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Hispanic Older Adult Mortality in the United States: New Estimates and an Assessment of Factors Shaping the Hispanic Paradox

Joseph T. Lariscy · Robert A. Hummer · Mark D. Hayward

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Abstract Hispanics make up a rapidly growing proportion of the U.S. older adult population, so a firm grasp of their mortality patterns is paramount for identifying racial/ethnic differences in life chances in the population as a whole. Documentation of Hispanic mortality is also essential for assessing whether the Hispanic paradox—the similarity in death rates between Hispanics and non-Hispanic whites despite Hispanics' socioeconomic disadvantage—characterizes all adult Hispanics or just some age, gender, nativity, or national-origin subgroups. We estimate age-/sex- and cause-specific mortality rate ratios and life expectancy for foreign-born and U.S.-born Hispanics, foreign-born and U.S.-born Mexican Americans, non-Hispanic blacks, and non-Hispanic whites ages 65 and older using the 1989–2006 National Health Interview Survey Linked Mortality Files. Results affirm that Hispanic mortality estimates are favorable relative to those of blacks and whites, but particularly so for foreign-born Hispanics and smoking-related causes. However, if not for Hispanics' socioeconomic disadvantage, their mortality levels would be even more favorable.

Keywords Adult mortality · Race/ethnicity · Hispanic paradox · Socioeconomic status · Smoking

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J. T. Lariscy (✉)
Population Research Institute and Department of Sociology, Duke University, 271 Soc-Psyc Building, Campus Box 90088, Durham, NC 27708, USA
e-mail: joseph.lariscy@duke.edu

R. A. Hummer · M. D. Hayward
Population Research Center and Department of Sociology, University of Texas at Austin, 305 E. 23rd Street, G1800, Austin, TX 78712, USA

R. A. Hummer
e-mail: rhummer@prc.utexas.edu

M. D. Hayward
e-mail: mhayward@prc.utexas.edu

Introduction

Hispanic older adult mortality rates are much more comparable with those of non-Hispanic whites (hereafter, "whites") than non-Hispanic blacks (hereafter, "blacks"), despite the similarly low socioeconomic status (SES) of Hispanics and blacks relative to whites (Markides and Eschbach 2011). Given the fundamental importance of SES in determining mortality differences, the unique mortality profile for Hispanics relative to these other two large U.S. racial/ethnic groups is surprising, leading to its characterization as the "Hispanic paradox" (Markides and Coreil 1986; Markides and Eschbach 2005). Despite this longstanding intriguing mortality pattern, the National Center for Health Statistics (NCHS) only recently published its first official Hispanic life tables (Arias 2010). This report drew on 2006 mortality data consisting of death certificate–based numerators and census estimate–based denominators and adjusted for ethnic misclassification, which biases Hispanic mortality rates downward (see also Elo et al. 2004; Rosenberg et al. 1999). Life expectancy at birth was estimated as 80.6 years for Hispanics, which is 2.5 years higher than for whites and nearly 8 years higher than for blacks.

This research note contributes new insights to the Hispanic paradox literature by first providing alternative estimates of Hispanic older adult (ages 65 and older) mortality and life expectancy, using a data set completely independent of that used by Arias (2010). Importantly, we distinguish the mortality patterns of foreign-born Hispanics from those of U.S.-born Hispanics; moreover, we separately specify the mortality and life expectancy patterns of Mexican-origin adults within each nativity group. Second, we contribute to this literature by examining how nativity, SES, and smoking shape the Hispanic paradox. The substantial immigrant composition and low rates of cigarette smoking may keep Hispanic mortality levels lower than for whites and blacks; on the other hand, the overall low SES of the Hispanic population may be deleterious to mortality levels of Hispanic older adults. This article evaluates the contribution of these three factors as they shape mortality patterns for Hispanics in comparison with whites and blacks.

