

Revisiting the Hispanic Paradox in the United States: the role of smoking

Andrew Fenelon*

Population Studies Center and Department of Sociology, University of Pennsylvania

* 239 McNeil Building, 3718 Locust Walk, Philadelphia, PA 19104
email: afenelon@sas.upenn.edu
phone: (805) 886-6586

Introduction

More than three decades of research on Hispanic health in the United States has consistently found lower adult mortality risks among Hispanics than their non-Hispanic white counterparts (Markides and Coreil 1986; Liao et al. 1998; Elo et al. 2004; Hummer et al. 2000).¹ This occurs despite lower average education and income and higher rates of poverty among Hispanics, which gives rise to the term “Hispanic Paradox”(Markides and Eschbach 2005; Palloni and Arias 2004).² The phenomenon has been identified using nationally-representative surveys, small-sample cohort studies, and vital statistics. The Hispanic advantage in life expectancy is non-trivial, amounting to 2.5 years at birth according to recently-released life tables by Hispanic origin produced by the National Center for Health Statistics (Arias 2010). Corresponding advantages are observed for many chronic health conditions including cardiovascular disease, cancers, and chronic respiratory diseases. The topic has received a large amount of attention in the literature, has been described extensively, and a number of possible hypotheses have been offered. However, despite its ubiquity, the Hispanic paradox has previously eluded a convincing explanation.

Examining Hispanics as a homogeneous group with a singular mortality experience is problematic. The US Hispanic population has origins in many different countries with varied cultural backgrounds, economic circumstances, and health profiles. The heterogeneity of

¹ Non-Hispanic whites typically serve as the comparison group for studies of Hispanic mortality in the United States, despite Hispanics more closely resembling African-Americans in terms of socioeconomic attainment. As the majority race/ethnic group in the US, non-Hispanic whites are more often used in the literature (Markides and Eschbach 2005). In this paper, the terms “white” and “non-Hispanic white” will refer exclusively to US-born non-Hispanic whites.

² The accepted terminology for identifying individuals of Hispanic origin in the United States is varied. According to the US census bureau, the terms Hispanic and Latino refer interchangeably to persons of “Cuban, Mexican, Puerto Rican, South or Central American, or other Spanish culture or origin regardless of race.” Brazilians are not counted as Hispanic by the census bureau. Although both “Hispanic” and “Latino” are commonly used in the literature, I use Hispanic exclusively for consistency.

mortality experiences among subgroups within the Hispanic population is as large as that between Hispanics and other race/ethnic groups in the US (Hummer et al. 2000). Recent research contends that the Hispanic paradox is not a feature of all Hispanics, only of certain subgroups. Consistent advantages vis-à-vis non-Hispanic whites are found for those identifying as Mexican, Central American, or South American (Palloni and Arias 2004). Comprising nearly two-thirds of Hispanics in the United States, Mexican-Americans represent the largest national origin subgroup.³ According to the 2010 Census, there were more than 30 million individuals of Mexican descent in the US, making up more than 10% of the total population (US Census Bureau 2011). Although the Mexican and Mexican-American populations are fairly concentrated in the Southwestern United States, there are also large populations in new immigrant destinations in the South and Midwest (Zúñiga and Hernández-León 2006). In addition to being the largest Hispanic subgroup, the Mexican population also shows perhaps the most consistent mortality advantage relative to non-Hispanic whites (Hummer et al. 2000; Sorlie et al. 1993; Abraido-Lanza et al. 1999; Markides and Black 1996; Eschbach et al. 2004). Evidence for the advantage of Cubans is more mixed (Pinheiro et al. 2009; Abraido-Lanza et al. 1999; Sorlie et al. 1993). Puerto Ricans differ from other Hispanic subgroups in that they are often disadvantaged relative to whites with respect to mortality, especially those born in the 50 states (Markides and Eschbach 2005; Hummer et al. 2000).

Related to the Hispanic paradox is the immigrant paradox, the tendency for foreign-born populations to outlive the native-born despite lower socioeconomic status (SES). A

³ Throughout the paper, the term “Mexican-American” will refer to individuals of Mexican descent living in the United States. I will also distinguish between US-born Mexican-Americans (born in the United States) and foreign-born Mexican-Americans (born in Mexico).

similar pattern is observed within the Hispanic population, as foreign-born Hispanics have substantially lower mortality than their US-born counterparts. Some research contends that the Hispanic paradox exists only for the foreign-born (Eschbach, Kuo, and Goodwin 2006; Palloni and Morenoff 2001). Although some studies find an advantage for US-born Hispanics (Abraido-Lanza et al. 1999), it is at best greatly diminished compared with that of foreign-born Hispanics (Acevedo-Garcia et al. 2010; Vega, M. A. Rodriguez, and Gruskin 2009; Cho et al. 2004). Since nearly 60% of adult Hispanics are foreign-born, it is inappropriate to consider Hispanic immigrants and US-born Hispanics in combination, and explaining the Hispanic paradox necessarily requires attention to the role of nativity.

This paper examines the contribution of cigarette smoking to the adult life expectancy advantage of Hispanics relative to US-born non-Hispanic whites, and tests the extent to which differences in cigarette smoking in these populations reflect the two most prominent explanations for the phenomenon: the *selective migration hypothesis* and the *cultural hypothesis*.

Evidence for the Hispanic Mortality Advantage

Early research regarding the health and mortality experience of Hispanics demonstrated that Mexican-Americans in the Southwestern US exhibited adult death rates similar to those of non-Hispanic whites, despite substantial socioeconomic disadvantage (Becker et al. 1988; Markides and Coreil 1986). These studies were forced to identify Hispanic status using Spanish surname or other indirect methods since the category was not collected in US vital statistics until the 1980s. In addition, many focused on local populations and thus suffered from small samples and a lack of generalizability (Sullivan et al. 1984). The first analysis to use a large, population-based sample was by Sorlie and colleagues (1993)

who investigated the survivorship of Hispanic subgroups using the National Longitudinal Mortality Study (NLMS) for the period 1979-1987. They found significantly lower mortality among Mexican-Americans, Puerto Ricans, Cubans, and other Hispanics compared with non-Hispanics, especially at older ages, with the largest advantage for cardiovascular disease and cancers. Since then, evidence of the Hispanic mortality and health advantage has come from a variety of data sources, each valuable for examining different aspects of the phenomenon.

The major sources of data on Hispanic mortality are US vital statistics and nationally representative surveys. Studies using vital statistics use Hispanic ethnicity coded on death certificates and pair these to census estimates of the Hispanic population. Differences in the identification of Hispanic ethnicity on death certificates (typically reported by a funeral director) and the census (self-reported) have the potential to underestimate Hispanic mortality (Arias et al. 2008); Elo et al. (2004) find that data from the Social Security Administration (NUMIDENT), which does not suffer from ethnicity mismatch, imply a smaller advantage than that found in vital statistics. Representative surveys with prospective mortality follow-up partially solve this issue, since ethnicity is self-reported and respondents are matched to records in the National Death Index. The use of large-sample surveys also allows the researcher to examine the Hispanic advantage across a variety of other covariates, including socioeconomic variables and health behaviors (e.g. Rogers et al. 2005), and to examine the mortality of multiple Hispanic subgroups (Palloni and Arias 2004). Although the size of the observed Hispanic advantage varies somewhat depending on the data source used, it has been a remarkably consistent finding for the past several decades (Markides and Eschbach 2005).

Although evidence for the Hispanic paradox is abundant, very few studies have produced convincing explanations for the unexpected phenomenon (Markides and Eschbach

2005). Hypotheses offered to explain the paradox typically fall into two broad categories: *selective migration* and *culture*.

Selective migration hypothesis

Since 60% of adult Hispanics in the United States are foreign born, any examination of the Hispanic mortality experience must consider the composition of the migrant population vis-à-vis the non-migrant population. If migrants differ significantly from non-migrants on important measures of health, our estimates of the mortality of the foreign-born in the US may be biased. Selective migration can refer to both in-migration of the healthy (healthy migrant effect) and out-migration of the unhealthy (salmon bias). The former concerns the greater human capital and health resources that may be necessary to undertake an international move, such that we observe a highly select group of individuals from sending countries, which may offset the negative effects of the poor socioeconomic profile (Abraido-Lanza et al. 1999). The latter suggests that foreign-born individuals in the United States may return to their countries of origin when they become ill, both leaving behind a relatively healthy stock of foreign-born individuals in the United States and causing many deaths to be unobserved in American vital registration (Palloni and Ewbank 2004; Pablos-Méndez 1994).

Health-related selection among migrants is a common theme in research on foreign-born populations in many countries (Guillot, Gavrilo, and Pudrovska 2011; Chen, Wilkins, and Ng 1996; Razum et al. 1998). Better health outcomes among immigrants have been observed in the US, Canada, Australia, Germany, and Russia among other countries. If the force of immigrant selection is sufficiently strong, it might explain why Hispanics, particularly the foreign-born have better health outcomes than native-born non-Hispanic whites. But health-related migrant selection may occur without leading to lower mortality

among Hispanics compared to non-Hispanic whites (Abraido-Lanza et al. 1999). That is, Hispanic immigrants may be healthier than their origin-country populations but still less healthy than non-Hispanic whites in the United States. In general, direct investigation of health selection with respect to immigration from Mexico to the US is lacking. The most comprehensive recent study was by Rubalcava and colleagues (2008), who examined differences between Mexican immigrants to the United States and Mexicans who remained in Mexico on several measures of health. They found that male migrants to the United States were less likely than non-migrants to be overweight and have high blood pressure, but did not find this same effect for female migrants. They also found no evidence for health selection on self-rated health, though this variable may not predict mortality risk especially well among Mexicans in particular (Finch et al. 2002). Although health-related selection almost certainly occurs, it remains unclear to what extent it can explain the Hispanic paradox (Markides and Eschbach 2005).

Cultural hypothesis

The specific ways in which culture affects health are not well-defined in the sociological literature on health disparities, though there is widespread agreement that culture does play a role in shaping individual and group behaviors. Differing conceptions of culture have different implications for understanding its impact on individual or group behavior (Sewell 1999). With respect to health, it makes sense to view culture as active, referring to the dynamic strategies individuals employ when navigating the social landscape (Kreuter and McClure 2004). Viewed as a resource that individuals draw upon to direct social behavior, culture's pertinence to health becomes especially clear. Swidler's (1986) idea of culture as a shared 'toolkit' for organizing social experience and generating effective strategies for social

interaction is an important development in the conceptual understanding of how culture impacts social behavior.

