2004) found that the immigrant health advantage was much smaller after living in the United States for 10 or more years, and a 2006 report from the National Center for Health Statistics showed that among Hispanic immigrants, length of stay in the United States was associated with higher prevalence of hypertension and cardiovascular disease (Dey & Lucas, 2006).

What are some of the factors that account for the reported health advantages of Hispanics in chronic diseases (except for diabetes), foreign-born Hispanics in particular? Some researchers attributed health advantages to cultural factors in origin societies that have protective effects on health (Jasso, Massey, Rosenzweig, & Smith, 2004). For example, first-generation immigrants from Mexico, despite socioeconomic disadvantages, appear to benefit from better nutrition and proscriptions against risky behaviors such as smoking, alcohol, and drug abuse (Landale, Oropesa, & Gorman, 2000; Markides & Coreil, 1986). This perspective suggests that nativity differentials are relatively insensitive to SES differentials across the groups, while immigrants have more beneficial health behaviors.

Other researchers have argued that self-reports of chronic conditions may not accurately reflect the underlying health status of the Hispanic population, because of cultural differences in reporting health problems or a lack of health knowledge about certain diseases due to Hispanics' limited access to the health care system (Crimmins, Kim, Alley, Karlamangla, & Seeman, 2007). Foreign-born Hispanics have the highest proportion of uninsured people compared with other groups (Palloni, 2007), pointing to the possibility that many Hispanics do not have regular checkups and may not even know

whether they have hypertension or high cholesterol, because many chronic diseases have no symptoms in the early stages. Crimmins et al. (2007) recently looked at the health of adult Hispanics using biological risk profiles, which are less influenced by access to health care, and found that Hispanics had a higher average biological risk score than Whites but a lower score than Blacks. However, Hispanics were more similar to Blacks in metabolic risk profiles than to Whites.

Selectivity is another possible factor contributing to nativity differentials. Some research has suggested, for example, that migrants are robust opportunity seekers, willing to risk leaving a familiar environment for a better life in a foreign country (Jasso et al., 2004; Palloni & Arias, 2004); this has been characterized as the healthy migrant hypothesis. As a self-selecting group, migrants were argued to be healthier and more resilient than those who stayed in the sending countries as well as the average person in the receiving country (Palloni & Arias, 2004). In addition, the presence of a shared border between the United States and Mexico increases opportunities for the return migration of Mexican immigrants in poor health: the salmon bias hypothesis. This migration stream had the potential to make morbidity and mortality rates of immigrants remaining in the United States lower than would otherwise be the case (Abraido-Lanza, Dohrenwend, Ng-Mak, & Turner, 1999). However, although there is evidence that the salmon bias exists, recent research has suggested that it cannot account for the significant health advantages of foreign-born Hispanics (Hummer, Powers, Pullum, Gossman, & Frisbie, 2007; Turra & Elo, 2008).

Because the present study relies on cross-sectional data to examine disease prevalence, we are unable to directly evaluate which selection process is operating, the healthy migrant effect or the salmon bias. However, the healthy migrant hypothesis suggests that controlling for SES is unlikely to alter the nativity differentials in health. Furthermore, like the cultural protection argument, the healthy migrant hypothesis points to better health behaviors among immigrants compared with natives as a possible mechanism, suggesting that controlling for health behaviors should reduce the health advantage of foreign-born Hispanics. As is evident, both the cultural protection and healthy migrant hypotheses point to immigrant health advantages partly stemming from health behaviors.

Hypotheses

On the basis of previous research, we expect that (a) foreign-born and U.S.-born Hispanics have equivalent or lower odds of chronic diseases (except for diabetes) compared with Whites, net of demographic controls; (b)

with health behavior controls, foreign-born and U.S.-born Hispanics' health advantages over Whites in chronic conditions will be reduced; (c) with SES controls, foreign-born and U.S.-born Hispanics' health advantages over Whites in chronic conditions will increase; (d) both foreign-born and U.S.-born Hispanics have lower odds of chronic diseases compared with Blacks, net of demographic controls; and (e) foreign-born Hispanics have lower odds of chronic diseases than U.S.-born Hispanics, net of demographic controls. We also expect that results from biomarker data will be largely consistent with the findings from self-reporting of chronic diseases, but Hispanics' advantages in health will be smaller.

We emphasize that our assessment of the second and third hypotheses is constrained by the fact that we rely on cross-sectional data. Our SES and health behavior "mechanisms" are potentially endogenous with respect to some of our health outcomes. In our study, we assume that racial/ethnic/nativity differences in health behaviors and SES are established relatively early in life, and there is substantial evidence to support this assumption (e.g., Johnson & Hoffmann, 2000; Must, Gortmaker, & Dietz, 1994). Realistically, however, we recognize that changes in these characteristics are possible in response to the onset of health problems and are thus endogenous. Some changes, particularly changes in health behaviors, are expected to minimize the degree to which these factors statistically explain racial/ethnic/nativity differentials in health. An example is that an individual may quit smoking after a heart attack or a diagnosis of lung cancer, attenuating the association between smoking status and the diagnosis of the health problem. Other changes, however, particularly changes in SES characteristics such as income, may increase the extent to which SES statistically accounts for racial/ethnic/nativity differentials. For example, a health problem may prompt a reduction in work effort and thus reduce income. We attempt to gain some insights into the role that endogeneity might play in this analysis by estimating a series of nested models and examining the sensitivity of the results to alternative model specifications.

Methods

Data

We used the 2006 wave of the Health and Retirement Study (HRS) and the 2006 HRS biomarker data. The 2006 wave of HRS is a national sample of noninstitutionalized adults born before 1954; starting in 2006, HRS began to collect biomarkers from half of the sampled adults.

The 2006 wave of HRS included 18,469 respondents who took part in core interviews. We restricted our analytic sample to age-eligible foreign-born and U.S.-born Hispanics, U.S.-born non-Hispanic Blacks (hereafter, Blacks), and U.S.-born non-Hispanic Whites (hereafter, Whites). The final analytic sample consisted of 15,985 age-eligible respondents, among whom 837 were foreign-born Hispanics, 690 were U.S.-born Hispanics, 2,252 were Blacks, and 12,206 were Whites. For systolic blood pressure, diastolic blood pressure, and pulse, the analytic sample size included 6,776 respondents: 301 foreign-born Hispanics, 244 U.S.-born Hispanics, 920 Blacks, and 5,311 Whites. For total blood cholesterol, HDL cholesterol, and glycosylated hemoglobin, the sample size was 5,783 respondents: 269 foreign-born Hispanics, 216 U.S.-born Hispanics, 741 Blacks, and 4,557 Whites.