Prior Literature

The development of the first official Hispanic life tables (Arias 2010) was a monumental accomplishment because they created a benchmark for future and alternative Hispanic mortality estimates and facilitated comparisons with other groups. Nonetheless, the report did not separately specify Hispanic mortality patterns by nativity or national origin. Hispanic immigrants generally exhibit 15 % to 20 % lower mortality than U.S.-born Hispanics (Borrell and Crawford 2009; Hummer et al. 2000; Singh and Siahpush 2002), most likely because immigrants are self-selected on good health, positive health behaviors, and other health-enhancing attributes relative to nonmigrants (Akresh and Frank 2008; Crimmins et al. 2005). Additionally, selective outmigration may downwardly bias mortality rates among Hispanic immigrants and particularly so if emigration is correlated with poor health, a phenomenon termed "salmon bias" (Abraído-Lanza et al. 1999; Palloni and Arias 2004). Moreover, Hispanic mortality estimates should be specified by national origin whenever data

allow, given that there are Hispanic subgroup differences in adult mortality (Hummer et al. 2000; Palloni and Arias 2004). Thus, our analyses stratify Hispanics by nativity and, in addition to examining all Hispanics, separately specify Mexican-origin adults (the largest Hispanic subgroup).

Smoking patterns may also play a critical role in producing the Hispanic paradox. Lung cancer and respiratory disease mortality, both attributable to life course patterns of cigarette smoking, are much lower among Hispanics than blacks and whites (Singh and Siahpush 2001). One recent study suggests that 50 % to 75 % of the mortality advantage among immigrants relative to U.S.-born adults is due to lower levels of smoking among immigrants (Blue and Fenelon 2011). Moreover, less smoking among Mexican immigrants relative to U.S.-born whites may be responsible for over one-half of the life expectancy advantage at age 35 for Mexican immigrants relative to whites (Fenelon 2013). Our study builds on this recent smoking-related work in three ways. First, we estimate cause-specific mortality differences by race/ethnicity/nativity to best understand the disease-based patterns of advantage for Hispanics relative to whites and blacks. Second, we adjust for differential smoking patterns across groups as well as estimate mortality differences among never smokers. The latter exercise estimates racial/ethnic/nativity mortality differences in a hypothetical population for which smoking never existed. Finally, we focus our analysis on ages 65 and older because those cohorts, born before 1940, were severely exposed to the burden of smoking in the United States (Preston and Wang 2006) but much less so in Mexico.

Although Hispanics' lower level of smoking may be important for understanding why they exhibit favorable mortality rates relative to blacks and whites, socioeconomic disadvantage may keep Hispanics from achieving even lower mortality rates (Hummer et al. 2000; Sorlie et al. 1993). At the same time, socioeconomic differences in mortality risk for Hispanics are significantly smaller than those observed for whites, and the Hispanic paradox is concentrated at lower SES levels (Turra and Goldman 2007). Thus, in addition to nativity and smoking, we examine the extent to which racial/ethnic differences in SES shape Hispanic older adult mortality levels relative to those of whites and blacks.

Methods

Data and Samples

We use National Health Interview Survey Linked Mortality Files (NHIS-LMF) data (NCHS 2009). The NHIS is an annual, cross-sectional, probabilistic survey of the noninstitutionalized U.S. population. The NCHS linked the 1986–2004 NHIS to National Death Index (NDI) death records through December 31, 2006. Although the probabilistic linkage procedure has been determined to be highly accurate, linkage quality between NHIS and NDI records is better for whites and blacks than for Hispanics (Lariscy 2011; Liao et al. 1998), most likely because Hispanic immigrants were less likely to report Social Security numbers in the NHIS. Although linkage quality tends to diminish with advanced age, Hispanic–white hazard ratios are much more robust among older adults than among adults under age 65 (Lariscy 2011), most likely because of the density of deaths for all groups at older ages. We restrict our

analysis to ages 65 and older for this reason and also because of the substantial smoking burden among U.S.-born older adults. NHIS-LMF presents several advantages for studying Hispanic older adult mortality: individuals self-report race/ethnicity, SES and behavioral covariates are included, NHIS cross-sections are nationally representative, and mortality ascertainment is highly accurate.