As with their mortality experience, it may be inappropriate to classify Hispanics as having a singular consistent culture or assume that attitudes and practices are similar between or within all Hispanic subgroups. Heterogeneity in the cultural practices and attitudes among Hispanic subgroups is certainly large (S. Rodriguez 1995) and attributing health outcomes of the Hispanic population to cultural characteristics may ignore important variation. Still, certain aspects of shared culture may promote better health and prevent mortality among specific Hispanic subgroups (G. Marin and B. V. Marin 1991). First, culture may produce a set of values or preferences for health behaviors or health-related outcomes (Unger et al. 2003). To the extent that the orientation towards social support is stronger for Hispanics than non-Hispanic whites, differences in health behaviors may help to explain Hispanics' mortality advantage. Second, culture may define the acceptable realms of behavior by establishing a system of social constraints. There is evidence that individual health behavior responds to normative social roles; group expectations serve to regulate health-related behaviors of individual group members (Morales et al. 2002). Hispanics, in particular, may benefit from a traditional familial orientation and religious preference (G. Marin and B. V. Marin 1991), characterized by orientations toward loyalty and reciprocity which may permit more effective coping with stress (Gallo et al. 2009). Finally, culture may equip individuals with a repertoire of strategies for making health-related decisions within a system of values and constraints. This operant view suggests that culture influences health by generating strategies for navigating the complex landscape of health information and practices (Eckersley, Dixon, and Douglas 2001; Swidler 1986). Given the conceptual issues in studying culture, very few

studies have produced empirical evidence for these pathways (Pescosolido and Olafsdottir 2010). Nevertheless, there remains widespread agreement that culture, however defined, has demonstrable impacts on behavior and outcomes.

Cigarette Smoking and the Hispanic Paradox

Cigarette smoking may play a key role in the Hispanic mortality advantage for two reasons. First, cigarette is the single greatest cause of premature death in the United States (Peto et al. 1994; Mokdad et al. 2004; Haldorsen and Grimsrud 1999; M. J. Thun and C. W. Heath 1997). Despite rapid declines in smoking, the mortality burden associated with the behavior remains high, around 20% of adult deaths (Preston, Gleij, and Wilmoth 2010b). Second, survey data indicate that Hispanics in the US have a relatively low prevalence of the behavior. Non-Hispanic whites are more likely than Hispanics to smoke and are likely to have higher amounts accumulated physiological damage from a history of heavy smoking (Rogers and Crank 1988; Bethel and Schenker 2005; Pinsky 2006; Pérez-Stable, Marín, and Posner 1998). Hispanics who do smoke are also less likely to do so every day, smoke fewer cigarettes per day, and have smoked for fewer years on average than non-Hispanic whites (Caraballo and C. W. Lee 2004; Trinidad et al. 2009; Siahpush et al. 2010).

Evidence for the role of smoking has grown in recent years, and several studies have considered its relevance to the Hispanic paradox. Singh and Siahpush (2002) found that the Hispanic advantage was largest for causes of death that are most strongly associated with smoking including lung cancers, respiratory diseases, and ischemic heart disease. Blue and Fenelon (2011) were the first to directly examine the contribution of smoking to the Hispanic paradox. They used vital statistics data from the year 2000 and an indirect method for estimating smoking-attributable mortality. They found that smoking-related mortality was

responsible for 75% of the Hispanic advantage in life expectancy at age 50 for men and for women (both slightly more than 2 years). They did not consider heterogeneity within Hispanics.

Foreign-born Hispanics

The foreign-born make up 60% of the Hispanic adult population, and their smoking behavior represents an important aspect of the smoking behavior of the Hispanic population as a whole. Much of the reason we observe such low prevalence and intensity of smoking among Hispanics is the particularly light smoking of the foreign-born (Singh and Siahpush 2002). Consistent with the immigrant health advantage, evidence suggests that foreign-born Hispanics smoke less than their US-born counterparts and significantly less than non-Hispanic whites (Singh and Siahpush 2002). Despite advertising efforts targeted at first generation immigrants, this population has retained substantially more favorable smoking behavior than US-born populations (Acevedo-Garcia et al. 2004).

Mexican-Americans

As the largest subgroup of both foreign- and US-born Hispanics, Mexican-Americans smoking behavior has substantial leverage in determining the smoking behavior of the Hispanic population as a whole. Representative surveys indicate that Mexican-Americans smoke less than many other Hispanic subgroups including Cubans and Puerto Ricans (Singh and Siahpush 2002; Caraballo and C. W. Lee 2004; Perez-Stable et al. 2001).⁴ Mexican-Americans also appear to have exceptionally low cigarette consumption, with a large fraction of smokers in this group identifying as “intermittent” or “occasional” rather than “daily”

⁴ There is also some evidence that immigrants from Central and South America have smoking prevalence and cigarette consumption levels that are as low as or lower than those of Mexican-Americans (Perez-Stable et al. 2001).

smokers. Contrarily, at least half of non-Hispanic white smokers consume at least one pack (20 cigarettes) per day (Caraballo et al. 2001; Haiman et al. 2006).

Hypotheses

The principal contribution of this paper is to evaluate the extent to which cigarette smoking is a proximate cause of Hispanics' longevity advantage over US-born non-Hispanic whites (hereafter, the terms 'non-Hispanic whites' or 'whites' refer exclusively to US-born non-Hispanic whites) despite lower socioeconomic status. Given heterogeneity among Hispanics, I consider US-born and foreign-born Hispanics separately, with particular attention to Mexican-Americans. The paper also attempts to distinguish between the selective migration and cultural hypotheses in explaining the Hispanic paradox. The expectations for empirical findings are as follows

- 1) If smoking explains the life expectancy advantage of Hispanics, we should find that Hispanic subgroups are less likely to smoke and/or smoke less heavily than non-Hispanic whites.
- 2) If smoking explains the advantage, we should also find that removing smoking-related mortality narrows the life expectancy advantage of Hispanics.
- 3) If selective migration explains the advantage for Mexican-Americans in the US, we should expect Mexican individuals who migrate to the United States to smoke less than Mexicans who remain in Mexico and do not migrate.
- 4) If cultural factors explain the advantage, we should expect Mexican-born individuals in both Mexico and the United States to have similar smoking behavior, and for increases in smoking to occur for those born in the United States.

Data

This paper uses data from the public-use release of the National Health Interview Survey Linked-Mortality Files (NHIS-LMF) which are obtained through the Integrated Health Interview Series (IHIS 2010). NHIS is a nationally representative survey that collects demographic, behavioral, and health information in large annual cross-sectional samples. A benefit of the NHIS-LMF data is that respondents are linked to US death records through the National Death Index with relatively accurate matching (CDC 2010). This allows us to ascertain mortality status through the end of 2006. Total sample sizes in each survey are about 100,000. In most survey years, questions about cigarette smoking and other health behaviors are asked to a subset of the adult sample, typically with about 30,000 cases.⁵ I pool annual surveys for the years 1990 – 2004, including only individuals aged 35 or older and for whom smoking status was identified. Some individuals were younger than 35 at baseline and were allowed to enter the sample over the course of follow-up as they turn 35.⁶ The final sample includes a total of 155,173 women and 119,138 men,⁷ more than 2 million person-years of exposure, and 35,224 deaths. Observations are weighted using supplement-specific annual person weights for survey years 1990 – 1995 and using eligibility-adjusted mortality sample adult weights for 1997 – 2004 (National Center for Health Statistics 2000).⁸

⁵ Smoking status is determined for 1990 and 1991 surveys using the Health Promotion and Disease Prevention supplement, for 1992 using the Cancer Control and Epidemiology supplements, for 1993 – 1995 using the year 2000 Objectives supplement, and for 1997 – 2004 using the NHIS sample adult core. No smoking supplement is available for 1996.

⁶ Age 35 is chosen as a cutoff because very few smoking-related deaths occur prior to age 35 and because evidence indicates that the Hispanic advantage is concentrated in the adult age range (Turra and Goldman 2007).

⁷ A total of 3,689 individuals are removed from the sample. 2,730 individuals are removed because they do not have usable information on smoking status. 2,124 refused to report or did not know current status and 601 did not report daily cigarette consumption because they either refused or did not know. 588 individuals have unknown or unreported race and 371 have unknown Hispanic origin.

⁸ The use of weighted or unweighted data did not produce different results, which is consistent with other population studies of mortality using NHIS-LMF data (Lochner et al. 2008). Weighted results are presented for consistency.

Smoking status is measured using 6 categories reflecting current and past smoking behavior and current daily cigarette consumption. Status is determined through a series of questions and is intended to capture the impact of cigarette smoking on individual mortality risk. Respondents are asked if they have smoked more than 100 cigarettes in their entire lives. If they have not, they are classified as “never smokers”. All others are considered ever smokers. Respondents are then asked if they currently smoke cigarettes, either every day or some days. Ever smokers who no longer smoke every day or some days are classified as “former smokers”. Since the mortality risk of smoking rises with increased cigarette consumption, current smokers are also grouped by typical daily cigarette consumption. The groups are current very light smoker (current smokers who usually smoke fewer than 10 cigarettes per day), current light smoker (10-19 per day), current medium smoker (20-29 per day), and current heavy smoker (30+ per day).

Individuals report their race, place of birth, and whether they are of Hispanic/Latino origin. Hispanic individuals also report their specific Hispanic origin subgroup (e.g. Mexican, Cuban). Individuals are categorized into 5 race/ethnic groups. 1) US-born non-Hispanic whites,⁹ who serve as the majority comparison group for each Hispanic subgroup, 2) US-born Hispanics, individuals who are of Hispanic origin who were born in the United States, 3) foreign-born Hispanics, individuals of Hispanic origin born outside the United States, 4) US-born Mexican-Americans, Hispanic individuals specifically identifying as being of Mexican origin born in the United States, and 5) foreign-born Mexican-Americans, Mexican-born individuals who have immigrated to the United States. I examine the life expectancy advantage of each of the four Hispanic subgroups relative to non-Hispanic whites.

Methods

Statistical model

Loglinear hazard regression models are used to estimate all-cause mortality and the impact of smoking by race/ethnic group (Rogers et al. 2005). The dependent variable in the model is the all-cause mortality hazard (M_i) predicted as a function of age, race/ethnic group, and smoking status

$$\ln(M_i) = \beta_0 + \beta_A A_i + \beta_H H_i + \beta_S S_i + \varepsilon \quad (1)$$

A_i are 5-year age groups – 35-39, 40-44, ..., 80-84, 85+. Age is modeled as a time-varying covariate such that individuals move in and out of age groups over the course of follow-up. H_i refers to the race/ethnic group and S_i to the smoking status of individual i .¹⁰ I also include an interaction between the “former smoker” category and race/ethnic group in order to account for race/ethnic differences in smoking intensity among former smokers. Individuals contribute one year of risk exposure for each year between baseline (or age 35 for those younger at baseline) and death or censoring. Censoring occurs for individuals who are assumed to be alive as of December 31, 2006. Models are stratified by sex and models including all Hispanics are run separately from those focusing specifically on Mexican-Americans.

Calculating smoking-attributable mortality

Mortality attributable to cigarette smoking in each race/ethnic group is calculated using a conventional attributable-risk approach (Rockhill, Newman, and Weinberg 1998).