Dependent Variables

Prevalence is more reliably measured than incidence, and it identifies the stamp of lifecycle health problems on the surviving population subgroups. We examined the prevalence of the following major chronic conditions: heart disease, stroke, diabetes, high blood pressure, cancer, chronic lung disease, and arthritis. The chronic disease classification rested on the respondents' answers to the question whether a doctor had ever told them that they had a particular condition. For heart disease, the respondents were asked whether the doctor had told them that they had a heart attack, coronary heart disease, angina, congestive heart failure, or other heart problems.

Following the measurement approach of Crimmins et al. (2007) on the Hispanic paradox in biological risk profiles, we classified individuals as being in a clinically high-risk group for a series of biomarkers. There are a number of ways to measure physiological status in terms of biological risk. Here, we examine two major types of biological risk that are precursors of cardiovascular disease and type 2 diabetes: blood pressure risk and metabolic risk. Blood pressure risk is measured in terms of systolic and diastolic blood pressure as well as pulse rate. Metabolic risk is measured using three indicators: total cholesterol, HDL cholesterol, and glycosylated hemoglobin. The determination of whether a respondent was "high risk" was based on results from physical measurements and laboratory tests, without consideration of prescription drug use. Crimmins et al. argued that although "drugs can be used to control hypertension and cholesterol levels, many people who take them do not achieve levels below the cutoff of what is considered high" (p. 1306). Following their approach also allows for a more systematic comparison to their prior study.

Independent Variables

We measured race/ethnicity/nativity as a categorical variable on the basis of place of birth and coded it in combination with self-reported race and Hispanic origin. Four categories were created: foreign-born Hispanics, U.S.-born Hispanics, Blacks, and Whites. We investigated two major factors that might influence racial/ethnic/nativity differentials in health: SES and health behaviors. SES is multifactorial and is measured using education (years of completed schooling), total household income in the year prior to the survey, and net household wealth. Education typically is completed prior to the onset of chronic health problems and is thus an important SES measure to probe the extent to which SES potentially accounts for racial/ethnic/nativity health differentials. Household wealth, although not immune to influence from health problems, is less sensitive than income to health changes. Household income and wealth were adjusted because of their skewed distributions by adding constants to all households to eliminate zero income or negative wealth, and then the values were logged. In this study, we used imputed household income and wealth provided by the RAND Center for the Study of Aging.

We controlled for health insurance coverage to compensate for racial/ethnic/nativity differences in the access to health care, because previous research has shown that first-generation immigrants had lower levels of health insurance coverage (National Research Council, 2002), which may lead to the underreporting of chronic diseases and a bias in favor of the healthy migrant hypothesis (Angel & Angel, 1996). Respondents were classified as uninsured when they were covered neither by federal government health insurance programs nor by private insurance programs.

We examined four health-related "behaviors" that are associated with health and well-being: smoking status, alcohol consumption, exercise, and obesity. Smoking status was measured as a categorical variable, including the categories current smokers and past smokers, with people who have never smoked as the reference group. Past smokers was the group most likely to include people who have stopped smoking in response to a health problem. Alcohol consumption was measured as a dummy variable, with nondrinkers as the reference group. Exercise was measured using the dummy variable "moderate or vigorous exercise" (indicating that the respondent took part in sports or activities that were vigorous or moderately energetic more than once a week or every day), with those who exercised once a week or less as a reference group. Strictly speaking, obesity (as measured by a body mass index ≥ 30 kg/m²) is not a health behavior and is often treated as a health

outcome. Here, we included it as a mediating variable because it indirectly reflects diet and energy expenditure that might be related to race/ethnicity/nativity as well as genetic constitution.

We also controlled for marital status and church attendance, which have been found to be closely associated with health outcomes (Hummer, Ellison, Rogers, Moulton, & Romero, 2004; Waite, 1995). Marital status (married = 1) was measured as a dummy variable. Church attendance was measured as frequent church attendance (one or more times a week) and occasional church attendance (monthly or yearly attendance), with nonchurchgoers as the reference category. Although health could potentially affect both marital status and church attendance, racial/ethnic/nativity differentials in these characteristics are typically set in young adulthood (Bulcroft & Bulcroft, 1993; Oropesa & Landale, 2004). Other control variables included age and gender. Age was measured as a continuous variable. Gender (female = 1) was measured as a dummy variable.

We also included three indicators of acculturation in an additional analysis for foreign-born Hispanics. Citizenship status (American citizen = 1) was measured as a dummy variable, duration of stay in the United States as a continuous variable, and interview language (English = 1) as a dummy variable.

Analysis

First, we estimated a series of nested logistic regression models to identify the overall association between race/ethnicity/nativity and the self-reported morbidity outcomes, controlling for age and gender. Each chronic condition was treated as an independent outcome. Then, the measures of SES and health behaviors were entered respectively for each outcome to assess whether the main effect of race/ethnicity/nativity was reduced or became stronger. The HRS was based on a complex sample design that involved stratification and oversamples of Blacks, Hispanics, and residents of Florida. Therefore, we estimated our models using Stata's survey (svy) commands, which adjusted standard errors for complex sample design. Descriptive statistics and the regression estimates were based on weighted data. We compared the weighted and unweighted results for regression models, and they were similar. For biomarker data, we estimated the same sets of models for each type of risk.

Overall, there were very few or no missing data for the independent variables. To reduce the influence of missing items on our data analysis and inferences, we used a multiple imputation approach to fill in missing values (Allison, 2001). The results were based on 10 random, multiple-imputed replicates. All analyses were performed using Stata Version 10.1.

