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Do Mexican immigrants "import" social gradients in health to the US?

Alison Buttenheim,
University of Pennsylvania, Philadelphia, PA USA

Noreen Goldman,
Princeton University

Anne R Pebley,
University of California, Los Angeles

Rebeca Wong, and
University of Texas Medical Branch

Chang Chung
Princeton University

Abstract

Greater educational attainment is consistently associated with lower mortality and better health, a pattern known as the social gradient. However, recent research suggests that Mexican-origin adults in the US have weak or flat gradients, in contrast to steep gradients for non-Hispanic whites. In this study we evaluate one hypothesis for this finding: Is the relative weakness of education gradients in health behaviors observed among Mexican-origin adults in the US due to weak gradients in the sending population? We test this "imported gradients" hypothesis with data from two nationally-representative datasets: the US National Health Interview Survey (NHIS) and the Mexican National Health Survey (ENSA 2000). We compare education gradients in smoking and obesity for recently-arrived Mexican immigrants in the US to the corresponding gradients in high-migration regions of Mexico. Results partially support the imported gradients hypothesis and have implications for health education and promotion programs targeted to immigrant populations to reduce racial and ethnic disparities in health in the US.

Keywords

Mexico; Latino health; immigrant health; social disparities; migration; obesity; smoking; USA; education

Introduction

Better social position, as measured by education, income, and occupational status, is associated with lower mortality risks and better health at all levels of the socioeconomic ladder. This "social gradient" in health has been found in many populations and for many

Corresponding Author: abutt@wharton.upenn.edu.

health outcomes ("Healthy People 2010: Understanding and Improving Health," 2001; Pamuk, Makuc, Heck, Reuben, & Lochner, 1998). The relationship appears particularly strong in the US. A rich and growing literature has explored the sources and implications of such a gradient (Adler, Boyce, Chesney, Cohen, Folkman, Kahn et al., 1994; Goldman, 2001; Lynch, Kaplan, & Salonen, 1997; Marmot, Ryff, Bumpass, Shipley, & Marks, 1997; Williams & Collins, 1995).

Several recent studies, however, have identified a much weaker link between social status and health for US immigrant groups (Acevedo-Garcia, Pan, Jun, Osypuk, & Emmons, 2005a; Acevedo-Garcia, Soobader, & Berkman, 2005b, 2007; Chen, Martin, & Matthews, 2006; Goldman, Kimbro, Turra, & Pebley, 2006; Gordon-Larsen, Adair, & Popkin, 2003; Kimbro, Bzostek, Goldman, & Rodriguez, 2008; Sanchez-Vaznaugh, Kawachi, Subramanian, Sanchez, & Acevedo-Garcia, 2009). The Mexican-origin population appears to have particularly flat gradients. For example, Goldman et al. (2006) demonstrated that education gradients in obesity, smoking, binge drinking, low birthweight, asthma, and work limitations are relatively weak for Mexican-origin adults in the US (particularly foreign-born Mexicans) compared with those observed for non-Hispanic whites. Other studies have found weaker social gradients among Mexican-Americans for obesity (Chang & Lauderdale, 2005; Khan, Sobal, & Martorell, 1997; Martorell, Khan, Hughes, & Grummer-Strawn, 1998) and mortality (Turra & Goldman, 2007).

In this study we investigate the hypothesis that these atypically flat gradients among Mexican-Americans are due, at least in part, to the "importation" of social gradients in health behaviors by immigrants. There are two foundations for this hypothesis. First, some health behaviors require at least a minimum amount of disposable income or are associated with higher status occupations; in poor countries, then, the well-off may be more likely to adopt unhealthy behaviors. The second premise is that many health behaviors are adopted early and persist throughout adulthood (Janson, 1999; Kelder, Perry, Kleppe, & Lytle, 1994; Lantz, 2003). Thus, the imported gradients hypothesis suggests both that Mexican immigrants to the US have grown up in a setting in which unhealthy behaviors are at least as common among higher-status individuals, and that immigrants bring these behaviors with them when they migrate.