⁹ Throughout the article, the terms “whites”, “non-Hispanic whites”, and “US-born whites” will be used interchangeably to refer to US-born non-Hispanic whites.

¹⁰ Some studies claim that statistical estimates of the relative mortality risk of smoking (such as that estimated here) are confounded by unobserved differences between smokers and non-smokers (Rogers et al. 2005). As a result, excess mortality among smokers might be expected to reflect more than just smoking.

This method estimates the proportion of deaths in each group that would not occur if smokers experienced no excess mortality relative to never-smokers, as estimated by the hazard regression model in Equation 1. Attributable risk is calculated for each race/ethnic group by sex and 5-year age-groups by

$${}_5A_x = \frac{\sum_{S=i}^n {}_5p_x^i (RR_i - 1)}{1 + \sum_{S=i}^n {}_5p_x^i (RR_i - 1)}$$

where ${}_5p_x^i$ is the proportion of individuals, by race/ethnic group and sex, in smoking status i in the age group x to $x+5$, and RR_i is the relative mortality risk of smoking status i compared with never smokers (also equal to $\exp(\beta_{Si})$). The removal of the fraction of deaths attributable to smoking produces estimates of age-specific death rates in the absence of smoking

$${}_5M_x^* = {}_5M_x \cdot (1 - {}_5A_x)$$

Life expectancy in the presence and absence of smoking

Life expectancies for each race/ethnic group in the presence of smoking (e_{35}) are calculated using death rates (${}_5M_x$) predicted using observed covariate values, while corresponding life expectancies in the absence of smoking (e_{35}^*) are calculated using death rates with smoking-related mortality removed (${}_5M_x^*$). The contribution of smoking to the life expectancy advantage of each Hispanic subgroup depends on the magnitude of the advantage in the presence of smoking-related mortality compared to the magnitude of the advantage in the absence of smoking. The change in the life expectancy gap after the removal of smoking represents the portion of the advantage that is attributable to smoking. The contribution is calculated as

$$contribution_s = ({}_H e_{35} - {}_W e_{35}) - ({}_H e_{35}^* - {}_W e_{35}^*)$$

where ${}_H e_{35}$ and ${}_W e_{35}$ are life expectancies at age 35 for the Hispanic subgroup and US-born non-Hispanic whites, respectively. The first term refers to the life expectancy advantage (in years) for the Hispanic subgroup in the presence of smoking and the second term is the advantage in the absence of smoking.

Given that the results come from survey samples, estimates of the statistical uncertainty of the reported measures is important. Standard errors for attributable-risk fractions and the contribution of smoking are estimated by simulated resampling based on regression parameter uncertainty. I simulate 1,000 sets of age-specific death rates by allowing these death rates to vary within the regression-predicted parameter variance determined by the variance-covariance matrix of the hazard regression model. These sets of death rates produce a simulated sample of attributable-fractions and contributions of smoking from which it is possible to calculate standard errors. 95% confidence intervals are reported in the results below.

Testing the selective migration and cultural hypotheses

Both hypotheses for explaining the paradox imply different expectations for the pattern of smoking by place of birth and migrant status. Selective migration refers to the phenomenon in which individuals who migrate differ in some pertinent way from individuals who do not migrate (Palloni and Ewbank 2004). Since Mexicans in the United States have considerably better mortality outcomes than the Mexican population as a whole, some studies have claimed that selective migration essentially must be operating (Jasso et al. 2004; Lara et al. 2005). But in order to determine if this difference truly reflects selective migration rather than some characteristics of the origin versus destination (e.g. better health care services in the

United States), it is necessary to compare health-related characteristics of migrants and non-migrants in Mexico prior to migration (Kennedy et al. 2006).

To do this, I combine data from the NHIS with data from the Mexican Family-Life Survey (MxFLS), a nationally-representative panel survey in Mexico. MxFLS collects detailed socioeconomic, behavioral, and health information on more than 30,000 individuals in 8,000 households. A useful feature of the survey is its longitudinal design. Wave 2, collected in 2005, attempts to complete follow-up interviews for all respondents irrespective of changes in residential location. This follow-up includes more than 300 individuals who migrated to the United States between 2002 and 2005. Information on cigarette smoking comes from respondent self-reports of current and past behavior, and is comparable to that in the NHIS.

Among individuals ages 18 – 39, I use logistic regression to predict the probability of being a current smoker for five groups based on place of birth and migrant status. Two groups come from MxFLS: 1) Mexican non-migrants who remain in Mexico and do not migrate to the US between 2002 and 2005, and 2) Mexico-to-US migrants who enter the United States during this period. Three groups come from the NHIS: 3) Mexican immigrants who arrived in the past 5 years, 4) US-born Mexican-Americans, and 5) US-born non-Hispanic whites. If selective migration is operating, Mexico-to-US migrants and Mexican immigrants in the US should be less likely to smoke than non-migrants in Mexico. Alternatively, the cultural hypothesis suggests that rates of smoking should be very similar among all Mexican-born populations both in Mexico and the United States.

Results

Consistent with previous research on the Hispanic paradox, I find that Hispanics significantly outlive US-born non-Hispanic whites at age 35, though there are large differences by nativity among Hispanics (Table 1). Non-Hispanic whites have the lowest life expectancy of all race/ethnic groups followed closely by US-born Hispanics. US-born Mexican-Americans have a more sizeable advantage (95% CI: 1.8 – 2.1 years among women), indicating that the slight advantage of US-born Hispanics may be entirely supported by Mexican-Americans. Foreign-born Hispanics have the highest life expectancy of any group, and Mexican-Americans are very similar to the foreign-born Hispanic average (nearly 3 years among women; 95% CI: 2.6 – 3.0). The differences and between US-born non-Hispanic whites and Hispanics are similar to those in official US life tables (Markides and Eschbach 2005; Arias 2010).¹¹

Estimated regression results (hazard ratios) are presented in Table 2 for women and Table 3 for men. Each column denotes whether all Hispanics are considered or whether it is limited to Mexican-Americans. The results indicate that mortality risk is higher for smokers than never smokers, and rises with consumption. Heavy smokers are at more than three times the risk of death of never smokers. Models also include race/ethnic-specific interactions with former smoking, since groups are likely to differ in the duration and intensity of past smoking. Indeed, the mortality risk of former smoking is typically lower for foreign-born Hispanic subgroups than for non-Hispanic whites (interaction hazard ratio below 1.0).

¹¹ Estimated life expectancies are slightly higher than those in official life tables since NHIS only samples the non-institutionalized population. The addition of nursing home or hospice respondents would produce slightly lower life expectancy estimates. However, this difference is small, and should have little or no impact on the difference between Hispanics and non-Hispanic whites.

Data on smoking status (Table 4) indicate that Hispanics are more likely to be never-smokers and less likely to smoke currently than whites. At baseline, only 37% of white men were never smokers compared with 42% of US-born and 49% of foreign-born Hispanic men. The prevalence of current smoking among men was similar for all race/ethnic groups, about 20%. The major difference between whites and Hispanic subgroups in the impact of smoking is in the prevalence of heavy smoking. While more than 70% of white men smokers consume at least one pack (20 cigarettes) per day, only 38% of US-born Hispanic men and 30% of foreign-born Hispanic men do. Foreign-born Mexican-Americans are exceptionally light smokers with fewer than one-fifth smoking a pack or more and the majority smoking fewer than 10 cigarettes per day.

Differences in smoking between whites and Hispanic subgroups are larger for women than for men. While only half of white women have never smoked, 64% of US-born Hispanic women and 78% of foreign-born Hispanic women are never smokers. As for men, Mexican-American women tend to smoke less than the Hispanic average; 68% of US-born Mexican-American women and 81% of the foreign-born are never smokers. The prevalence of current smoking is lower for each Hispanic subgroup than for non-Hispanic whites, and lower for foreign-born Hispanics and Mexican-Americans, *ceteris paribus*. 19% of white women are current smokers compared with 16% of US-born Hispanic women and only 9% of foreign-born Hispanic women. Daily cigarette consumption is also higher for whites women. Nearly 60% of white women smokers smoke a pack or more per day, compared to only 28% of US-born Hispanic smokers and 21% of foreign-born Hispanics. Only 11% of foreign-born Mexican-American smokers smoke a pack a day, while almost 75% smoke fewer than 10 cigarettes per day.

These findings support Hypothesis (1), but with notable differences among Hispanic subgroups. The regression coefficients in Tables 2 and 3 along with the smoking data in Table 4 are used to predict the fraction of deaths attributable to smoking by sex for each race/ethnic group, shown in Figure 1. The highest attributable fractions are seen among US-born non-Hispanic whites, and there is substantial variation among Hispanics in the mortality burden of smoking. 28% (95% CI: 26%-30%) of deaths among white men and 21% (19%-22%) among white women are due to smoking. US-born Hispanics have the next highest burden, 26% (23%-29%) among men and 19% (16%-21%) among women. Smoking related mortality among foreign-born Hispanics is lower than among whites or US-born Hispanics, 21% (18%-24%) for men and just 8% (7%-9%) for women. Attributable risk for foreign-born Mexican-Americans have is lower still, just 16% (12%-19%) for men and only 10% (9%-12%) for women. Despite quite similar prevalence of current smoking among white and Hispanic men, the mortality burden of smoking is lower among Hispanics, reflecting higher likelihood of never smoking and likely lower duration and consumption among former smokers.

Once smoking-attributable mortality has been removed, it is possible to calculate the contribution of smoking to the life expectancy advantage of each Hispanic subgroup (shown in Figure 2A for women and 2B for men). The black bar represents the portion of the advantage that is attributed to smoking-related mortality while the grey bar represents the contribution of other factors. 95% confidence intervals indicate uncertainty in the estimates. Smoking is a major factor explaining the life expectancy advantage of each Hispanic subgroup vis-à-vis US-born non-Hispanic whites, though the absolute contribution differs significantly by sex and across Hispanic subgroups. Among women, smoking explains 0.4 years (66%) of the advantage of US-born Hispanics and 1.8 years (58%) of the advantage of

foreign-born Hispanics, cutting the foreign-born advantage by more than half in the absence of smoking. The contribution is similar for foreign-born Mexican-Americans, 1.64 years (57%). Among men, the nativity pattern of the contribution of smoking is similar, with a larger absolute contribution of smoking among the foreign-born. In fact, the life expectancy advantage of US-born Hispanics would be reversed with the removal of smoking. The 0.8-year advantage of US-born Mexican-Americans would be almost completely eliminated in the absence of smoking. Low smoking-attributable mortality is responsible for 1.3 – 1.7 years of the advantage of foreign-born Hispanics and Mexican-Americans, explaining 60% among all foreign-born Hispanics and 74% among Mexican-Americans. Cigarette smoking emerges as the principal reason for each Hispanic subgroup's life expectancy advantage over non-Hispanic whites, providing strong support for Hypothesis (2).