Results

Bivariate Results

The descriptive profiles in Table 1 show significant racial/ethnic/nativity differences in SES and health behaviors. Whereas foreign-born Hispanics had much lower SES compared with the native-borns—the lowest educational attainment, household income, and health insurance coverage of any of the groups—they had similar or better health behaviors compared with Whites. An especially notable and favorable health behavior advantage for foreign-born Hispanics is the fact that they had the lowest rate of ever having smoked among all groups. The profile of health behaviors for U.S.-born Hispanics was mixed compared with those of Whites. They had a lower rate of drinking but a higher rate of obesity. A significantly lower proportion of U.S.-born Hispanics than of Whites exercised regularly. Both foreign-born and U.S.-born Hispanics had better health behaviors compared with Blacks in terms of regular exercise and low rates of obesity.

Is there a Hispanic epidemiologic paradox in later life in terms of chronic conditions and biological risk? Table 1 shows that compared with Whites, both foreign-born and U.S.-born Hispanics had similar or lower rates of six major chronic diseases but a significantly higher rate of diabetes. Compared with Blacks, foreign-born Hispanics had significantly lower rates of six major chronic diseases and a similar rate of chronic lung disease; U.S.-born Hispanics had significantly lower rates of heart disease, high blood pressure, and stroke and similar rates of the other four chronic diseases. However, foreign-born Hispanics were not significantly different from U.S.-born Hispanics, except that the former had a significantly lower rate of arthritis. Overall, despite their substantial SES disadvantages, reported health was surprisingly good (with the exception of diabetes) for Hispanics, foreign-born Hispanics in particular. In terms of biological risk, the pattern is less clear. Although foreign-born and U.S.-born Hispanics were statistically similar to Whites in all biomarkers with the exception of glycosylated hemoglobin, both were also statistically similar to Blacks in all biomarkers, except that U.S.-born Hispanics had a significantly lower rate of high diastolic blood pressure than Blacks. Blacks, however, had significantly higher rates of all biomarkers than Whites except for total cholesterol and HDL cholesterol.

Multivariate Results

We next turn to our models to evaluate the roles that SES and health behaviors play in contributing to these patterns in health. In Table 2, we summarize the

Table 1. Means and Percentages for Variables Used in the Analysis, Health and Retirement Study, 2006

Variable	Foreign-Born Hispanics	U.S.-Born Hispanics	Blacks	Whites
Self-reported chronic conditions				
Heart disease	15.5 ^{ab}	15.6 ^{ab}	22.8	24.1
High blood pressure	49.5 ^b	55.6 ^b	69.5 ^a	51.8
Cancer	7.6 ^{ab}	10.7 ^a	10.4 ^a	14.1
Chronic lung disease	5.5 ^a	6.4 ^a	7.9 ^a	10.2
Diabetes	24.3 ^{ab}	29.4 ^a	29.0 ^a	16.1
Stroke	4.0 ^{ab}	5.5 ^b	10.4 ^a	5.9
Arthritis	46.8 ^{abc}	55.9	58.9	57.0
Biomarkers^d				
Systolic blood pressure (≥140 mm Hg)	34.6	31.0	39.1 ^a	28.6
Diastolic blood pressure (≥90 mm Hg)	22.6	18.5 ^b	27.4 ^a	17.4
Pulse rate (≥90 beats/min)	7.7	5.7	9.5 ^a	5.4
Total cholesterol (≥240 mg/dL)	14.0	14.1	12.7	14.8
HDL cholesterol (<40 mg/dL)	13.0	7.8	7.6	9.2
Glycosylated hemoglobin (≥6.4%)	23.9 ^a	25.1 ^a	22.5 ^a	11.8
Demographic factors				
Age (years)	63.6 ^a	63.3 ^a	64.0 ^a	66.0
Women (%)	56.4	53.4 ^b	58.6 ^a	53.6
Socioeconomic factors				
Education (years)	8.1 ^{abc}	10.6 ^{ab}	11.8 ^a	13.3
Household income (×\$1,000)	27.9 ^{abc}	38.3 ^a	35.6 ^a	72.3
Household Wealth (×\$1,000)	143.7 ^a	196.3 ^a	134.5 ^a	612.1
No health insurance (%)	22.5 ^{ab}	16.8 ^{ab}	9.8 ^a	4.6
Health behaviors				
Moderate or vigorous exercise (%)	56.8 ^b	54.6 ^{ab}	49.7 ^a	61.7
Ever drink alcohol (%)	38.9 ^a	44.2 ^a	36.9 ^a	57.2
Smoking status (%)				
Current smoker	11.6 ^{bc}	16.1	20.4 ^a	14.6
Past smoker	36.1 ^a	43.1	39.5 ^a	43.3
Never smoked	52.3 ^{abc}	40.8	40.1	42.1
Obese (%)	28.6 ^{bc}	35.9 ^{ab}	42.0 ^a	28.5
Family and religion				
Married (%)	59.7 ^b	60.9 ^b	38.8 ^a	64.8
Church attendance (%)				
Frequent church attendance	45.4 ^{ab}	38.2 ^b	52.1 ^a	36.4
Occasional church attendance	35.7	41.0	34.9	34.8
Nonchurchgoers	18.9 ^{ab}	20.8 ^{ab}	13.0 ^a	28.8
<i>n</i>	837	690	2,252	12,206

Note: Weighted data. HDL = high-density lipoprotein.

a. Significantly different from Whites ($p < .05$).

b. Significantly different from Blacks ($p < .05$).

c. Significantly different from U.S.-born Hispanics ($p < .05$).

d. The sample came from the 2006 Health and Retirement Study biomarker data set.

results of the nested models for the seven major chronic conditions. Later, we examine the results for the six biomarkers. Model 1 in Table 2 includes age and gender, and the pattern of results largely parallels the bivariate results. Compared with Whites, foreign-born Hispanics had equivalent or significantly lower odds of reporting all chronic conditions, with the exception of diabetes. Foreign-born Hispanics' lower rates of heart disease and cancer (the odds of heart disease and cancer were 65% and 55% as high for foreign-born Hispanics as for Whites) closely resembled racial and ethnic differences in cause-specific mortality (Heron et al., 2006). U.S.-born Hispanics had equivalent or significantly lower odds of reporting all chronic conditions, with the exception of high blood pressure and diabetes. In additional analyses, we used Blacks as the reference group (results not shown). We observed that compared with Blacks who were also disadvantaged in SES, foreign-born Hispanics had significantly lower odds of reporting high blood pressure, diabetes, heart disease, stroke, and arthritis; U.S.-born Hispanics had significantly lower odds of reporting high blood pressure, heart disease, and stroke. However, foreign-born Hispanics did not have statistically significant health advantages over U.S.-born Hispanics except for arthritis.