We use large, nationally-representative datasets from Mexico and the US to test the imported gradients hypothesis and to extend the work of Goldman and colleagues in several ways. First, their analysis was based on two unrealistic assumptions: (1) that the gradients are the same for men and women; and (2) that the education-health relationship is linear. Here we analyze men and women separately and use a more flexible specification for education that allows for a non-linear relationship, as has been identified in both the US (Kimbro et al., 2008) and in Mexico (Buttenheim, Wong, Goldman, & Pebley, in press). Second, we add to a small number of studies that use data from both Mexico and the United States to address health disparities in Hispanic populations (Crimmins, Soldo, Kim, & Alley, 2005; Wong, Ofstedal, Yount, & Agree, 2008). Unlike these previous studies, we focus on prime-age rather than older adults and incorporate explicit statistical tests of the equality of social gradients in Mexico and the US.

We focus our analysis on two behaviors: smoking and obesity. (We refer to obesity as a health behavior, although obesity is the result of health behaviors, including diet and physical activity, plus other factors such as genetic endowment). Smoking and obesity are strongly correlated with chronic disease and contribute significantly to the burden of disease and mortality in Mexico and the US (Mokdad, Marks, Stroup, & Gerberding, 2004; Stevens, Dias, Thomas, Rivera, Carvalho, Barquera et al., 2008). Urbanization, food and tobacco marketing, and income growth have produced rapid changes in dietary habits and tobacco

use in Mexico (Franco-Marina, 2007; Popkin, 2001, 2006). These changes have a direct impact on the US: Because people of Mexican descent are the most rapidly-growing segment of the US population (Guzman, 2001), the social patterning of health behaviors generally, and smoking and obesity specifically, will have important implications for the burden of chronic disease in the US in coming decades.

Explaining a weak SES-health behavior relationship among US immigrants

Weak social gradients in health would be socially desirable if all socioeconomic groups within a population experience good health and exhibit few unhealthy behaviors. However, if flat gradients occur at poor levels of health or for unhealthy behaviors, the situation is more problematic. For Mexican immigrants in the US, weak gradients could imply that the Mexican-origin population faces greater barriers to improvement in health or health behaviors than other ethnic groups even as socioeconomic status improves—in effect, trapping Mexican-origin individuals at poorer levels of health. From a policy perspective, then, it is important to understand the patterns of social gradients in origin countries.

Three hypotheses have been proposed to explain weak gradients for the Mexican-origin population in the US (Acevedo-Garcia et al., 2005a; Acevedo-Garcia et al., 2007; Goldman et al., 2006; Sanchez-Vaznaugh et al., 2009; Turra & Goldman, 2007): First, if Mexico-US migration is selective on good health, particularly among lower-SES Mexicans, this selection could attenuate the expected relationship between socioeconomic status and health among Mexicans in the US. This “healthy migrant” hypothesis is consistent with findings of slight positive migrant selection on education (Chiquiar & Hanson, 2005; Crimmins et al., 2005; Feliciano, 2005). However, Rubalcava et al. (2008) find only weak evidence for health-related migration from Mexico to the US.

Second, “acculturation” to the US social and economic climate (Lara, Gamboa, Kahramanian, Morales, & Bautista, 2005) or “segmented assimilation” of migrants into poorer segments of US society (Landale, Oropesa, Llanes, & Gorman, 1999) may have disproportionately negative effects on US-born Mexicans. These hypotheses suggest that either exposure to US society in general or exposure to particular segments of US society lead Mexican immigrants to adopt poorer health behaviors (over time and across generations) than non-Hispanic whites of comparable social standing.

The third hypothesis, which is the central focus of this paper, suggests that immigrants “import” weaker social gradients to the US from Mexico. A recent study of social gradients in smoking and obesity among adults in Mexico shows that education gradients are weak but in the expected direction for male smoking and female obesity, flat for male obesity, and reversed (higher SES is associated with poorer health behaviors) for female smoking (Buttenheim et al., in press). If these patterns apply to Mexican immigrants in the US, they could account for the observed relationship between education and health behaviors among the Mexican-origin population in the US.