We can also calculate the contribution of smoking to the life expectancy advantage of foreign-born over US-born Hispanics. Among women, smoking explains 56% of this advantage for all Hispanics and 54% for Mexican-Americans. For men, it is responsible for 48% for all Hispanics and 66% for Mexican-Americans, closing the gap from 1.5 to 0.5 years. Higher mortality from smoking is thus also a major reason why the life expectancy advantage enjoyed by foreign-born Hispanics over whites narrows considerably for US-born Hispanics.

Testing the selective migration and cultural hypotheses

Data from MxFLS provide smoking status information on 315 Mexico-to-US migrants collected in 2002 prior to migration. Figure 3 compares smoking behavior of this group to non-migrants in order to test the selective migration hypothesis. Panel (a) shows the prevalence of current smoking for women by migrant status. Overall, there is no evidence of selective migration with respect to smoking status. Mexico-to-US migrants and non-migrants

show very similar prevalence of smoking (23% among men, 6-7% among women). The prevalence of smoking among recent Mexican immigrants in the US is also very similar, 25% among men and 4% among women, suggesting that low rates of smoking in Mexico are maintained among Mexicans in the United States. US-born Mexican-Americans show higher prevalence than Mexican-born groups among women but not among men. US-born whites show the highest prevalence among both men and women, consistent with the finding that smoking contributes to the life expectancy advantage for Mexican-born individuals in the US.

Discussion

This study examines the contribution of cigarette smoking to the Hispanic mortality advantage in the United States compared with non-Hispanic whites. The results confirm that the Hispanic advantage is not consistent across all Hispanics. Foreign-born Hispanics, and especially Mexican-Americans, enjoy a relatively large life expectancy advantage, 3 years at age 35 for women. Although I find an advantage among US-born Hispanics, it is substantially diminished (1-2 years for Mexican-Americans, 0.5 years or less for all Hispanics). The principal contribution of this study is establishing that low smoking-related mortality among Hispanics is the primary proximate reason for their unexpectedly favorable mortality experience. The first direct treatment of the issue indicated that low rates of lung cancer and other smoking-related conditions explained the majority of Hispanics' adult life expectancy advantage over non-Hispanic whites (Blue and Fenelon 2011). The current study improves on this analysis in two ways. First, it establishes a better connection of the findings to real data on cigarette smoking, showing indeed that smoking is less common among Hispanics than non-Hispanic whites, and that this translates into a substantially lower mortality burden of smoking. Blue and Fenelon's analysis did not employ any individual-level data on smoking

behavior. Second, examining the process by nativity and specifically among Mexican-Americans reveals meaningful variation within the Hispanic population both in mortality and in the importance of smoking. These two major improvements reflect the data source used; the NHIS provides detailed information on smoking behavior, Hispanic origin, and nativity status, which allows more thorough consideration of the Hispanic paradox.

Smoking emerges as the principal proximate explanation of the Hispanic life expectancy advantage across Hispanic subgroups. But what accounts for the favorable smoking behavior in these populations? This paper tests the performance of the selective migration hypothesis and the cultural hypothesis in explaining the low smoking prevalence among Mexican immigrants in the United States. This is the first study to directly examine the selective migration hypothesis with respect to cigarette smoking. The results reveal no evidence of the selective migration of non-smokers from Mexico. On the contrary, Mexican individuals who migrate to the United States are about as likely to smoke as their counterparts who remain in Mexico, and smoke at comparable rates after arriving in the US. Cigarette smoking itself does not appear to present a barrier to migration. This finding is consistent with previous research documenting that health selection among Mexican immigrants is relatively weak, perhaps due to geographic proximity (Rubalcava et al. 2008; Akresh and Frank 2008).

The finding that Mexican-born individuals in both Mexico and the United States smoke at very similar rates supports the cultural hypothesis. This suggests that a cultural orientation towards a low prevalence of smoking originates in Mexican sending communities and is imported to the United States (Barger and Gallo 2008). Although second generation children of Mexican immigrants appear to smoke at higher rates than their parents, Mexican-born populations in the United States are relatively successful at maintaining this orientation

in enclave communities (Almeida et al. 2009). Unfortunately, the data used here are insufficient to specify the particular pathway through which Mexican culture discourages smoking, but there is plenty of indirect evidence of the role of culture.

Some research finds that Mexican culture tends to stress the role of the group in health and social considerations (Gallo et al. 2009). The “allocentric” perspective places the needs of the group above those of the individual, which may eliminate some individual health behavior decision-making (Hulme et al. 2003). Social expectations that an individual privileges the health and well-being of the family or community members might discourage reckless or unhealthy behavior (G. Marin and B. V. Marin 1991). Strong social support networks in Mexican families may also discourage unhealthy behaviors by providing an outlet for stress (Morales et al. 2002; Gallo et al. 2009). Mexican *familism* implies that access to social support may be greater in Mexico than in non-Mexican populations in the United States, although Mexican immigrants may bring this characteristic with them during migration (N. Rodriguez et al. 2007; Almeida, Molnar, et al. 2009). To the extent that smoking is a response to psychosocial stressors, strong social ties may improve an individual’s ability to cope with stressful life events without engaging in unhealthy behaviors (Stephoe et al. 1996). This is consistent with evidence in the United States of a health benefit to Mexican immigrants from living in neighborhoods with greater concentrations of other Mexicans (Patel et al. 2003; Eschbach, Mahnken, and Goodwin 2005; Aranda et al. 2011). As the concentration grows, beneficial health characteristics may be compounded, improving the health of all community members. As a result, Mexican immigrants in the US have a low burden of smoking but are also more successful at maintaining favorable smoking behavior if they reside in enclave neighborhoods.

This paper has several limitations. The major limitation is the inability to empirically account for return migration. In the absence of mortality data on individuals who leave the United States, we cannot be sure that the Hispanic mortality advantage is a real phenomenon. To fully address the challenge of salmon bias would require multinational data capturing the mortality experience of foreign-born individuals outside the United States. Although NUMIDENT data provide the necessary information, it is only available for beneficiaries, which may themselves be a select group. Essentially, investigating the role of migration bias in the Hispanic paradox is presently an issue of data availability. I was also unable to control for smoking histories in my estimation of the impact of smoking on mortality. Current status data such as those used in this study may underestimate the effect of smoking, especially if there are unobserved changes in smoking status that occur after baseline. Ideally, we would use detailed data on temporal changes in smoking duration and intensity of cohorts, which capture very specific influences of smoking on mortality. Since such data are unavailable for a representative population of the United States, we use indirect methods and current status methods, which have been shown to produce reasonable estimates of attributable risk (CDC 2008; Fenelon and Preston 2012; Peto et al. 1992).

Conclusion

In light of the results of this study, what conclusions can we draw about the Hispanic paradox? The paradox represents an important situation in social science research in which a group with lower socioeconomic status outperforms the high-status majority group with respect to health outcomes. Explaining the Hispanic paradox thus improves our knowledge of the factors that mediate the relationship between socioeconomic status and health, in addition to providing a fruitful description of the mortality experience of Hispanics. This study

examined one such factor that has a significant impact on mortality in the United States: cigarette smoking. Hispanics receive a substantial mortality benefit relative to non-Hispanic whites from a low burden of smoking. Although this benefit is larger for Hispanic immigrants, smoking contributes to the advantage among US-born Hispanics as well, particularly Mexican-Americans. Separating Hispanics by place of birth adds an additional layer to the Hispanic paradox, since foreign-born Hispanics outlive US-born Hispanics despite lower socioeconomic status among foreign-born Hispanics. Furthermore, the results suggest that smoking is important for the nativity difference as well. Among Hispanics, linguistic and cultural assimilation is accompanied by behavioral assimilation (Acevedo-Garcia et al. 2005); health behaviors converge to the mainstream norm with greater exposure to the US context, and this includes heavier smoking among US-born Hispanics than their parents' generation (Gordon-Larsen et al. 2003; Coreil, Ray, and Markides 1991; Haynes et al. 1990). This convergence suggests that the US environment may be “toxic” to the health of immigrants as they are exposed to dominant behavioral social norms, increased tobacco advertising, and perhaps increased income and affordability of cigarettes (Bethel and Schenker 2005; Acevedo-Garcia et al. 2004; Thrasher et al. 2009).

This study also provides strong evidence that the favorable health and mortality experience of Mexican immigrants in the United States is not a consequence of selective migration. This finding is important in itself, but it should also inform a future research agenda on the factors that mediate the relationship between socioeconomic status and health for many immigrant groups in the United States. Studies examining better-than-expected health outcomes among immigrant populations should not assume that these findings are being driven by health-selective migration, and should look deeper into social and behavioral

characteristics of the migrant populations, both in their origin countries and in the United States. For example, Elo and colleagues (2011) documented very low rates of disability among black immigrants from Africa and the Caribbean compared to both US-born blacks and US-born whites. This may reflect health-selective migration from these regions, but it may also be a consequence of better health behaviors among foreign-born blacks (Singh and Siahpush 2002).

Smoking does not explain the *entire* advantage for foreign-born Hispanics. In the absence of smoking, they would still outlive US-born non-Hispanic white men by 0.9 years and women by 1.3 years. The factors responsible for these residual differences are important, since they compose about 40% of the male and female advantages. The cultural hypothesis that not smoking is merely one dimension of generally healthy lifestyles among Hispanic immigrants; other health behaviors such as exercise, low alcohol consumption, and proper diet may also contribute to their advantage. Mexican immigrants have been shown to be less likely to drink alcohol heavily and may be more likely to engage in physical activity, especially related to occupational labor (Singh and Siahpush 2002; Brownson et al. 2000). The role of overweight and obesity is more controversial since Hispanics as a whole exhibit a much higher obesity risk than non-Hispanic whites (Denney et al. 2004; Kaplan et al. 2004). Future research should examine whether whites have a higher burden of other risk behaviors in addition to cigarette smoking. Although it may be the most significant behavior, smoking is likely situated in a larger network of factors that protects Hispanics from the negative health consequences of socioeconomic disadvantage.

It is important to remember that the health and mortality effects of cigarette smoking reflect smoking behavior over the course of an individual's adult life. Smoking usually begins

in adolescence or early adulthood but smoking-related diseases are not observed until older ages (Flanders et al. 2003; Preston, Gleib, and Wilmoth 2010a). As a result, current smoking-related mortality reflects accumulated damage over a period of several decades up to the present. In the past 40 years, the United States experienced a precipitous drop in cigarette consumption from among the highest levels in the developed world to relatively moderate levels. Although corresponding data for Hispanic immigrant countries of origin are of lower quality,¹² smoking was presumably rather low in these countries since the cigarette epidemic was greatly delayed in the developing world (Lopez, Collishaw, and Piha 1994; Pampel 2005). The significant contribution of smoking to the contemporary difference in life expectancy between Hispanics and non-Hispanic whites in part reflects this large historical difference in the onset of the smoking epidemic. Although cigarette use has declined significantly in the US population (Forey et al. 2009), changes in the contribution of smoking to the Hispanic mortality advantage may not be observed for several decades.