We then added SES to Model 1 (see Model 2). Foreign-born Hispanics' advantages compared with Whites became even more pronounced, except for cancer, and in addition, they had significantly lower odds of having high blood pressure. Foreign-born Hispanics' disadvantage in diabetes relative to Whites was reduced substantially. The change suggests that lower SES plays a significant role in the higher risk for diabetes for foreign-born Hispanics. Similarly, U.S.-born Hispanics' health advantages in heart disease also increased slightly, and they had significantly lower odds of having chronic lung disease, although they were still more likely to have diabetes than Whites. In additional analyses, we examined the sensitivity of our results to the possible problem of endogeneity between SES and health. We reestimated Model 1 and added health insurance as a covariate. The original nativity effects shown for Model 1 in Table 2 remained robust and relatively unchanged. As education is often set prior to most of the chronic conditions, we reestimated Model 2 for all the health outcomes by stepping in education only. We found that in most cases, parameters for foreign-born Hispanics, U.S.-born Hispanics, and Blacks were very similar to those shown in Model 2 in Table 2. In general, our results were robust when we used different measures of SES.

When we controlled for health behaviors in Model 3, foreign-born Hispanics' advantages in heart disease, cancer, chronic lung disease, and arthritis relative to Whites persisted, and the odds changed only slightly. As

Table 2. Estimated Odds Ratios (and 95% Confidence Intervals) From Logistic Regressions of Whether Respondents Had Chronic Diseases,^a Health and Retirement Study, 2006 (n = 15,985)

	High Blood Pressure	Diabetes	Heart Disease	Cancer	Chronic Lung Disease	Stroke	Arthritis
Model 1 (includes demographic controls)							
Foreign-born Hispanics	1.00 (0.83-1.22)	1.77** (1.47-2.14)	0.65** (0.50-0.86)	0.55** (0.39-0.77)	0.54** (0.34-0.84)	0.78 (0.49-1.23)	0.71** (0.59-0.85)
U.S.-born Hispanics	1.31** (1.11-1.55)	2.29** (1.77-2.97)	0.67** (0.50-0.89)	0.83 (0.59-1.16)	0.63 (0.40-1.01)	1.12 (0.79-1.60)	1.10 (0.86-1.39)
Blacks	2.37** (2.03-2.76)	2.25** (1.98-2.55)	1.07 (0.93-1.22)	0.77** (0.65-0.92)	0.77** (0.61-0.99)	2.18** (1.83-2.60)	1.17** (1.06-1.29)
Model 2 (includes demographic controls and SES)							
Foreign-born Hispanics	0.70** (0.56-0.88)	1.16 (0.92-1.45)	0.46** (0.34-0.61)	0.64* (0.44-0.93)	0.19** (0.11-0.33)	0.49** (0.29-0.81)	0.49** (0.39-0.61)
U.S.-born Hispanics	1.06 (0.90-1.26)	1.78** (1.34-2.36)	0.53** (0.39-0.73)	0.92 (0.64-1.31)	0.35** (0.21-0.59)	0.84 (0.58-1.21)	0.89 (0.68-1.18)
Blacks	2.01** (1.72-2.36)	1.83** (1.59-2.11)	0.91 (0.79-1.04)	0.82* (0.69-0.97)	0.53** (0.41-0.68)	1.79** (1.47-2.18)	0.99 (0.90-1.10)
Model 3 (includes demographic controls and health behaviors)							
Foreign-born Hispanics	0.97 (0.79-1.20)	1.67** (1.33-2.10)	0.62** (0.47-0.82)	0.56** (0.39-0.79)	0.55* (0.35-0.87)	0.71 (0.44-1.13)	0.69** (0.56-0.83)
U.S.-born Hispanics	1.20* (1.02-1.42)	2.04** (1.61-2.58)	0.61** (0.45-0.81)	0.82 (0.59-1.16)	0.56* (0.35-0.90)	0.99 (0.68-1.43)	0.99 (0.77-1.29)
Blacks	2.08** (1.77-2.45)	1.79** (1.55-2.08)	0.93 (0.81-1.07)	0.76** (0.64-0.90)	0.61** (0.47-0.79)	1.84** (1.53-2.21)	0.98 (0.89-1.09)
Model 4 (includes demographic controls, health behaviors, SES, family and religious factors)							
Foreign-born Hispanics	0.73** (0.58-0.92)	1.32* (1.03-1.70)	0.51** (0.38-0.68)	0.66* (0.45-0.96)	0.30** (0.19-0.50)	0.59* (0.35-0.97)	0.54** (0.43-0.67)
U.S.-born Hispanics	1.02 (0.86-1.22)	1.80** (1.38-2.34)	0.53** (0.39-0.73)	0.92 (0.64-1.32)	0.40** (0.24-0.65)	0.87 (0.60-1.28)	0.88 (0.66-1.17)
Blacks	1.83** (1.55-2.17)	1.69** (1.46-1.96)	0.86* (0.74-0.99)	0.81* (0.68-0.96)	0.50** (0.39-0.65)	1.75** (1.43-2.14)	0.91 (0.81-1.02)

Note: Weighted data. SES = socioeconomic status.

a. The reference group is Whites.

*p < .05. **p < .01.

for U.S.-born Hispanics, their advantages in heart disease persisted, and they now had significantly lower rates of chronic lung disease than Whites. These results suggest that health behaviors are not the major factors accounting for Hispanics' health advantages in these chronic diseases.

Finally, Model 4 includes all covariates. Panning across the models, it is evident that foreign-born and U.S.-born Hispanics had equivalent or significantly lower odds of all major chronic diseases relative to Whites except for diabetes, all else being equal.