Why would SES-health behavior differentials in Mexico be weaker than those in the US? The probable mechanisms linking education, income, and occupational status to healthier behaviors in developed countries include better health information, improved cognitive skills, access to health-promoting resources including medical care, less stressful and dangerous jobs, higher social rank, and faster diffusion of innovative (health-promoting) behaviors through social networks (Cutler & Lleras-Muney, 2008). Weak or reversed gradients in developing countries, in contrast, may result from the fact that some unhealthy behaviors require a minimum level of income and/or occupational status. The shift in social gradients from reversed or flat to the typical gradients observed in developed countries is likely to be part of the larger process of socioeconomic development and the health

transition. For example, in the case of the tobacco epidemic, regular smoking may initially be affordable only to the elite and may be a status symbol. In later stages of the transition, dissemination of information on the health consequences of smoking may encourage more educated individuals to avoid or quit smoking (Pampel, 2002). If we are observing Mexico's gradients at the middle of the nutritional and epidemiologic transitions, they may appear flat.

We evaluate the imported gradients hypothesis in three ways. First, we examine whether weak education differentials for the Mexican-origin population in the US as a whole are also observed when the sample is stratified by gender and when we use a more flexible education specification. We distinguish between recently-arrived and longer-term Mexican immigrants to facilitate our comparisons.

Second, we test for differences in social gradients in health behaviors between regions of Mexico with low and high levels of migration to and from the US. In some Mexican regions with well-established migration patterns, emigration is a common livelihood strategy, as established social networks in receiving communities reduce the costs of cross-border migration.(Fussell & Massey, 2004; Wong, Pérez, & Martiñón, 2006). With frequent seasonal and circular migration, we expect that consumption patterns, cultural influences, and other health determinants in sending communities in Mexico and in the US may influence each other. Thus, comparisons of health behavior gradients between Mexico as a whole and the Mexican-origin population in the US may mask potential similarities between Mexican migrant-sending communities and Mexicans in the US.

Third, we evaluate the central tenet of the imported gradients hypothesis: Are social gradients in health behaviors for recently-arrived Mexicans in the US similar to the patterns in high-migration regions in Mexico? If so, this evidence would provide support for the imported gradients hypothesis.

Methods

Data and measures

Data for the study are drawn from two nationally-representative surveys: the National Health Interview Survey (NHIS) in the United States and the 2000 Mexican National Health Survey (ENSA) in Mexico. The NHIS is an annual cross-sectional survey of the civilian, non-institutionalized US population, sampling approximately 35,000 households and 75,000 individuals each year (National Center for Health Statistics, 2006). We pooled six waves of the NHIS (2000–2005) to generate a sufficiently large sample of foreign-born Mexicans. We restrict the sample to 94,595 adults age 25 to 64 to minimize both the number of adults who are still in school and recall and survivor biases among older respondents. We also exclude pregnant women. The pooled sample is weighted according to the NHIS sampling scheme.

Our dependent variables are dichotomous measures of current smoking and obesity. In the NHIS, current smoking is self-reported and is defined as having ever smoked a total of 100 cigarettes and currently smoking "every day" or "some days". We exclude 640 respondents with missing data on smoking from the smoking analyses. Obesity is defined as having a BMI ≥ 30.0 kg/m^2, calculated from self-reported height and weight. The obesity analyses exclude 6,798 cases with missing or extreme outlier BMI values, the latter defined as more than twice the interquartile range below the first or above the third quartile (Larson 2006).

The focal independent variables are educational attainment and ethnicity/nativity. As in many other studies, we use educational attainment as our measure of socioeconomic status (Acevedo-Garcia et al., 2005b, 2007; Chen et al., 2006; Kimbro et al., 2008). Other work has explored the independent and interactive relationships between multiple dimensions of

SES and health behaviors and outcomes (Acevedo-Garcia et al., 2005a; Monteiro, Conde, & Popkin, 2001; Sanchez-Vaznaugh et al., 2009; Schnittker, 2004; Smith & Goldman, 2007). The challenges of relying on a single measure of SES have been discussed elsewhere (Braveman, Cubbin, Egerter, Chideya, Marchi, Metzler et al., 2005). We limit our analysis to education due to data availability and comparability between datasets. Educational attainment has the advantage of being stable after early adulthood) and, once completed, is not influenced by migration. We define educational attainment as the number of years of schooling completed (in the US or in Mexico). This variable ranges from 0 to 21. The continuous specification of education offers several analytic advantages discussed below.