References

- Abraido-Lanza, A. F., B. P. Dohrenwend, D. S. Ng-Mak, and J. B. Turner. 1999. "The Latino mortality paradox: A test of the 'salmon bias' and healthy migrant hypotheses." *American Journal of Public Health* 89(10):1543–1548.
- Acevedo-Garcia, D, LM Bates, TL Osypuk, and N McArdle. 2010. "The effect of immigrant generation and duration on self-rated health among US adults 2003-2007." *SOCIAL SCIENCE & MEDICINE* 71(6):1161–1172. Retrieved April 17, 2011.
- Acevedo-Garcia, D., Elizabeth Barbeau, Jennifer Anne Bishop, Jocelyn Pan, and Karen M. Emmons. 2004. "Undoing an Epidemiological Paradox: The Tobacco Industry's Targeting of US Immigrants." *American Journal of Public Health* 94(12):2188–2193.

¹² Data compiled by Forey et al. (2002) provide smoking prevalence and cigarette consumption figures for most developed countries since 1950. Data for developing countries are limited and unreliable or unrepresentative in many cases.

- Acevedo-Garcia, D., J. Pan, H. J. Jun, T. L. Osypuk, and K. M. Emmons. 2005. "The effect of immigrant generation on smoking." *Social Science & Medicine* 61(6):1223–1242.
- Akresh, Ilana Redstone, and Reanne Frank. 2008. "Health Selection Among New Immigrants." *Am J Public Health* 98(11):2058–2064. Retrieved June 28, 2011.
- Almeida, J., I. Kawachi, B. E. Molnar, and S. V. Subramanian. 2009. "A Multilevel Analysis of Social Ties and Social Cohesion among Latinos and Their Neighborhoods: Results from Chicago." *Journal of Urban Health-Bulletin of the New York Academy of Medicine* 86(5):745–759.
- Arias, E. 2010. "United States Life Tables by Hispanic Origin." *Vital Health Statistics* 152(2).
- Arias, E., William S. Schauman, K. Eschbach, P. D. Sorlie, and Eric Backlund. 2008. "The validity of race and Hispanic origin reporting on death certificates in the United States." *Vital Health Stat* 2 (148):1–23.
- Barger, S. D., and L. C. Gallo. 2008. "Ability of Ethnic Self-Identification to Partition Modifiable Health Risk Among US Residents of Mexican Ancestry." *American Journal of Public Health* 98(11):1971–1978.
- Becker, T. M., C. Wiggins, C. R. Key, and J. M. Samet. 1988. "ISCHEMIC HEART-DISEASE MORTALITY IN HISPANICS, AMERICAN-INDIANS, AND NON-HISPANIC WHITES IN NEW-MEXICO, 1958-1982." *Circulation* 78(2):302–309.
- Bethel, J. W., and M. B. Schenker. 2005. "Acciduration and smoking patterns among Hispanics - A review." *American Journal of Preventive Medicine* 29(2):143–148.
- Blue, L., and A. Fenelon. 2011. "Explaining low mortality among US immigrants relative to native-born Americans: the role of smoking." *International Journal of Epidemiology* 40(3):786 –793.
- Brownson, RC et al. 2000. "Patterns and correlates of physical activity among US women 40 years and older." *Am J Public Health* 90(2):264–270. Retrieved April 11, 2011.
- Caraballo, R. S., G. A. Giovino, T. F. Pechacek, and P. D. Mowery. 2001. "Factors associated with discrepancies between self-reports on cigarette smoking and measured serum cotinine levels among persons aged 17 years or older - Third National Health and Nutrition Examination Survey, 1988-1994." *American Journal of Epidemiology* 153(8):807–814.
- Caraballo, R. S., and C. W. Lee. 2004. "Tobacco use among Mexicans and their descendents in the United States." *Salud Publica De Mexico* 46(3):241–250.
- CDC. 2010. "Data Access - Data Linkage Activities - NHIS Mortality Linkage - Public-use." Retrieved

(http://www.cdc.gov/nchs/data_access/data_linkage/mortality/nhis_linkage_public_us_e.htm).

- CDC. 2008. "Smoking-attributable mortality, years of potential life lost, and productivity losses--United States, 2000-2004." *MMWR Morb Mortal Wkly Rep* 57(45):1226-8.
- Chen, J., R. Wilkins, and E. Ng. 1996. "Health expectancy by immigrant status, 1986 and 1991." *HEALTH REPORTS-STATISTICS CANADA* 8:29-38.
- Cho, Y., W. P. Frisbie, R. A. Hummer, and R. G. Rogers. 2004. "Nativity, Duration of Residence, and the Health of Hispanic Adults in the United States1." *International Migration Review* 38(1):184-211. Retrieved November 29, 2011.
- Coreil, J., L. A. Ray, and K. S. Markides. 1991. "PREDICTORS OF SMOKING AMONG MEXICAN-AMERICANS - FINDINGS FROM THE HISPANIC HANES." *Preventive Medicine* 20(4):508-517.
- Denney, J. T., P. M. Krueger, R. G. Rogers, and J. D. Boardman. 2004. "Race/ethnic and sex differentials in body mass among us adults." *Ethnicity & Disease* 14(3):389-398.
- Eckersley, Richard, Jane Meredith Dixon, and Robert Matheson Douglas. 2001. *The social origins of health and well-being*. Cambridge University Press.
- Elo, I. T., N. K. Mehta, and C. Huang. 2011. "Disability Among Native-born and Foreign-born Blacks in the United States." *Demography* 48:241-265. Retrieved December 4, 2011.
- Elo, I. T., C. M. Turra, B. Kestenbaum, and B. R. Ferguson. 2004. "Mortality among elderly Hispanics in the United States: Past evidence and new results." *Demography* 41(1):109-128.
- Eschbach, K., Y. F. Kuo, and J. S. Goodwin. 2006. "Ascertainment of Hispanic ethnicity on California death certificates: Implications for the explanation of the Hispanic mortality advantage." *American Journal of Public Health* 96(12):2209-2215.
- Eschbach, K., G. V. Ostir, K. V. Patel, K. S. Markides, and J. S. Goodwin. 2004. "Neighborhood context and mortality among older Mexican Americans: Is there a barrio advantage?" *American Journal of Public Health* 94(10):1807-1812.
- Fenelon, A., and S. H. Preston. 2012. "Estimating Smoking-Attributable Mortality in the United States." *Demography*.
- Finch, Brian Karl, R. A. Hummer, Maureen Reindl, and W. A. Vega. 2002. "Validity of Self-rated Health among Latino(a)s." *American Journal of Epidemiology* 155(8):755-759. Retrieved November 21, 2011.

- Flanders, W. D., C. A. Lally, B. P. Zhu, S. J. Henley, and M. J. Thun. 2003. "Lung cancer mortality in relation to age, duration of smoking, and daily cigarette consumption: Results from Cancer Prevention Study II." *Cancer Research* 63(19):6556–6562.
- Forey, B. A., J. Hamling, P. Lee, and N. Wald. 2002. *International smoking statistics: a collection of historical data from 30 economically developed countries, 2nd Edition*. London: Oxford University Press.
- Forey, B. A., Jan Hamling, John Hamling, and P. Lee. 2009. "International Smoking Statistics WEB Edition." Retrieved (<http://www.pnlee.co.uk/ISS3.htm>).
- Gallo, L. C., F. J. Penedo, K. E. de los Monteros, and W. Arguelles. 2009. "Resiliency in the Face of Disadvantage: Do Hispanic Cultural Characteristics Protect Health Outcomes?" *Journal of Personality* 77(6):1707–1746.
- Gordon-Larsen, P., K. M. Harris, D. S. Ward, and B. M. Popkin. 2003. "Acculturation and overweight-related behaviors among Hispanic immigrants to the US: the national longitudinal study of adolescent health." *Social Science & Medicine* 57(11):2023–2034.
- Guillot, Michel, Natalia Gavrilova, and Tetyana Pudrovska. 2011. "Understanding the 'Russian Mortality Paradox' in Central Asia: Evidence from Kyrgyzstan." *Demography* 48(3):1081–1104.
- Haiman, C. A. et al. 2006. "Ethnic and racial differences in the smoking-related risk of lung cancer." *New England Journal of Medicine* 354(4):333–342.
- Haldorsen, T., and T. K. Grimsrud. 1999. "Cohort analysis of cigarette smoking and lung cancer incidence among Norwegian women." *International Journal of Epidemiology* 28(6):1032–1036.
- Haynes, S. G., C. Harvey, H. Montes, H. Nickens, and B. H. Cohen. 1990. "Patterns of Cigarette-Smoking Among Hispanics in the United States - Results from HHANES 1982-1984." *American Journal of Public Health* 80:47–53.
- Hummer, R. A., R. G. Rogers, S. H. Amir, D. Forbes, and W. P. Frisbie. 2000. "Adult mortality differentials among Hispanic subgroups and non-Hispanic whites." *Social Science Quarterly* 81(1):459–476.
- IHIS. 2010. "Integrated Health Interview Series: Version 2.0."
- Jasso, G., D.S. Massey, M.R. Rosenzweig, and J.P. Smith. 2004. "Immigrant health: selectivity and acculturation." *Critical perspectives on racial and ethnic differences in health in late life* 227–266.

- Kaplan, M. S, N. Huguet, J. T Newsom, and B. H McFarland. 2004. "The association between length of residence and obesity among Hispanic immigrants." *American Journal of Preventive Medicine* 27(4):323–326.
- Kreuter, M.W., and S.M. McClure. 2004. "The role of culture in health communication." *Annu. Rev. Public Health* 25:439–455.
- Lara, M., C. Gamboa, M. I. Kahramanian, L. S. Morales, and D. E. H. Bautista. 2005. "Acculturation and latino health in the United States: A review of the literature and its sociopolitical context." *Annual Review of Public Health* 26:367–397.
- Liao, Y. L. et al. 1998. "Mortality patterns among adult Hispanics: Findings from the NHIS, 1986 to 1990." *American Journal of Public Health* 88(2):227–232.
- Lochner, Kimberly, R. A. Hummer, Stephanie Bartee, Gloria Wheatcroft, and Christine Cox. 2008. "The Public-Use National Health Interview Survey Linked Mortality Files: Methods of Reidentification Risk Avoidance and Comparative Analysis." *American Journal of Epidemiology* 168(3):336 –344. Retrieved November 22, 2011.
- Lopez, A. D., N. E. Collishaw, and T. Piha. 1994. "A descriptive model of the cigarette epidemic in developed countries." *Tobacco Control* 3:242–247.
- Marin, Gerardo, and Barbara Vanoss Marin. 1991. *Research with Hispanic Populations*. 1st ed. Sage Publications, Inc.
- Markides, K. S., and S. A. Black. 1996. "Aging and health behaviors in Mexican Americans." *Family & Community Health* 19(2):11–18.
- Markides, K. S., and J. Coreil. 1986. "The Health of Hispanics in the Southwestern United-States - An Epidemiologic Paradox." *Public Health Reports* 101(3):253–265.
- Markides, K. S., and K. Eschbach. 2005. "Aging, migration, and mortality: Current status of research on the Hispanic paradox." *Journals of Gerontology Series B-Psychological Sciences and Social Sciences* 60:68–75.
- Mokdad, A. H., J. S. Marks, D. F. Stroup, and J. L. Gerberding. 2004. "Actual causes of death in the United States, 2000." *Journal of the American Medical Association* 291(10):1238–1245.
- Morales, L. S., M. Lara, R. S. Kington, R. O. Valdez, and J. J. Escarce. 2002. "Socioeconomic, cultural, and behavioral factors affecting Hispanic health outcomes." *Journal of Health Care for the Poor and Underserved* 13(4):477–503.
- National Center for Health Statistics. 2000. "Design and Estimation for the National Health Interview Survey, 1995-2004." *Vital Health Stat* 2(130).