In Table 3, we examine the heterogeneity among Hispanic immigrants by looking at how proxies of acculturation including citizenship, duration of stay in the United States, and interview language are associated with chronic diseases. Results from Model 1 in Table 3 show that duration of stay in the United States was positively associated with the odds of having diabetes and heart disease. Each additional year in the United States was associated with a 2% increase in the odds of having diabetes and heart disease. A caveat here is that in our sample, the majority of foreign-born Hispanics have stayed in the United States for more than 10 years. Given previous literature showing that recent immigrants were healthier than long-term immigrants (Cho & Hummer, 2001), our results may have underestimated the effects of duration of U.S. residence on the risk for chronic diseases. Citizenship and using English in the survey were not significantly associated with any chronic diseases. In Model 2, we added all the controls, and the effects of duration of stay in the United States on heart disease and diabetes persisted.

With regard to biological risk, the results of Model 1 in Table 4 show that compared with Whites, foreign-born Hispanics were significantly more likely to have systolic blood pressure at high-risk levels but were not statistically different from Whites in terms of the other markers of blood pressure risk—high diastolic pressure and high pulse rate—although the parameter estimates suggest a greater propensity for being at high risk than Whites but also a lower propensity for being at high risk than Blacks. U.S.-born Hispanics were not statistically different from Whites in three indicators of blood pressure risk. Moreover, both foreign-born and U.S.-born Hispanics did not have significantly elevated metabolic risks compared with Whites, with the exception of glycosylated hemoglobin. It is important to keep in mind that the smaller sample sizes of foreign-born and U.S.-born Hispanics for the biological risk analysis may be hampering our models' ability to identify racial/ethnic/nativity differences in biological risk.

In an additional analysis, we explored the possibility that foreign-born Hispanics might not have the same access to blood pressure and diabetes medications as Whites by controlling for use of such medications (results not

Table 3. Estimated Odds Ratios (and 95% Confidence Intervals) From Logistic Regressions of Whether Hispanic Immigrants Had Chronic Diseases, Health and Retirement Study, 2006 (n = 837)

	High Blood Pressure	Diabetes	Heart Disease	Cancer	Chronic Lung Disease	Stroke	Arthritis
Model 1 (includes demographic controls)							
American citizen (vs. noncitizen)	1.14 (0.77-1.69)	0.85 (0.55-1.31)	1.65 (0.98-2.77)	1.18 (0.53-2.61)	1.57 (0.62-3.95)	1.20 (0.49-2.93)	1.12 (0.76-1.65)
English as survey language (vs. Spanish)	0.77 (0.49-1.22)	0.63 (0.38-1.06)	0.99 (0.56-1.77)	1.29 (0.55-3.05)	1.15 (0.41-3.27)	1.70 (0.62-4.65)	0.79 (0.51-1.24)
Duration of stay in the U.S.	1.00 (0.99-1.02)	1.02** (1.01-1.04)	1.02* (1.00-1.04)	1.00 (0.98-1.02)	1.02 (1.00-1.05)	1.01 (0.98-1.05)	1.01 (0.99-1.03)
Model 2 (includes demographic controls, health behaviors, SES, family and religious factors)							
American citizen (vs. noncitizen)	1.11 (0.73-1.70)	0.93 (0.59-1.48)	1.48 (0.83-2.65)	0.86 (0.37-2.00)	1.98 (0.76-5.17)	1.16 (0.45-2.96)	1.13 (0.75-1.70)
English as survey language (vs. Spanish)	0.99 (0.60-1.63)	0.95 (0.55-1.65)	1.33 (0.72-2.46)	0.70 (0.27-1.79)	1.34 (0.50-3.61)	1.76 (0.67-4.65)	0.97 (0.59-1.59)
Duration of stay in the U.S.	1.00 (0.98-1.01)	1.02* (1.00-1.03)	1.02* (1.00-1.04)	1.00 (0.98-1.02)	1.02 (0.99-1.06)	1.01 (0.98-1.04)	1.01 (0.99-1.02)

Note: Weighted data. SES = socioeconomic status.

*p < .05. **p < .01.

Table 4. Estimated Odds Ratios (and 95% Confidence Intervals) From Logistic Regressions of Whether Respondents Had Biological Risk Factors That Met Clinical High-Risk Criteria,^a Health and Retirement Study, 2006

	High Systolic Pressure	High Diastolic Pressure	High Pulse Rate	High Total Cholesterol	Low HDL Cholesterol	High Glycosylated Hemoglobin
Model 1 (includes demographic controls)						
Foreign-born Hispanics	1.47* (1.10-1.97)	1.35 (0.99-1.86)	1.42 (0.89-2.25)	0.88 (0.60-1.29)	1.62 (1.00-2.64)	2.48** (1.78-3.43)
U.S.-born Hispanics	1.30 (0.86-1.97)	1.04 (0.76-1.42)	1.01 (0.58-1.78)	0.88 (0.56-1.38)	0.86 (0.38-1.92)	2.68** (1.70-4.20)
Blacks	1.82** (1.53-2.16)	1.76** (1.37-2.27)	1.80** (1.35-2.41)	0.78 (0.57-1.08)	0.91 (0.56-1.46)	2.27** (1.81-2.84)
Model 2 (includes demographic controls and SES)						
Foreign-born Hispanics	1.19 (0.88-1.61)	1.17 (0.84-1.63)	0.86 (0.44-1.66)	0.80 (0.51-1.25)	1.02 (0.58-1.79)	1.62* (1.09-2.39)
U.S.-born Hispanics	1.14 (0.75-1.73)	0.92 (0.67-1.26)	0.82 (0.41-1.65)	0.84 (0.54-1.33)	0.67 (0.28-1.56)	2.22** (1.36-3.61)
Blacks	1.66** (1.37-2.02)	1.69** (1.31-2.19)	1.50* (1.09-2.06)	0.77 (0.56-1.06)	0.74 (0.45-1.22)	1.91** (1.50-2.42)
Model 3 (includes demographic controls and health behaviors)						
Foreign-born Hispanics	1.50** (1.12-2.02)	1.41* (1.02-1.94)	1.41 (0.87-2.29)	0.89 (0.61-1.31)	1.51 (0.93-2.46)	2.29** (1.59-3.31)
U.S.-born Hispanics	1.31 (0.86-1.99)	1.04 (0.77-1.42)	0.98 (0.57-1.69)	0.93 (0.59-1.45)	0.73 (0.32-1.68)	2.20** (1.44-3.35)
Blacks	1.71** (1.42-2.06)	1.72** (1.32-2.23)	1.53** (1.12-2.08)	0.83 (0.59-1.17)	0.68 (0.42-1.11)	1.76** (1.40-2.22)