Our analyses use two subsets of the NHIS-LMF. First, we calculate age-/sex- and cause-specific mortality rates, rate ratios, and life expectancies for Hispanics and comparison groups. We limit the sample to 1989 forward because NHIS did not measure nativity in earlier years. We include Hispanics, whites, and blacks, but exclude other racial/ethnic groups because of their small numbers of deaths. We combine all Hispanic subgroups into an "all Hispanic" category; we further distinguish mortality estimates for Mexican-origin adults. Moreover, because black and white immigrants outlive their U.S.-born counterparts (Hummer et al. 1999b), we include only whites and blacks who are U.S.-born in order to reduce heterogeneity in those comparison groups. We create a person-year file based on the year in which each respondent was surveyed until the time the person either died or survived through the end of follow-up. This NHIS-LMF subset includes 2,093,970 person-years, with 87,390 deaths during follow-up.

We use the second NHIS-LMF subset to examine how SES and smoking influence racial/ethnic/nativity differences in older adult mortality. We limit the NHIS-LMF to 1990–1995 supplements that measured smoking and 1997–2004 Sample Adult data, which collected smoking information from one adult in each household. Because mortality risk estimates among foreign-born and U.S.-born Mexican-origin adults resemble those of foreign-born and U.S.-born Hispanics in the first analytic subset, we proceed with all foreign-born and U.S.-born Hispanics in this analytic stage. (We include results for Mexican-origin adults in Tables S5–S7, Online Resource 1). This NHIS-LMF subset includes 629,689 person-years and 26,072 deaths.

Analysis

In the first analytic stage, we present age-/sex- and cause-specific mortality rate ratios for foreign-born and U.S.-born Hispanics, foreign-born and U.S.-born Mexican Americans, and blacks relative to whites to assess whether groups differ in their mortality experiences, at what ages, and for what causes. Mortality rate ratios and standard errors are estimated using Poisson regression models in SUDAAN 10.0 to account for clustering and stratification in the NHIS survey design (Research Triangle Institute 2008). We apply eligibility-adjusted sample weights so that our results represent the noninstitutionalized U.S. population ages 65 and older. Cause-specific analyses specify seven underlying cause-of-death categories: heart diseases, lung cancer, all other cancers, cerebrovascular diseases, respiratory diseases, external causes, and all other causes. We estimate life expectancy at age 65 (e65) using discrete-time hazard models of mortality risk and calculate 95 % confidence intervals for e65 using a rescaling bootstrap approach that randomly draws 300 samples from the analytic sample to repeatedly estimate life table functions and evaluate their variability (Cai et al. 2010). These confidence intervals allow us to conduct significance tests across racial/ethnic/nativity groups as well as compare our NHIS-LMF e65 with vital statistics–based estimates (Arias 2010).

In the second analytic stage, we adjust for SES and smoking in sequential models to observe their influence on mortality rate ratios for foreign-born Hispanics, U.S.-born Hispanics, and blacks relative to whites. Socioeconomic variables include education (less than high school, high school (reference), and college) and the ratio of annual household income to the poverty threshold (<1.0 as poor, 1.0+ as nonpoor (reference), and income missing[1]). Consistent with the literature (Rogers et al. 2000), smoking is categorized as current heavy smoker (20+ cigarettes (a pack or more) per day), current light smoker (<20 cigarettes per day), former smoker, and never smoker (reference). After controlling for smoking, we estimate models for never smokers. This approach eliminates the possibility that unobserved variability in group-specific smoking duration or intensity may be pronounced in the smoker categories, albeit with a smaller and likely healthier subsample, and allows us to come closer to answering the question, What would racial/ethnic/nativity differences in older adult mortality look like if smoking-related mortality was irrelevant?

Results

We begin by documenting age-/sex-specific mortality rate ratios in Table 1 (rates are available in Table S1, Online Resource 1). Hispanic mortality advantages are evident among foreign-born women and range from 25 % to 33 % lower than white women in every five-year age group. Mortality rates do not differ between U.S.-born Hispanic women and white women. Among men, foreign-born Hispanics have 20 % to 40 % lower mortality rates than whites in every age group. Mortality rates for U.S.-born Hispanic men are 13 % to 25 % lower than those of white men ages 75–84 and are statistically equal in other age groups. Rate ratios among foreign-born and U.S.-born Mexican-origin females and males closely resemble those of all Hispanics. The advantage for foreign-born Hispanics relative to whites, similarity in U.S.-born Hispanic mortality with whites, and highly favorable mortality profiles for Hispanics compared with blacks are consistent with the original conceptualization of the Hispanic paradox (Markides and Coreil 1986).