- Pablos-Méndez, Ariel. 1994. "Mortality Among Hispanics." *JAMA: The Journal of the American Medical Association* 271(16):1237–1238. Retrieved November 21, 2011.
- Palloni, A., and E. Arias. 2004. "Paradox lost: Explaining the Hispanic adult mortality advantage." *Demography* 41(3):385–415.
- Palloni, A., and D. C Ewbank. 2004. "Selection processes in the study of racial and ethnic differentials in adult health and mortality." *Critical perspectives on racial and ethnic differences in health in late life*.
- Palloni, A., and J. D. Morenoff. 2001. "Interpreting the paradoxical in the Hispanic paradox - Demographic and epidemiologic approaches." Pp. 140–174 in *Population Health and Aging - Strengthening the Dialogue between Epidemiology and Demography, Annals of the New York Academy of Sciences*, edited by M. Weinstein, A. I. Hermalin, and M. A. Stoto. Retrieved (://000173961000010).
- Pampel, F. C. 2005. "Patterns of tobacco use in the early epidemic stages: Malawi and Zambia, 2000-2002." *American journal of public health* 95(6):1009.
- Perez-Stable, E. J. et al. 2001. "Cigarette smoking behavior among US Latino men and women from different countries of Origin." *American Journal of Public Health* 91(9):1424–1430.
- Pérez-Stable, Eliseo J, Gerardo Marín, and Samuel F Posner. 1998. "Ethnic Comparison of Attitudes and Beliefs About Cigarette Smoking." *Journal of General Internal Medicine* 13(3):167–174. Retrieved November 22, 2011.
- Pescosolido, Bernice A, and Sigrun Olafsdottir. 2010. "The Cultural Turn in Sociology: Can It Help Us Resolve an Age-Old Problem in Understanding Decision Making for Health Care?" *Sociological Forum* 25(4):655–676. Retrieved February 8, 2012.
- Peto, R., A. D. Lopez, J. Boreham, M. Thun, and C. Heath. 1992. "Mortality From Smoking in Developed Countries - Indirect Estimation From National Vital-Statistics." *Lancet* 339(8804):1268–1278.
- Peto, R., A. D. Lopez, J. Boreham, M. J. Thun, and C. Heath. 1994. *Mortality from Smoking in Developed Countries 1950-2000*. Oxford: Oxford University Press.
- Pinheiro, P. S. et al. 2009. "Cancer Incidence in First Generation US Hispanics: Cubans, Mexicans, Puerto Ricans, and New Latinos." *Cancer Epidemiology Biomarkers & Prevention* 18(8):2162–2169.
- Pinsky, P. F. 2006. "Racial and ethnic differences in lung cancer incidence: how much is explained by differences in smoking patterns? (United States)." *Cancer Causes & Control* 17(8):1017–1024.

- Preston, S. H., D. A. Gleij, and J. R. Wilmoth. 2010a. "A new method for estimating smoking-attributable mortality in high-income countries." *International Journal of Epidemiology* 39(2):430–438.
- Preston, S. H., D. A. Gleij, and J. R. Wilmoth. 2010b. "Contribution of Smoking to International Differences in Life Expectancy." in *International Differences in Mortality at Older Ages: Dimensions and Sources*, edited by E. Crimmins, S. H. Preston, and B. Cohen. Washington, D.C.: National Academy Press.
- Razum, O., H. Zeeb, H.S. Akgün, and S. Yilmaz. 1998. "Low overall mortality of Turkish residents in Germany persists and extends into a second generation: merely a healthy migrant effect?*" *Tropical Medicine & International Health* 3(4):297–303.
- Rockhill, B., B. Newman, and C. Weinberg. 1998. "Use and misuse of population attributable fractions." *American Journal of Public Health* 88(1):15–19.
- Rodriguez, S. 1995. "Hispanics in the United States: An insight into group characteristics." *Washington DC: Department of Health and Human Services*.
- Rogers, R. G., and J. Crank. 1988. "ETHNIC-DIFFERENCES IN SMOKING PATTERNS - FINDINGS FROM NHIS." *Public Health Reports* 103(4):387–393.
- Rogers, R. G., R. A. Hummer, P. M. Krueger, and F. C. Pampel. 2005. "Mortality attributable to cigarette smoking in the United States." *Population and Development Review* 31(2):259–292.
- Rubalcava, L. N., G. M. Teruel, D. Thomas, and N. Goldman. 2008. "The healthy migrant effect: New findings from the Mexican family life survey." *American Journal of Public Health* 98(1):78–84.
- Sewell, W. 1999. "The concept(s) of culture." in *Beyond the cultural turn: new directions in the study of society and culture*. University of California Press.
- Siahpush, M., G. K. Singh, P. R. Jones, and L. R. Timsina. 2010. "Racial/ethnic and socioeconomic variations in duration of smoking: results from 2003, 2006 and 2007 Tobacco Use Supplement of the Current Population Survey." *Journal of Public Health* 32(2):210–218.
- Singh, G. K., and M. Siahpush. 2002. "Ethnic-immigrant differentials in health behaviors, morbidity, and cause-specific mortality in the United States: An analysis of two national data bases." *Human Biology* 74(1):83–109.
- Sorlie, P. D., E. Backlund, N. J. Johnson, and E. Rogot. 1993. "MORTALITY BY HISPANIC STATUS IN THE UNITED-STATES." *Jama-Journal of the American Medical Association* 270(20):2464–2468.

- Sullivan, T. A., F. P. Gillespie, M. Hout, and R. G. Rogers. 1984. "ALTERNATIVE ESTIMATES OF MEXICAN-AMERICAN MORTALITY IN TEXAS, 1980." *Social Science Quarterly* 65(2):609–617.
- Swidler, Ann. 1986. "Culture in Action: Symbols and Strategies." *American Sociological Review* 51(2):273–286. Retrieved February 7, 2012.
- Thrasher, J. F. et al. 2009. "Does the availability of single cigarettes promote or inhibit cigarette consumption? Perceptions, prevalence and correlates of single cigarette use among adult Mexican smokers." *Tobacco Control* 18(6):431–437. Retrieved April 20, 2011.
- Thun, M. J., and C. W. Heath. 1997. "Changes in mortality from smoking in two American Cancer Society prospective studies since 1959." *Preventive Medicine* 26(4):422–426.
- Trinidad, D. R. et al. 2009. "Intermittent and light daily smoking across racial/ethnic groups in the United States." *Nicotine & Tobacco Research* 11(2):203–210.
- Turra, C. M., and N. Goldman. 2007. "Socioeconomic differences in mortality among US adults: Insights into the Hispanic paradox." *Journals of Gerontology Series B-Psychological Sciences and Social Sciences* 62(3):S184–S192.
- Unger, Jennifer et al. 2003. "Exploring the cultural context of tobacco use: A transdisciplinary framework." *Nicotine & Tobacco Research* 5(6):101–107. Retrieved February 8, 2012.
- US Census Bureau. 2011. "2010 Census Summary File 1—United States. prepared by the U.S. Census Bureau, 2011."
- Vega, W. A., M. A. Rodriguez, and E. Gruskin. 2009. "Health Disparities in the Latino Population." *Epidemiologic Reviews* 31(1):99–112.
- Zúñiga, Víctor, and Rubén Hernández-León. 2006. *New Destinations: Mexican Immigration in the United States*. Russell Sage Foundation.

Table 1: Estimated remaining life expectancy in years at age 35 by race/ethnic group and sex

	Women		Men	
	Life Expectancy	Advantage ¹	Life Expectancy	Advantage
US-born non-Hispanic white	47.60 (47.3 - 47.9)	--	41.67 (41.5 - 41.9)	--
US-born Hispanic	48.18 (47.9 - 48.4)	0.58 (0.4 - 0.7)	41.88 (41.2 - 42.6)	0.21 (-0.1 - 0.6)
US-born Mexican-American	49.52 (48.9 - 50.1)	1.92 (1.8 - 2.1)	42.48 (42.5 - 43.6)	0.81 (0.5 - 1.2)
Foreign-born Hispanic	50.71 (50.4 - 51.0)	3.11 (3.0 - 3.3)	43.81 (43.2 - 44.4)	2.14 (1.8 - 2.5)
Foreign-born Mexican-American	50.44 (49.7 - 51.1)	2.84 (2.6 - 3.0)	43.96 (43.5 - 44.4)	2.29 (1.9 - 2.6)

Notes: Estimated with hazard regression using NHIS pooled samples 1990 - 2004. Refers to number of additional years of expected life at age 35. 95% confidence intervals in parentheses.