(continued)

Table 4. (continued)

	High Systolic Pressure	High Diastolic Pressure	High Pulse Rate	High Total Cholesterol	Low HDL Cholesterol	High Glycosylated Hemoglobin
Model 4 (includes demographic controls, health behaviors, SES, family and religious factors)						
Foreign-born Hispanics	1.26 (0.94-1.70)	1.25 (0.89-1.75)	1.05 (0.55-2.00)	0.74 (0.49-1.13)	1.19 (0.66-2.12)	1.81** (1.20-2.74)
U.S.-born Hispanics	1.17 (0.76-1.79)	0.94 (0.69-1.28)	0.88 (0.46-1.69)	0.85 (0.54-1.34)	0.64 (0.27-1.54)	2.03** (1.29-3.20)
Blacks	1.58** (1.30-1.92)	1.66** (1.29-2.14)	1.37 (0.97-1.94)	0.79 (0.58-1.09)	0.64 (0.40-1.04)	1.69** (1.31-2.18)
n	6,776	6,776	6,776	5,783	5,783	5,783

Note: Weighted data. HDL = high-density lipoprotein; SES = socioeconomic status.

a. The reference group is Whites.

* $p < .05$. ** $p < .01$.

shown), but our results remained the same. We also followed the study of Crimmins et al. (2007) and created an overall score for blood pressure risk (by adding high systolic pressure, high diastolic pressure, and high pulse rate) and a metabolic risk score (by adding high total cholesterol, low HDL, and high glycosylated hemoglobin). Then we examined racial/ethnic/nativity differences in these two overall biological risk scores. The results showed that foreign-born Hispanics had significantly higher blood pressure and metabolic risk scores than Whites after we controlled for age and gender; U.S.-born Hispanics also had significantly higher metabolic risk scores than Whites but were not different from Whites in blood pressure risk score.

Model 2 in Table 4 added SES to Model 1. Controlling for SES, foreign-born Hispanics' biological risk disadvantages in systolic pressure and glycosylated hemoglobin were substantially reduced relative to Whites (note also the dramatic drop for low HDL cholesterol). This finding suggests that lower SES contributed to foreign-born Hispanics' disadvantages in some of the biomarkers. When we added health behaviors in Model 3, the disadvantages of foreign-born Hispanics shown in Model 1 in systolic pressure and glycosylated hemoglobin persisted. In addition, foreign-born Hispanics now had significantly higher odds of having high-risk levels of diastolic blood pressure than Whites. After controlling for all the covariates in Model 4, both foreign-born and U.S.-born Hispanics were still more likely to have high-risk levels of glycosylated hemoglobin than Whites. However, there were no statistically significant differences between foreign-born and U.S.-Born Hispanics in any of the biomarkers either with or without controls.

We also examined the heterogeneity among Hispanic immigrants by looking at how citizenship, duration of stay in the United States, and interview language were associated with all of the biomarkers. No statistically significant associations were found (results not shown).

Finally, we examined potential gender differences in the association between race/ethnicity/nativity and health (results not shown), because previous research has suggested that the selection effect for immigration might be stronger for men (Swallen, 1997). We created three interaction terms (Foreign-Born Hispanics \times Gender, U.S.-Born Hispanics \times Gender, and Blacks \times Gender) and included them in Model 4 of Table 2. We only found a few statistically significant interactions. Being male seemed more protective for foreign-born Hispanics in terms of high blood pressure and arthritis. Being male was also more protective for U.S.-born Hispanics in terms of cancer. With regard to biomarkers, when the three interaction terms were added to Model 4 in Table 4, only one interaction term was statistically significant: Foreign-born Hispanic men were significantly more likely to have high-risk

levels of diastolic blood pressure than White men, whereas foreign-born Hispanic women were not statistically different from White women.

Discussion

Our goal in this study was to assess whether the Hispanic epidemiologic paradox in mortality also extends to a range of chronic conditions and biological risk. Our results highlight that in spite of their socioeconomic disadvantage, foreign-born Hispanics appear to be particularly healthy in terms of having equivalent or lower rates of several major chronic diseases (with the exception of diabetes) compared with Whites, and their health advantage is even more pronounced when we control for SES. Like their foreign-born counterparts, U.S.-born Hispanics also have equivalent or lower rates of major chronic conditions except for diabetes and high blood pressure, controlling for age and gender. Both foreign-born and native-born Hispanics show significant health advantages over Blacks. The self-reported chronic morbidity patterns of both foreign-born and U.S.-born Hispanics are thus largely consistent with the epidemiologic paradox described by Markides and Coreil (1986) as well as current findings on racial and ethnic differences in all-cause and cause-specific mortality. Our findings suggest that part of the reason for the significantly lower mortality of Hispanics compared with Whites is due to the lower burden of major fatal chronic diseases such as heart disease, cancer, chronic lung disease, and stroke among Hispanics. The fascinating question is why the socially disadvantaged older Hispanics who have worked and lived in America for many years can defy their odds in later life of having these major chronic diseases, many of which are the leading causes of death in America.

In our study, we examined one potential mechanism: health behaviors. However, our results cast doubt on the idea that the better-than-expected health profiles of Hispanics are due largely to their healthier behaviors. First, Hispanics do not have advantages over Whites in every health behavior. Although foreign-born Hispanics are less likely to drink and smoke than Whites, they are similar to Whites in terms of exercise and obesity. Moreover, the health behaviors of U.S.-born Hispanics are in fact worse than those of Whites in terms of exercise and obesity. Overall, greater acculturation (i.e., native-born vs. foreign-born) is associated with worse health behaviors for older Hispanics. Second, our research shows that although health behaviors are significantly associated with the risk for most conditions, they explain a very small part of the health gap across racial/ethnic/nativity groups. However, given that we are unable to measure long-term exposure to smoking, drinking,

exercise, or dietary practices, we may have underestimated the role of these factors. Longitudinal data on acculturation and health behaviors over the life course are clearly needed for us to fully understand the role health behaviors play in Hispanic epidemiologic paradox. In addition, we think that the research on the Hispanic paradox should go beyond focusing on a few health behaviors and explore other important factors, such as family cohesion and support, social networks, neighborhood characteristics, religion and coping strategy, early life conditions, dietary pattern and nutrition, and the selectivity of immigrants on certain psychological attributes such as sense of control and optimism, all of which have powerful effects on health.