NHIS-LMF e65 estimates (Table 2) are strikingly similar to those produced from vital statistics data (Arias 2010). For example, our NHIS-LMF e65 estimate for all Hispanic females is 21.89, compared with 21.72 from the official data. Similarly, our e65 estimate for all Hispanic males is 18.76, compared with 18.96 from the official data. NHIS-LMF e65 is 2.98 years and 1.60 years higher for all Hispanic females than for black and white females, respectively; NHIS-LMF e65 is 3.75 years and 2.01 years higher for all Hispanic males than for black and white males, respectively. The e65 estimates are highest among foreign-born Hispanics. For women, e65 for foreign-born Hispanics is 3.28 years higher than for U.S.-born Hispanics; the advantage for foreign-born Hispanic men compared with U.S.-born Hispanic men is 2.19 years. In contrast, e65 for U.S.-born Hispanic females is statistically equivalent to that for white females, and e65 for U.S.-born Hispanic males is only slightly higher than that for white males.

[1] Because about 20 % of NHIS respondents did not report annual household income, we include them as "missing" rather than exclude them or impute income.

Table 1 Age-specific mortality rate ratios by race/ethnicity/nativity relative to non-Hispanic whites, U.S. adults ages 65 and older

	Foreign-born Hispanic		U.S.-born Hispanic			
Age	All	Mexican Origin	All	Mexican Origin	Non-Hispanic Black	Non-Hispanic White
Females						
65–69	0.75**	0.94	1.01	0.89	1.47**	1.00
	(0.10)	(0.12)	(0.10)	(0.13)	(0.04)	
70–74	0.74**	0.76*	0.97	0.89	1.38**	1.00
	(0.09)	(0.14)	(0.08)	(0.10)	(0.04)	
75–79	0.67**	0.85	1.04	1.09	1.30**	1.00
	(0.08)	(0.13)	(0.08)	(0.09)	(0.04)	
80–84	0.74**	0.62**	1.02	0.99	1.11**	1.00
	(0.08)	(0.14)	(0.07)	(0.10)	(0.03)	
85–89	0.68**	0.71**	1.08	0.98	1.02	1.00
	(0.08)	(0.13)	(0.08)	(0.11)	(0.03)	
90+	0.75**	0.79	1.01	0.96	0.82**	1.00
	(0.08)	(0.16)	(0.09)	(0.13)	(0.04)	
Deaths	1,215	432	1,124	708	6,128	37,123
Person-years	50,314	17,027	37,346	25,805	149,444	982,400
Males						
65–69	0.78**	0.70**	0.95	1.01	1.55**	1.00
	(0.07)	(0.12)	(0.08)	(0.09)	(0.04)	
70–74	0.80*	0.61**	0.99	0.99	1.35**	1.00
	(0.10)	(0.14)	(0.07)	(0.07)	(0.04)	
75–79	0.68**	0.65**	0.87*	0.89	1.20**	1.00
	(0.06)	(0.13)	(0.06)	(0.07)	(0.03)	
80–84	0.73**	0.72**	0.75**	0.78*	1.22**	1.00
	(0.07)	(0.13)	(0.08)	(0.10)	(0.04)	
85–89	0.69**	0.64**	1.03	0.85	0.95	1.00
	(0.10)	(0.16)	(0.09)	(0.13)	(0.05)	
90+	0.60**	0.71*	0.92	0.71	0.76**	1.00
	(0.12)	(0.17)	(0.19)	(0.27)	(0.07)	
Deaths	1,163	434	1,073	724	5,041	34,523
Person-years	35,481	13,601	27,574	19,208	90,800	720,611

Note: Rate ratios are weighted, whereas the total deaths and person-years are unweighted.

Source: 1989–2006 NHIS-LMF.