¹ Compared to US-born non-Hispanic whites

Table 2: Hazard ratios estimating impact of smoking on mortality for women

	All Hispanics ¹	Mexicans ²
Age		
35-39 (ref.)	--	--
40-44	1.7 (1.2 - 2.3)	1.7 (1.3 - 2.2)
45-49	2.6 (1.9 - 3.5)	2.6 (2.0 - 3.3)
50-54	3.9 (2.9 - 5.2)	3.9 (3.0 - 5.0)
55-59	6.2 (4.6 - 8.3)	6.1 (4.8 - 7.8)
60-64	10.3 (7.7 - 13.8)	9.8 (7.7 - 12.5)
65-69	16.3 (12.3 - 21.8)	15.1 (11.8 - 19.2)
70-74	26.0 (19.5 - 34.6)	23.5 (18.5 - 29.9)
75-79	44.3 (33.3 - 58.9)	39.2 (30.8 - 49.8)
80-84	77.0 (57.9 - 102.4)	66.7 (52.5 - 84.8)
85+	172.4 (129.8 - 229.1)	146.9 (115.7 - 186.6)
race/ethnic group		
US-born white (ref.)	--	--
US-born Hispanic	0.99 (0.91 - 1.09)	
Foreign-born Hispanic	0.91 (0.84 - 0.99)	
US-born Mexican-American		0.91 (0.81 - 1.03)
Foreign-born Mexican-American		0.97 (0.85 - 1.10)
Smoking		
Never smoker (ref.)	--	--
Former smoker	1.35 (1.31 - 1.40)	1.36 (1.32 - 1.40)
Current (0-9 cigarettes per day)	1.80 (1.66 - 1.95)	1.80 (1.68 - 1.93)
Current (10-19)	2.10 (1.95 - 2.26)	2.11 (1.98 - 2.25)
Current (20-29)	2.49 (2.34 - 2.65)	2.51 (2.38 - 2.63)
Current (30+)	3.11 (2.84 - 3.40)	3.13 (2.88 - 3.39)
Smoking Interactions		
Former x US-born Hisp.	1.10 (1.00 - 1.18)	
Former x Foreign-born Hisp.	0.84 (0.78 - 0.91)	
Former x US-born Mex.		1.05 (0.97 - 1.13)
Former x Foreign-born Mex.		0.93 (0.85 - 1.00)
Constant	0.000558	0.000539
N	155,173	144,463

Notes: Estimated using hazard regression on data from NHIS smoking supplements 1990 - 2004. Hazard ratios shown. 95% confidence intervals in parentheses. Interactions reflect differences in the mortality risk of former smoking by race/ethnic group

¹ Model includes all individuals of Hispanic origin, with dummy variables for US- and foreign-born

² Includes only Mexican-Americans among Hispanics

Table 3: Hazard ratios estimating impact of smoking on mortality for men

	All Hispanics ¹	Mexicans ²
Age		
35-39 (ref.)	--	--
40-44	1.6 (1.2 - 2.1)	1.6 (1.3 - 2.1)
45-49	2.3 (1.8 - 3.0)	2.3 (1.8 - 2.9)
50-54	3.9 (3.1 - 5.0)	3.9 (3.1 - 4.9)
55-59	5.5 (4.3 - 7.0)	5.3 (4.3 - 6.6)
60-64	9.2 (7.2 - 11.8)	8.8 (7.1 - 10.9)
65-69	15.4 (12.1 - 19.6)	14.4 (11.6 - 17.8)
70-74	25.1 (19.7 - 31.8)	22.8 (18.5 - 28.2)
75-79	38.5 (30.4 - 48.9)	35.0 (28.4 - 43.3)
80-84	62.0 (48.9 - 78.7)	56.0 (45.3 - 69.1)
85+	128.1 (101.1 - 162.5)	113.0 (91.5 - 139.5)
race/ethnic group		
US-born white (ref.)	--	--
US-born Hispanic	1.00 (0.91 - 1.10)	
Foreign-born Hispanic	0.90 (0.82 - 0.99)	
US-born Mexican-American		0.93 (0.82 - 1.04)
Foreign-born Mexican-American		0.99 (0.88 - 1.10)
Smoking		
Never smoker (ref.)	--	--
Former smoker	1.34 (1.29 - 1.39)	1.35 (1.30 - 1.40)
Current (0-9 cigarettes per day)	2.01 (1.83 - 2.22)	2.03 (1.91 - 2.22)
Current (10-19)	2.35 (2.15 - 2.56)	2.36 (2.20 - 2.54)
Current (20-29)	2.60 (2.44 - 2.78)	2.64 (2.50 - 2.79)
Current (30+)	3.21 (3.00 - 3.44)	3.25 (3.06 - 3.44)
Smoking Interactions		
Former x US-born Hisp.	1.01 (0.93 - 1.10)	
Former x Foreign-born Hisp.	0.96 (0.88 - 1.04)	
Former x US-born Mex.		0.95 (0.85 - 1.04)
Former x Foreign-born Mex.		0.85 (0.74 - 0.96)
Constant	0.00118	0.00115
N	119,138	111,897

Notes: Estimated using hazard regression on data from NHIS smoking supplements 1990 - 2004. Hazard ratios shown. 95% confidence intervals in parentheses. Interactions reflect differences in the mortality risk of former smoking by race/ethnic group

¹ Model includes all individuals of Hispanic origin, with dummy variables for US- and foreign-born

² Includes only Mexican-Americans among Hispanics, with dummy variables for US- and foreign-born

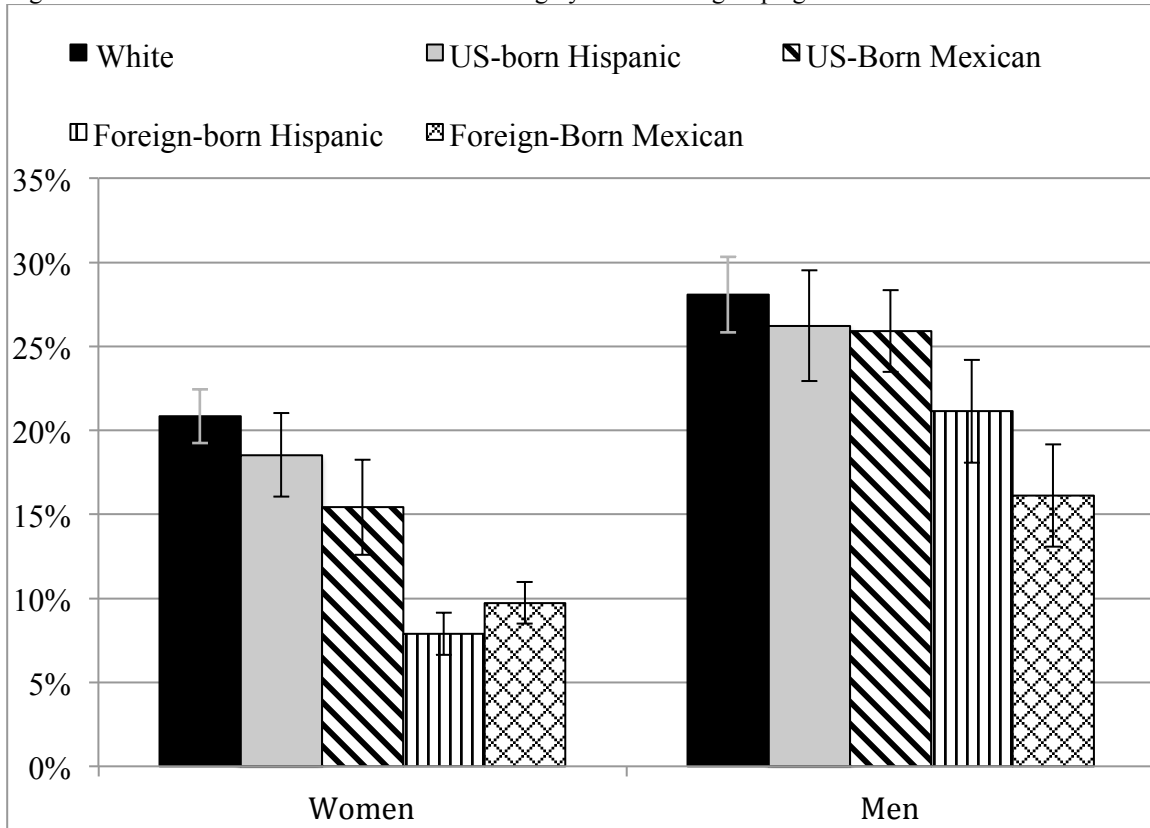
Table 4: Baseline smoking status by race/ethnic group ages 35 and above

	N	Never Smoker	Former Smoker	Current Smoker	Current Very Light Smoker	Current Light	Current Medium	Current Heavy
Women								
Non-Hispanic white	131,949	54.7%	26.5	18.8	2.6	5.2	7.6	3.3
US-born Hispanic	9,674	63.8%	20.5	15.7	6.4	4.9	3.4	1.1
US-born Mexican-American	6,196	67.6%	19.2	13.2	6.0	4.2	2.4	0.7
Foreign-born Hispanic	13,550	77.6%	13.1	9.3	5.1	2.2	1.7	0.3
Foreign-born Mexican-American	6,318	81.2%	11.1	7.7	5.6	1.2	0.8	0.1
Men								
Non-Hispanic white	101,861	37.0%	41.9	21.1	2.0	3.8	8.4	6.9
US-born Hispanic	6,910	42.1%	35.8	22.1	7.5	6.2	6.0	2.4
US-born Mexican-American	4,491	43.0%	35.8	21.2	8.3	5.8	5.2	1.9
Foreign-born Hispanic	10,367	49.1%	31.5	19.4	8.6	5.1	4.4	1.3
Foreign-born Mexican-American	5,545	48.8%	31.9	19.3	10.8	4.9	3.2	0.6

Notes: Cigarette consumption categories: very light = 0-9 cigarettes per day; light = 10-19 per day; medium = 20-29; heavy = 30+. All values are age-standardized for comparison. US-born Hispanic refers to all US-born individuals of Hispanic origin. Mexican-American refers to only those of Mexican descent. Mean daily cigarette consumption refers to the mean among smokers only, not the entire population

Source: National Health Interview Survey pooled smoking supplements 1990 - 2004.

Figure 1: Percent of deaths attributable to smoking by race/ethnic group ages 35 and above