Another interesting finding of our study is that foreign-born Hispanics do not have a significant health advantage over U.S.-born Hispanics in major chronic diseases except for arthritis. Our finding is consistent with the study of Gonzalez et al. (2009), who found no immigrant health advantages among older Mexican Americans in terms of self-rated health and chronic illnesses. These results do not mirror those in mortality research. Previous research showed that foreign-born Hispanics had survival advantages over their U.S.-born counterparts in all-cause and cause-specific mortality (e.g., cardiovascular disease, certain types of cancer, and chronic obstructive pulmonary disease), after controlling for various sociodemographic characteristics (Singh & Siahpush, 2001). Why is it that foreign-born Hispanics have similar risk as their U.S.-born counterparts for major chronic diseases such as heart disease, cancer, and chronic lung disease in later life but are significantly less likely to die from these diseases? Future research can shed light on this issue by looking at how the two groups manage chronic diseases in terms of the use of Western and alternative medications, lifestyle changes after the diagnosis, social support, and, for foreign-born Hispanics, plans to return to their home countries if their conditions deteriorate. By exploring what happens between the onset of a major disease and mortality, we can have a deeper understanding of the mechanisms underlying the intriguing findings in Hispanic health and mortality.

There are at least three potential explanations for the superior health reported by foreign-born Hispanics documented in our study. One possible explanation is that the measures of self-reported chronic conditions rely largely on doctor visits; thus, there is the possibility of underreporting of chronic conditions among foreign-born Hispanics, who reported the lowest rates of diseases and who also had the lowest rates of health insurance coverage. However, two pieces of evidence suggest that access to health care cannot fully explain the superior health profiles of foreign-born Hispanics in chronic diseases. First, when we added health insurance coverage to Model

1 in Table 2, the relative odds of foreign-born Hispanics hardly changed; second, foreign-born Hispanics did not report significantly lower prevalence of every major chronic condition that needs a doctor's diagnosis. In fact, they reported significantly higher rates of diabetes, a condition that depends on medical diagnosis. Still, in the absence of data from comprehensive physical exams and medical records, the issue of underreporting cannot be entirely ruled out.

The second explanation comes from the salmon bias hypothesis. Foreign-born Hispanics, Mexican Americans in particular, may be more likely to return to their home countries (to die) if they have fatal chronic diseases such as cancer, heart disease, and stroke, given that many foreign-born Hispanics do not have health insurance in the United States. However, recent research on the Hispanic mortality advantage (Turra & Elo, 2008) suggests that the salmon bias plays a relatively minor role in explaining the Hispanic mortality paradox. We think that it is important to conduct qualitative studies on return migration to Mexico and other Latin American countries to understand the role of fatal chronic illnesses, lack of health insurance, and quality of health care. The last explanation is the healthy migrant effect. There might be a positive health selection for migration in terms of chronic conditions such as cardiovascular disease. It is highly possible that all three explanations play some role in the chronic disease pattern we have documented in our analysis.

This chronic disease pattern is mirrored to some extent in our analysis of biological risk. Controlling for age and sex, foreign-born Hispanics are not significantly better, or worse, off than Whites in four of six biomarkers examined; U.S.-born Hispanics are similar to Whites in all biomarkers, except that they are at greater risk for having high glycosylated hemoglobin. Moreover, foreign-born and U.S.-born Hispanics are not significantly different in biological risk profiles. Our results on biomarkers are largely consistent with a recent study by Crimmins et al. (2007), despite the fact they used a different data set with a different sampling frame of Hispanics and looked at a group of Hispanics much younger than the cohorts in HRS. The only difference in results is that whereas Crimmins et al. found that foreign-born Hispanics were not significantly different from Whites in high blood pressure risk, our results suggest that foreign-born Hispanics are at significantly higher risk for having high systolic pressure. The inconsistent results on high blood pressure risk call for more research to replicate and expand our work. We are only able to examine a limited number of biomarkers in our study, and future research should examine a wider array of biological risk factors, including inflammation markers (e.g., C-reactive protein, plasma fibrinogen, urinary albumin) and metabolic markers (e.g., serum triglycerides, waist

circumference) that have been associated with cardiovascular disease and mortality. It is a bit puzzling that although Hispanics have significantly lower rates of heart disease and stroke compared with Whites, they do not show any advantages in the biological risk factors for cardiovascular disease.

For a range of reasons, this study should be viewed as part of the early stages of a body of research on the topic of older Hispanics' health. One of the major limitations of the study is that we grouped together Hispanics of different national origins because of sample size issues. Hispanics are a heterogeneous group, including Mexicans, Puerto Ricans, Cubans, Central and South Americans, and other Hispanics. They have different migration histories, SES, and health profiles. In our sample, about 62% of Hispanics are Mexican Americans, and therefore the results are largely driven by Mexican Americans. It is important to analyze chronic morbidity patterns among Hispanic subgroups in the future.

The second limitation is that we lack strong measures of acculturation. Although we find that a longer stay in the United States is associated with higher risks of diabetes and heart disease, we are unable to evaluate the mechanisms by which duration of stay leads to negative outcomes. We do not have a direct measure of immigrants' English language proficiency, diet, social networks, or experience with discrimination in workplace and health care settings, all of which may account for the declining health of Hispanic immigrants over time.

Nonetheless, our results suggest that it is important to assess the sensitivity of the immigrant health advantage to potential underreporting biases among immigrants as well as to use health measures that depend less on health care use (e.g., physical exam and laboratory data such as biomarkers). More research is needed to disentangle the inconsistent findings on reported high blood pressure, measured systolic blood pressure, and measured diastolic blood pressure among foreign-born Hispanics. Finally, our reliance on prevalence to evaluate Hispanic immigrants' health rests on potentially complex and differing processes for the groups in question. Future research should use longitudinal data sets to analyze how race and ethnicity combined with nativity is related to the onset and diagnosis of chronic conditions, the severity of diseases upon diagnosis, the management of chronic diseases, and survival with a given condition.