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

Two striking cause-specific mortality advantages emerge for Hispanics relative to whites (Table 3). First, compared with whites, Hispanics display substantially lower

Table 2 Estimates of life expectancy at age 65 (95 % confidence interval) by race/ethnicity/nativity

	Females		Males	
Race/Ethnicity/Nativity	NVSS	NHIS-LMF	NVSS	NHIS-LMF
Hispanic	21.72	21.89 (21.41–22.38)	18.96	18.76 (18.34–19.17)
Foreign-born		23.32 (22.68–23.95)		19.74 (19.08–20.40)
Mexican origin		22.87 (21.45–24.28)		20.47 (19.34–21.60)
U.S.-born		20.04 (19.47–20.61)		17.55 (17.04–18.06)
Mexican origin		20.38 (19.62–21.15)		17.78 (17.01–18.55)
Non-Hispanic Black	18.44	18.91 (18.65–19.18)	15.01	15.01 (14.74–15.29)
Non-Hispanic White	19.71	20.29 (20.19–20.40)	17.06	16.75 (16.64–16.85)

Note: Our 1989–2006 NHIS-LMF data are centered on 1998, whereas Arias' estimates rely on 2006 official U.S. data. Because of the eight-year difference, NHIS-LMF e65 estimates should be about one year lower than those from the official data because U.S. e65 increased by about one year between 1998 and 2006. At the same time, NHIS-LMF data yield life expectancy figures that are one to two years higher than comparable official U.S. data (Hummer et al. 1999a) because the NHIS-LMF excludes institutionalized individuals (e.g., nursing home residents). On balance, 1989–2006 NHIS-LMF data yield e65 estimates that are very close to those using official data.

Source: National Vital Statistics System (NVSS) estimates by Arias using 2006 official mortality data. NHIS-LMF estimates calculated using 1989–2006 data.

mortality ratios for lung cancer and respiratory diseases—causes that are strongly linked to smoking (Doll et al. 2004). Second, we observe few instances in which Hispanics exhibit higher cause-specific mortality relative to whites. Lower heart disease and non-lung cancer mortality among foreign-born Hispanics compared with whites is especially important because these two cause categories account for over one-half of all U.S. older adult deaths. Thus, although smoking-attributable causes hold the greatest promise for understanding why foreign-born and U.S.-born Hispanic older adults exhibit relatively favorable mortality rates, Hispanic mortality rates are relatively low across most cause-of-death categories.

Table 4 illustrates the pronounced socioeconomic disadvantages among foreign-born Hispanics relative to the other groups. Over 60 % of foreign-born Hispanics report less than a high school education; in contrast, less than 30 % of whites are in this low-education group. Foreign-born Hispanics report the highest proportions of living in poverty as well. At the same time, Hispanics are least likely to smoke: over 79 % of foreign-born Hispanic women report never smoking, compared with 59 % of white women.

Table 5 shows how mortality differences change with adjustment for behavioral and socioeconomic covariates. Model 1 echoes results from the age-specific mortality rate ratios in Table 1: when we control for age, foreign-born Hispanics exhibit 25 % to 26 % lower mortality risk than whites, whereas U.S.-born Hispanics have statistically equivalent mortality risk to whites. Controlling for SES (Model 2) accentuates the relative mortality advantage for the Hispanic populations compared with whites. The drop in mortality ratios for the Hispanic groups compared with whites indicates that Hispanic mortality rates would be even lower relative to whites if Hispanics and whites had equivalent SES. After smoking status is controlled (Model 3), the net mortality

Table 3 Rate ratios of cause-specific mortality by race/ethnicity/nativity relative to non-Hispanic whites, U.S. adults ages 65 and older