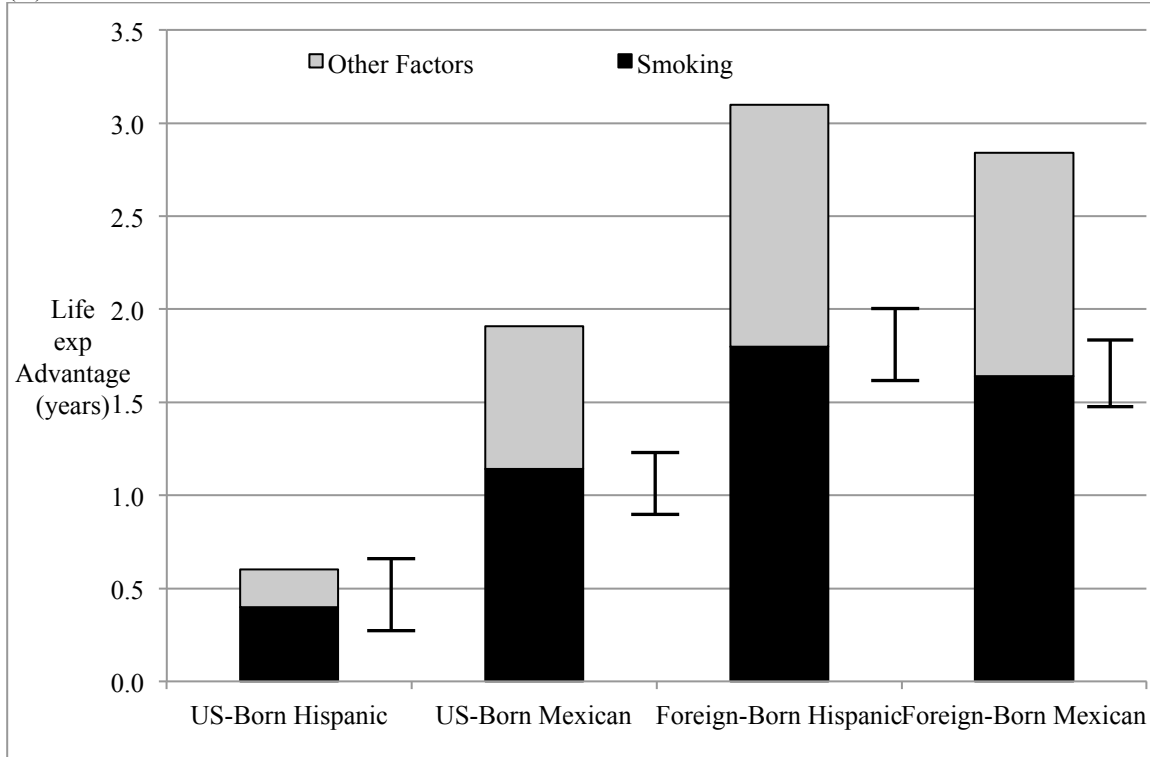


Notes: Percentage of deaths that would not occur at ages 35 and above if smokers in each group experienced no excess mortality relative to never-smokers. Estimated using hazard regression by comparing the predicted mortality for each race/ethnic using observed smoking status distribution to the predicted mortality for never smokers. Error bars indicate 95% confidence intervals of attributable-risk.

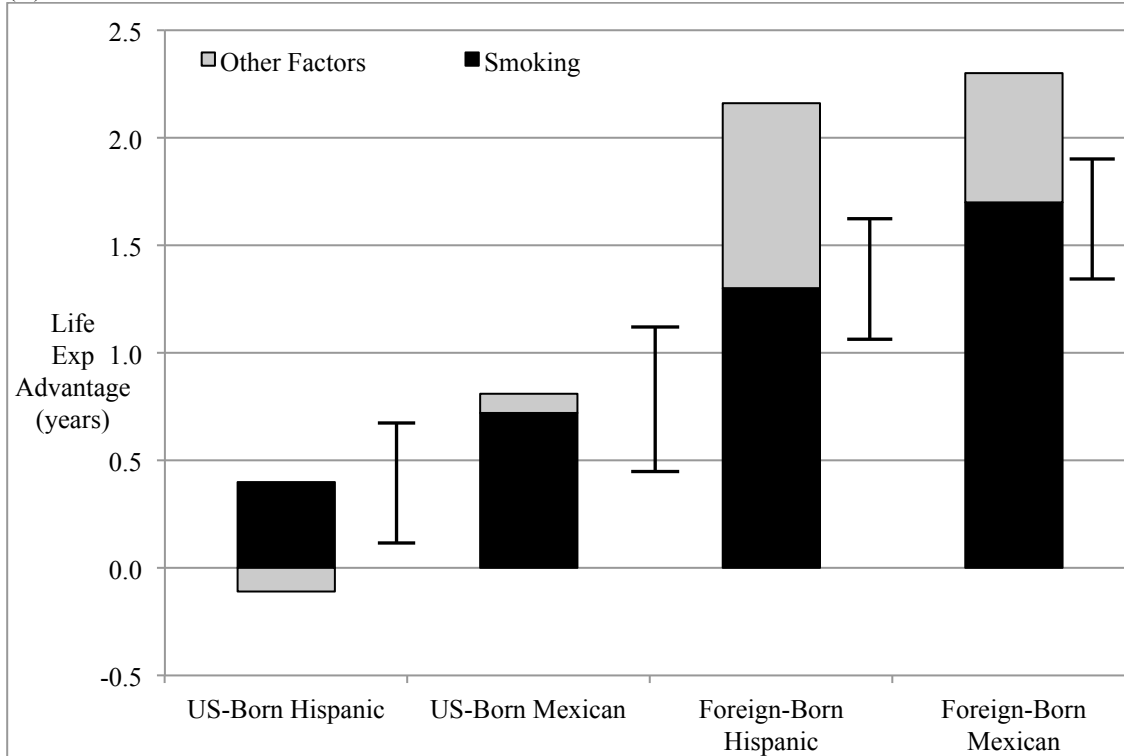
Source: Author's calculations from National Health Interview Survey pooled smoking supplements 1990 – 2004.

Figure 2: Contribution of smoking to the life expectancy advantage of each Hispanic subgroup over US-born non-Hispanic whites at age 35

(A) Women



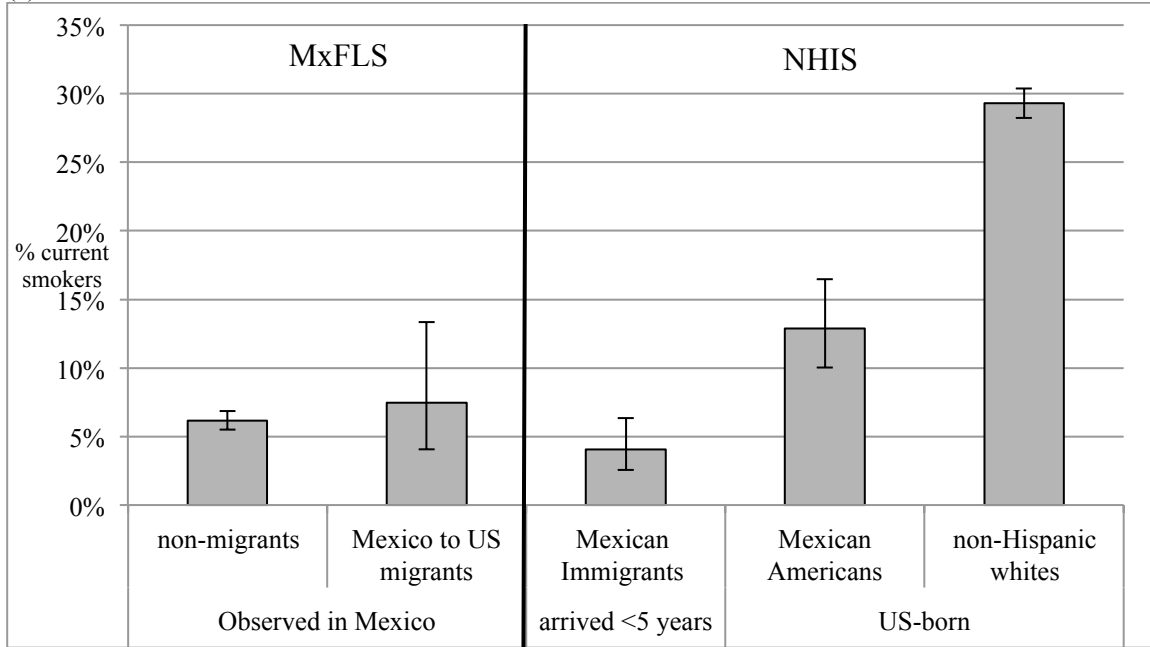
(B) Men



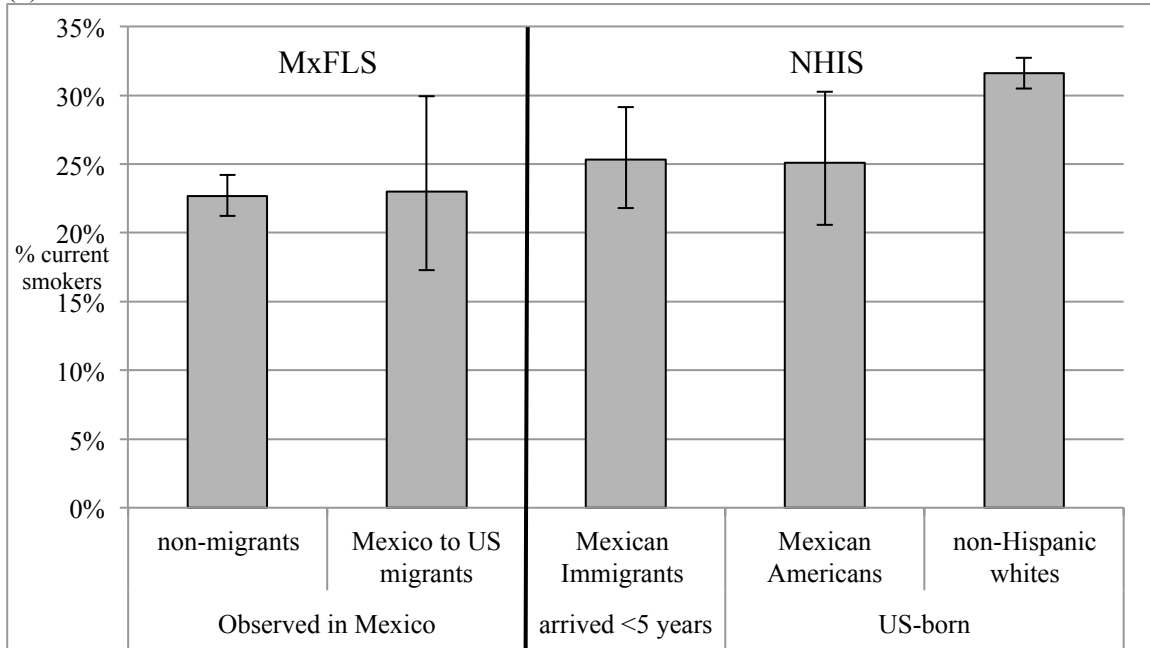
Notes: Black bar refers to the life expectancy advantage of each Hispanic nativity group over whites in the observed data. The grey bar refers to the advantage after the removal of smoking-related deaths in each group. The difference between the two bars can be interpreted as the contribution of smoking to the advantage of each Hispanic nativity group. A negative grey bar signifies higher life expectancy for whites in the absence of smoking. Error bars indicate 95% confidence intervals for the contribution of smoking. Source: Author's calculation using hazard regression and National Health Interview Survey pooled smoking supplements 1990 – 2004.

Figure 3: Current smoking prevalence by migrant status among individuals ages 18 – 39

(a) Women



(b) Men



Notes: Two groups on the left of the black line come from the Mexican Family Life Survey. Mexico to US migrants enter to the United States between 2002 and 2005, while non-migrants remain in Mexico. The three groups on the right of the black line come from the National Health Interview Survey 2002 – 2005. Mexican immigrants who arrived in the previous 5 years are on the left, US-born Mexican-Americans in the Middle and US-born non-Hispanic whites on the right. Testing selective migration involves comparing both MxFLS groups. Testing the cultural hypothesis involves comparing the three Mexican-born groups.

Source: Authors calculations using logistic regression on pooled NHIS-MxFLS sample.