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References

- Abraido-Lanza, A. F., Dohrenwend, B. P., Ng-Mak, D. S., & Turner, J. B. (1999). The Latino mortality paradox: A test of the “salmon bias” and healthy migrant hypotheses. *American Journal of Public Health, 89*, 1543-1548.
- Allison, P. D. (2001). *Missing data*. Thousand Oaks, CA: SAGE.
- Angel, R. J., & Angel, J. L. (1996). The extent of private and public health insurance coverage among adult Hispanics. *The Gerontologist, 36*, 332-340.
- Arias, E. (2010). United States life tables by Hispanic origin. *Vital Health Statistics, 2*(152), 1-33.
- Arias, E., Eschbach, K., Schauman, W. S., Backlund, E. L., & Sorlie, P. D. (2010). The Hispanic mortality advantage and ethnic misclassification on US death certificates. *American Journal of Public Health, 100*, S171-S177.
- Bulcroft, R. A., & Bulcroft, K. A. (1993). Race differences in attitudinal and motivational factors in the decision to marry. *Journal of Marriage and Family, 55*, 338-355.
- Cho, Y., & Hummer, R. A. (2001). Disability status differentials across fifteen Asian and Pacific Islander groups and the effect of nativity and duration of residence in the U.S. *Social Biology, 48*, 171-195.
- Cho, Y., Frisbie, W.P., Hummer, R.A., & Rogers, R.G. (2004). Nativity, duration of residence, and the health of Hispanic adults in the United States. *International Migration Review, 38*(2), 184-212.
- Crimmins, E. M., Hayward, M. D., & Seeman, T. E. (2004). Race/ethnicity, socioeconomic status, and health. In N. B. Anderson, R.A. Bulatao, & B. Cohen (Eds.), *Critical perspectives on racial and ethnic differences in health in late life* (pp. 310-352). Washington, DC: National Academies Press.
- Crimmins, E. M., Kim, J. K., Alley, D. E., Karlamangla, A., & Seeman, T. (2007). Hispanic paradox in biological risk profiles. *American Journal of Public Health, 97*, 1305-1310.
- Dey, A. N., & Lucas, J. W. (2006). Physical and mental health characteristics of U.S.- and foreign-born adults: United States, 1998-2003. *Advance Data, 369*, 1-19.

- Gonzalez, H. M., Ceballos, M., Tarraf, W., West, B. T., Bowen, M. E., & Vega, W. A. (2009). The health of older Mexican Americans in the long run. *American Journal of Public Health, 99*(10), 1879-1885.
- Grieco, E. M. (2010). *Race and Hispanic origin of the foreign-born population in the United States: 2007*. Washington, DC: U.S. Census Bureau.
- Heron, M., Hoyert, D. L., Murphy, S. L., Xu, J., Kochanek, K. D., & Tejada-Vera, B. (2009). *Death: Final data for 2006* (National Vital Statistics Reports Vol. 57 No. 14). Hyattsville, MD: National Center for Health Statistics.
- Hummer, R. A., Ellison, C. G., Rogers, R. G., Moulton, B. E., & Romero, R. R. (2004). Religious involvement and adult mortality in the United States: review and perspective. *Southern Medical Journal, 97*(12), 1223-1230.
- Hummer, R. A., Powers, D. A., Pullum, S. G., Gossman, G. L., & Frisbie, W. P. (2007). Paradox found (again): Infant mortality among the Mexican-origin population in the United States. *Demography, 44*(3), 441-457.
- Jasso, G., Massey, D. S., Rosenzweig, M. R., & Smith, J. P. (2004). Immigrant health-selectivity and acculturation. In N. B. Anderson, R. A. Bulatao, & B. Cohen (Eds.), *Critical perspectives on racial and ethnic differences in health in late life* (pp. 227-266). Washington, DC: National Academies Press.
- Johnson, R. A., & Hoffmann, J. P. (2000). Adolescent cigarette smoking in U.S. racial/ethnic subgroups: Findings from the National Education Longitudinal Study. *Journal of Health and Social Behavior, 41*, 392-407.
- Landale, N. S., Oropesa, R. S., & Gorman, B. K. (2000). Migration and infant death: Assimilation or selective migration among Puerto Ricans? *American Sociological Review, 65*, 888-909.
- Markides, K. S., & Coreil, J. (1986). The health of Hispanics in the southwestern United States: An epidemiologic paradox. *Public Health Reports, 101*(3), 253-265.
- Markides, K. S., & Eschbach, K. (2005). Aging, migration, and mortality: current status of research on the Hispanic paradox. *Journals of Gerontology Series B: Psychological Sciences and Social Sciences, 60*(Spec. No. 2), 68-75.
- Must, A., Gortmaker, S. L., & Dietz, W. H. (1994). Risk factors for obesity in young adults: Hispanics, African Americans and Whites in the transition years, age 16-28 years. *Biomedicine and Pharmacotherapy, 48*, 143-156.
- National Research Council. (2002). *Emerging issues in Hispanic health: Summary of a workshop*. Washington, DC: National Academies Press.
- Oropesa, R. S., & Landale, N. S. (2004). The future of marriage and Hispanics. *Journal of Marriage and Family, 66*, 901-920.
- Palloni, A. (2007). Health status of elderly Hispanics in the United States. In J. L. Angle & K. E. Whitfield (Eds.), *The health of aging Hispanics* (pp. 17-25). New York: Springer.

- Palloni, A., & Arias, E. (2004). Paradox lost: Explaining the Hispanic adult mortality advantage. *Demography*, *41*, 385-415.
- Singh, G. K., & Siahpush, M. (2001). All-cause and cause-specific mortality of immigrants and native born in the United States. *American Journal of Public Health*, *91*(3), 392-399.
- Swallen, K. (1997). Do health selection effects last? A comparison of morbidity rates for elderly adult immigrants and US-born elderly persons. *Journal of Cross-Cultural Gerontology*, *12*, 317-339.
- Turra, C. M., & Elo, I. T. (2008). The impact of salmon bias on the Hispanic mortality advantage: New evidence from social security data. *Population Research and Policy Review*, *27*, 515-530.
- Waite, L. J. (1995). Does marriage matter? *Demography*, *32*(4), 483-507.

Bios

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