	Foreign-born Hispanic		U.S.-born Hispanic		Non-Hispanic
Causes of Death	All	Mexican Origin	All	Mexican Origin	Black
Females					
Heart disease	0.77**	0.63**	1.05	1.06	1.31**
	(0.06)	(0.12)	(0.06)	(0.08)	(0.03)
Lung cancer	0.34**	0.32**	0.67*	0.45**	0.83*
	(0.19)	(0.36)	(0.16)	(0.24)	(0.07)
All other cancers	0.73**	0.75	0.85	0.78*	1.11*
	(0.08)	(0.15)	(0.09)	(0.12)	(0.04)
Cerebrovascular diseases	0.52**	0.83	1.12	1.12	1.15*
	(0.14)	(0.20)	(0.12)	(0.15)	(0.05)
Respiratory diseases	0.27**	0.26**	0.67*	0.46**	0.46**
	(0.21)	(0.40)	(0.17)	(0.24)	(0.10)
External causes	0.57*	0.64	1.10	0.99	0.67**
	(0.26)	(0.45)	(0.24)	(0.31)	(0.14)
All other causes	0.87*	1.08	1.21**	1.20*	1.22**
	(0.06)	(0.09)	(0.06)	(0.08)	(0.03)
Males					
Heart disease	0.76**	0.66**	1.01	0.97	1.21**
	(0.06)	(0.10)	(0.06)	(0.08)	(0.03)
Lung cancer	0.53**	0.39**	0.57**	0.53**	1.42**
	(0.13)	(0.26)	(0.14)	(0.18)	(0.05)
All other cancers	0.67**	0.50**	0.90	0.88	1.22**
	(0.09)	(0.16)	(0.09)	(0.11)	(0.04)
Cerebrovascular diseases	0.84	0.93	1.22	1.37*	1.35**
	(0.13)	(0.20)	(0.13)	(0.15)	(0.07)
Respiratory diseases	0.43**	0.41**	0.47**	0.39**	0.68**
	(0.17)	(0.28)	(0.19)	(0.25)	(0.08)
External causes	0.65	0.67	0.71	0.85	0.89
	(0.22)	(0.36)	(0.25)	(0.28)	(0.12)
All other causes	0.77**	0.77*	0.96	0.98	1.21**
	(0.07)	(0.11)	(0.07)	(0.09)	(0.03)

Note: All models adjust for age only. The lung cancer cause category includes deaths from cancer of the lung, trachea, and bronchus.

Source: 1989–2006 NHIS-LMF.

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

advantages for foreign-born and U.S.-born Hispanics dampen relative to whites. The mortality rate ratio for foreign-born Hispanic women changes from 0.66 (Model 2) to

Table 4 Means and percentages of demographic, socioeconomic, and behavioral characteristics by race/ethnicity/nativity and sex, U.S. adults ages 65 and older

	Foreign-born Hispanic	U.S.-born Hispanic	Non-Hispanic Black	Non-Hispanic White
Females				
Age (mean)	73.6* (73.2–74.1)	74.1* (73.6–74.6)	74.6* (74.3–74.8)	75.4 (75.3–75.5)
Educational attainment				
Less than high school	64.9* (61.8–68.0)	58.6* (53.9–63.2)	51.1* (48.8–53.4)	26.6 (25.8–27.5)
High school or GED	18.9* (16.2–21.6)	26.2* (22.2–30.1)	29.3* (27.5–31.0)	43.2 (42.5–43.9)
Some college or degree	16.2* (14.1–18.3)	15.2* (12.0–18.5)	19.6* (18.1–21.2)	30.2 (29.3–31.0)
Poverty status				
Poor	24.1* (20.4–27.8)	16.7* (13.3–20.0)	22.1* (20.4–23.8)	6.2 (5.8–6.6)
Nonpoor	56.8* (52.7–60.8)	65.0* (61.7–68.3)	53.7* (51.6–55.8)	75.4 (74.5–76.3)
Missing	19.2 (16.3–22.0)	18.4 (15.0–21.7)	24.2* (22.2–26.1)	18.4 (17.6–19.2)
Smoking status				
Current heavy smoker	1.6* (0.9–2.4)	3.2* (1.5–4.9)	2.7* (2.2–3.2)	6.9 (6.5–7.2)
Current light smoker	5.7 (4.2–7.1)	7.1 (5.5–8.7)	10.7* (9.7–11.7)	6.6 (6.3–7.0)
Former smoker	13.5* (11.4–15.6)	22.3* (18.9–25.8)	21.5* (20.0–23.0)	27.4 (26.7–28.2)
Never smoker	79.2* (76.7–81.8)	67.4* (63.6–71.2)	65.1* (63.3–67.0)	59.1 (58.3–59.9)
Deaths	329	335	1,876	12,282
Person-years	14,927	11,687	47,455	321,514
Males				
Age (mean)	73.1* (72.6–73.7)	73.0* (72.6–73.5)	73.2* (72.9–73.4)	74.0 (73.9–74.1)
Educational attainment				
Less than high school	60.3* (54.9–65.6)	48.7* (43.8–53.6)	54.4* (51.5–57.4)	24.9 (24.0–25.9)
High school or GED	18.7* (15.1–22.2)	27.3* (22.6–31.9)	25.6* (23.0–28.2)	34.1 (33.3–35.0)