Ethnicity/nativity distinguishes native-born whites from three groups of Mexican-origin adults: US-born Mexicans, foreign-born Mexicans who have been in the US for ten or more years (long-stay Mexican), and foreign-born Mexicans who have been in the US for less than ten years (short-stay Mexican). Age in years is included in all models as a control variable.

The second dataset is the 2000 Mexican National Health Survey (ENSA 2000). ENSA 2000 sampled 47,360 households in a stratified multistage sample that is representative of the Mexican population at the state level (Olaiz, Rojas, Barquera, Shamah, Aguilar, & Cravioto, 2003; Valespino, Olaiz, Lopez-Barajas, Mendoza, Palma, Velazquez et al., 2003). Within each sampled household, one adult (20 or older) was selected to answer questions about education, employment, health risk factors, health care services utilization, and other topics. Trained anthropometrists weighed and measured each respondent. We focus on 33,284 adults ages 25–64 (excluding pregnant women) and use the ENSA sample weights to adjust for nonresponse and design effects.

In ENSA 2000, current smoking is reported as a dichotomous measure, with 855 respondents missing these data. The obesity measure (BMI ≥ 30.0 kg/m^2) derives from measured height and weight. Based on the same procedure for identifying outliers, 1,961 respondents with missing or outlier BMI values are excluded from the obesity analysis.

In the ENSA analysis we classify respondents based on the level of migration in the *municipio* (comparable to a US county) of residence. *Municipio* migration level is calculated for all 2,443 Mexican *municipios* using 2000 Mexican census data and is defined as the number of residents migrating to or from the US between 1995 and 2000. The 321 *municipios* in the ENSA sample were then categorized into "high" (>80^{th} percentile) or "low" (≤80^{th} percentile) based on the percentile ranking of level of migration relative to all *municipios*.

Analytic approach

We first estimate the log odds of smoking and obesity for each of the six subpopulations of interest: four ethnicity/nativity groups in the US and two migration groups in Mexico. To ease interpretation, we use these logistic regression coefficients to generate predicted probabilities of smoking or obesity by age and educational attainment. Separate models are estimated for men and women, for a total of twelve models.

In each model we introduce age and education using regression splines. Splines are piecewise polynomial functions, with each polynomial defined between a series of two knots but constrained to have the same value and derivative where it meets the next polynomial. This flexible modeling approach retains more information from the data than the common alternative of treating age and education as categorical variables. Previous work on the measurement of social status, specifically education, has supported a continuous specification when possible (Braveman et al., 2005; Liberatos, Link, & Kelsey, 1988).

Results obtained using splines are substantively similar to results from exploratory analysis using education categories.

The predicted probabilities are used in three different comparisons. First, we graph them to show the relative strength of the education-health relationship for each subpopulation at age 40 (close to the median age in our samples). Next, we use two statistical tests for differences in gradients. The first is a Wald test of the equality of the education coefficients for each of six selected pairs of ethnicity/nativity groups (listed in Table 2), for each gender and health behavior. We use a conservative threshold p-value < .01 to account for the fact that we are performing multiple pair-wise tests. The second test compares education-health gradients at 12 years, i.e., the completion of high school in both the US and Mexican educational systems. The statistic we derive represents the rate of change in the log odds of smoking or obesity per year of schooling, evaluated at the completion of high school. These rates are plotted in Figure 2. Negative rates reflect decreases in the prevalence of smoking or obesity with additional years of schooling.

Using these tests, we first confirm the previous finding of weak gradients in health behaviors among Mexican-origin populations in the US. Next, we compare gradients in high vs. low migration *municipios* in Mexico. Finally, we focus on the imported gradients hypothesis by comparing education gradients for short-stay Mexicans in the US to gradients in high migration regions of Mexico.

Results

Smoking and overweight prevalence in the US and Mexico

Descriptive statistics for each of the six subpopulations are presented in Tables 1A (men) and 1B (women). In the US sample, smoking prevalence ranges from 21% for short-stay Mexican men to 27% among white men, and from 6% for short-stay Mexican women to 25% for white women. These figures are consistent with published estimates from the 2000–2005 NHIS (Pleis & Lethbridge-Cejku, 2006; Pleis, Schiller, & Benson, 2003). Smoking prevalence is 40% for men in high-migration regions of Mexico and 31% for men in low-migration regions; Mexican women have a similar differential for high- vs. low-migration regions (14% vs. 5%). These data also correspond to published reviews of smoking prevalence in Mexico (e.g., Valdés-Salgado, Lazcano-Ponce, & Hernández-Avila, 2005).

The patterns of obesity prevalence contrast sharply with those for smoking. In the US, obesity prevalence is highest among US-born Mexicans (37% of men and 36% of women), a pattern that has been true for at least the last decade (Flegal, Carroll, Kuczmarski, & Johnson, 1998). For men, obesity is lowest among short-stay Mexicans, and, for women, among both short-stay Mexicans and whites. These NHIS estimates are lower than comparable estimates from NHANES, in which height and weight were measured rather than self-reported. Obesity prevalence has risen at an alarming rate in the US, increasing from 11% and 16% (males and females 20 and older) in 1960 to 28% and 34% (male and female) in 2000 (Hedley, Ogden, Johnson, Carroll, Curtin, & Flegal, 2004; Ogden, Carroll, Curtin, McDowell, Tabak, & Flegal, 2006).

Mexico has witnessed even more dramatic recent increases in obesity due in part to a rapid nutritional transition to high-calorie, low-nutrient diets (Popkin & Gordon-Larsen, 2004). In our sample, 16% of men are obese in low migration regions vs. 22% in high-migration regions. The corresponding estimates for women are considerably higher at 28% and 32% respectively. While Mexico previously had a high prevalence of underweight women, overweight and obese women now outnumber underweight women by a factor of 20 or more

(Mendez, Monteiro, & Popkin, 2005). A study of 36 developing countries found Mexico to have the third-highest prevalence of female overweight and obesity (Mendez et al., 2005).

Are social gradients in health behaviors weaker for Mexican-origin adults?

Smoking—In the first graph of Figure 1, the weakness of the education-smoking relationship for short-stay and long-stay Mexican men (the two bottom lines) compared to US-born Mexican and white men is striking. While the probability of smoking declines steeply for white men as education increases, the two Mexican-born groups show no such decline. A similar pattern is evident for women in the second graph. In both cases, the smoking prevalence and educational gradients in smoking for US-born Mexicans lie between those of the Mexican-born groups and US whites. Wald tests (Table 2) reject the equality of the coefficients on the education spline terms for US whites and each of the Mexican-origin groups for both men and women. (For example, the p-value of .003 in top left cell of Table 2 indicates that we reject the hypothesis that the coefficients on the education spline terms for US-born Mexican men and US white men are equal to each other.) In contrast, for both men and women, we cannot reject the hypothesis (at $p < .01$) that US-born Mexican and short-stay Mexicans have the same gradients. The top row of Figure 2 confirms these findings of weaker gradients (represented as shorter bars) for foreign-born Mexicans compared to whites and US-born Mexicans at 12 years of education.

Obesity—Parallel analyses for obesity in the US reveal that, for men (Figure 1, Panel I, third graph), the gradients for short-stay and long-stay Mexicans vary little by years of schooling, whereas the white gradient slopes downward. The curve for US-born Mexican men stands out both for its higher obesity prevalence and for its inverted-U shape, with the highest predicted probability just before 12 years of chooling. However, the Wald tests (Table 2, third column and Figure 2) indicate that these gradients do not differ significantly.

For women, the story is quite different. The fourth graph in Figure 1, Panel I shows a declining prevalence of obesity for all groups as education increases, with the notable exception of short-stay Mexican women with 11 years or more of education—here obesity prevalence increases sharply with additional schooling. (The “hockey-stick” shape of this curve is not the result of small sample sizes, as more than 30% of the 1,310 women in this analysis have 12 or more years of education.) Table 2 confirms that the education-obesity relationship for short-stay Mexican women is distinct from those for whites and US-Born Mexicans. Figure 2 depicts the unique slope for short-stay Mexican women: a strong relationship between more schooling and higher levels of obesity at the completion of high school. Goldman et al.’s (2006) analysis apparently masked this distinct relationship for recently-arrived Mexican women. The patterns also support a general finding in the literature that male obesity is less responsive than female obesity to socioeconomic status (Chang & Lauderdale, 2005;Monteiro et al., 2001).