Table 4 (continued)

	Foreign-born Hispanic	U.S.-born Hispanic	Non-Hispanic Black	Non-Hispanic White
Some college or degree	21.0* (17.0–25.1)	24.0* (20.0–28.1)	20.0* (17.7–22.3)	41.0 (39.8–42.1)
Poverty status				
Poor	19.3* (15.7–23.0)	10.2* (7.7–12.6)	14.9* (13.0–16.7)	3.0 (2.7–3.2)
Nonpoor	65.0* (61.3–68.7)	72.8* (68.5–77.1)	65.4* (62.7–68.1)	81.9 (81.2–82.6)
Missing	15.7 (13.1–18.3)	17.1 (13.2–21.0)	19.7* (17.5–22.0)	15.1 (14.5–15.8)
Smoking status				
Current heavy smoker	5.3* (3.1–7.4)	4.9* (2.8–6.9)	10.1 (8.5–11.8)	9.7 (9.2–10.2)
Current light smoker	9.3* (7.3–11.4)	14.0* (10.0–17.9)	15.3* (13.3–17.3)	5.0 (4.6–5.3)
Former smoker	40.1* (35.9–44.4)	45.3* (40.6–50.1)	41.4* (38.8–44.0)	55.3 (54.5–56.1)
Never smoker	45.3* (40.6–50.0)	35.8* (31.2–40.5)	33.2* (30.8–35.6)	30.0 (29.2–30.7)
Deaths	306	307	1,385	9,252
Person-years	8,745	7,789	24,441	193,131

Note: Means and percentages are weighted, but the total deaths and person-years are unweighted.

Source: 1990–2006 NHIS-LMF (Supplement and Sample Adult files).

* Means or percentages are significantly different from those of non-Hispanic whites of the corresponding sex at $p < .05$.

Table 5 Rate ratios for association between race/ethnicity/nativity and mortality, U.S. adults ages 65 and older

	Full Sample			Never Smokers	
	Model 1	Model 2	Model 3	Model 4	Model 5
Females					
Race/ethnicity/nativity (ref. = Non-Hispanic white)					
Foreign-born Hispanic	0.75**	0.66**	0.74**	0.90	0.81*
	(0.08)	(0.08)	(0.08)	(0.09)	(0.09)
U.S.-born Hispanic	0.91	0.82**	0.85*	1.06	0.97
	(0.08)	(0.08)	(0.08)	(0.11)	(0.11)
Non-Hispanic black	1.12**	1.01	1.05	1.22**	1.11*
	(0.03)	(0.03)	(0.03)	(0.04)	(0.04)
Males					
Race/ethnicity/nativity (ref. = Non-Hispanic white)					
Foreign-born Hispanic	0.74**	0.63**	0.66**	0.83	0.72*
	(0.07)	(0.07)	(0.08)	(0.14)	(0.14)
U.S.-born Hispanic	0.92	0.82**	0.83*	1.06	0.94
	(0.07)	(0.07)	(0.08)	(0.12)	(0.12)
Non-Hispanic black	1.33**	1.15**	1.12**	1.46**	1.27**
	(0.04)	(0.04)	(0.04)	(0.08)	(0.08)

Notes: Models 1 and 4 control for age only. Models 2 and 5 control for age, educational attainment, and poverty status. Model 3 controls for age, educational attainment, poverty status, and smoking status. We suppress rate ratios for educational attainment, poverty status, and smoking status because we are concerned with how adjustment for these variables influences racial/ethnic/nativity differences in older adult mortality rather than the association between these covariates and mortality. This information is available in Tables S2 and S3, Online Resource 1.

Source: 1990–2006 NHIS-LMF (Supplement and Sample Adult files).

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

0.74 (Model 3)—a 24 % smaller mortality advantage. The rate ratio for foreign-born Hispanic men is reduced by 8 % when smoking is controlled.

Adjustment for smoking in Model 3 accounts for a relatively modest share of Hispanic-to-white mortality advantages, despite the strong smoking-related cause-of-death advantages for Hispanics shown earlier. To assess the influence of smoking in another manner, Models 4 and 5 show mortality differences for never smokers.[2] Model 4, which controls for age, shows the foreign-born Hispanic mortality advantage is no longer observed, but mortality of U.S.-born Hispanic never smokers remains statistically equal to mortality of whites. That is, no Hispanic mortality advantages are evident among never smokers. Model 5 adjusts for SES among never smokers and, similar to results for all older adults, shows that controlling for Hispanic socioeconomic disadvantages results in lower mortality for Hispanics relative to whites in comparison to the

[2] Table S4 in Online Resource 1 includes descriptive statistics for never smokers to address potential selectivity.

model without SES. Thus, the protective influence of lower smoking prevalence among Hispanics is countered by their socioeconomic disadvantages.

Discussion

Hispanics make up a rapidly growing proportion of the U.S. older adult population, so a firm grasp of their mortality patterns is paramount for understanding racial/ethnic health differences and assessing whether the Hispanic paradox is characteristic of all or just some Hispanic subgroups. Our analyses add considerable weight to the basic premise underlying the paradox: foreign-born *and* U.S.-born Hispanics have more favorable adult mortality risks than whites and much more favorable risks than blacks. The similarity in mortality rates of U.S.-born Hispanics and whites is often overlooked because researchers tend to focus on the mortality advantages of foreign-born Hispanics. Why is this foreign-born Hispanic mortality advantage erased for U.S.-born Hispanics? Negative acculturation may deteriorate the positive health behaviors among Hispanic immigrants over time and across generations, thereby eliminating the initial Hispanic mortality advantage (Antecol and Bedard 2006; Gorman et al. 2014). Evidence for negative acculturation in health behaviors was suggestive in our cause-specific mortality documentation and our analysis of mortality differences among never smokers.

Our analyses further provide two new insights into the paradox by examining how nativity, SES, and smoking shape it. First, our NHIS-LMF e65 estimates are very similar to those using vital statistics data, and they reveal a particularly strong foreign-born Hispanic e65 advantage that is concealed by official estimates for all Hispanics. Second, smoking and SES act as countervailing factors; although low smoking prevalence among Hispanics is a major contributor to their relatively low mortality, their mortality levels would potentially be even more favorable if not for their socioeconomic disadvantage.

Limitations

The development of large, nationally representative survey-based mortality data sets, like the NHIS-LMF, has contributed to the demographic understanding of mortality patterns for older adults in general and for Hispanics in particular. However, statistical power remains an issue when estimating mortality patterns for specific Hispanic subgroups, including Puerto Ricans and Cubans. Future updates to the NHIS-LMF will be instrumental for estimating mortality risk and life expectancy among more Hispanic subgroups. Additionally, an unknown but probably small percentage of NHIS-LMF respondents, particularly immigrants, may migrate out of the United States and be less likely ever to be linked to a U.S. death certificate. Such out-migration biases mortality estimates downward for Hispanic immigrants, particularly if emigration is correlated with poor health (Palloni and Arias 2004). Other researchers have concluded that salmon bias effects, although present, are too small in magnitude to explain the favorable mortality patterns among Hispanic immigrants (Hummer et al. 2007; Riosmena et al. 2013; Turra and Elo 2008). Furthermore, given that our Hispanic life expectancy estimates align extremely closely with those of Arias (2010), that our

mortality estimates for Mexican-origin immigrants do not statistically differ from all Hispanic immigrants, and that we considered only people ages 65 and older (most of whom reported living in the United Sates for a long time), salmon bias cannot possibly be so pervasive that the extensive set of patterns we documented are due to very large numbers of older adults out-migrating from the United States and dying elsewhere.

Conclusion

Hispanics have achieved relatively low mortality rates in the context of socioeconomic disadvantage. However, the Hispanic paradox is not guaranteed to persist. Layering current socioeconomic disadvantage on top of a projected doubling of the Hispanic older adult population in the next 50 years, substantial concern should exist regarding the future heath patterns of this population. As such, policy efforts to achieve socioeconomic parity between Hispanics and whites in the coming decades will be essential for future improvements in Hispanic mortality levels.

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