In summary, our results confirm the Goldman et al. (2006) finding that the education-health relationship is weaker among Mexican-origin populations in the US compared to whites, for both men and women. For obesity, it appears that men of all ethnicity/nativity groups have a weak education gradient, while recently-arrived Mexican women have a non-linear relationship that is distinct from the other groups.

Do social gradients in health behaviors in Mexico differ by extent of migration?

Our second question concerns social gradients in health in regions of Mexico with large migration streams to the US vs. those with smaller streams. A finding of distinct gradients between these two groups is not only of substantive interest, but also offers a more refined test of the imported gradients hypothesis.

The prevalence of smoking is higher in high-migration regions, though the general shape of the education-smoking associations is similar in both regions (Figure 1, Panel II). This result is confirmed by Wald tests (Table 2) and comparison of gradients at the completion of high school (Figure 2), for men. For women, the gradient for smoking in high-migration regions is nearly flat at this level of schooling, while in low-migration regions it is noticeably upward-sloping. The obesity analyses in the third and fourth graphs of Panel II reveal flat gradients in both high- and low-migration regions for both men and women, also confirmed by the Wald tests and by the graphs. We conclude that there is little evidence that gradients in either smoking or obesity differ between high- and. low-migration regions of Mexico, although the prevalence of smoking is higher in the former. .

Do migrants import gradients?

If migrants import gradients, we would expect gradients among short-stay Mexicans in the US to mirror gradients in high-migration regions of Mexico. However, even if the imported gradients hypothesis were a major explanation for flat gradients among Mexican-origin adults in the US, we would still expect some differences between the two groups in the prevalence and in the socioeconomic differentials of the behaviors due to selective migration and to acculturation, particularly given our 10-year cutoff for “short-stay” Mexicans in the US.

We find some support for the imported gradients hypothesis for male smoking: the gradient for short-stay Mexicans cannot be distinguished from the gradient in high-migration regions in Mexico (Table 2, p=.289). The similarity of the gradients among the Mexican-born populations in both NHIS and ENSA is also apparent from the first graph of Figure 1, Panel III and the top left graph in Figure 2. However, this finding is complicated by the stark difference in *levels* of smoking between the two groups: the predicted probability of smoking is higher at every educational level among men in high-migration regions of Mexico compared to short-stay Mexicans in the US. We discuss possible reasons for this gap below. The imported gradients hypothesis is also partially supported by women’s smoking patterns. The gradients for short-stay Mexican women and women in high-migration regions of Mexico cannot be distinguished statistically, and, at twelve years of schooling, predicted changes for all Mexican-born groups are positive (in contrast to US-born Mexicans and whites).

The patterns for male obesity provide less support for the imported gradients hypothesis, in part because men on both sides of the border show minimal association between education and obesity. All of our tests indicate that gradients are similar for recently-arrived Mexicans in the US and men in high-migration regions of Mexico. However, these gradients are also similar to those for whites and long-stay Mexican men in the US.

The results for female obesity are the most difficult to interpret. Certainly the “hockey-stick”-shaped gradient for short-stay Mexican women in the US looks very different from the pattern for women in high-migration regions of Mexico, particularly above 12 years of schooling, although the difference is not statistically significant at p<.01. Figure 2 also shows that, at 12 years of schooling, education is associated with higher smoking prevalence for short-stay Mexican women compared to women in Mexico. This finding suggests that recently-arrived highly educated Mexican women in the US do not resemble women of similar educational attainment in Mexico. This observation could result either from selective migration among the most educated Mexican women, or from changes in diet and physical activity after arrival in the US.

Discussion

We have investigated the hypothesis that Mexican immigrants bring social patterns of health behavior with them to the US and that this "importation" of gradients accounts for the relatively weak education differentials in health among US Mexican-origin populations. We find partial support for this hypothesis in the case of smoking for both men and women. Results are less clear for obesity, partly because SES-obesity relationships are generally weaker for men than for women and partly because the education-obesity curve for recently-immigrated Mexican women in the US has a unique shape. The findings suggest that other factors, such as selective migration, acculturation, and segmented assimilation, may also contribute to weak gradients in health behaviors.

As argued above, weak social gradients in health and health behaviors are not a concern if a population has excellent health. However, the existence of weak gradients in a population with poorer health or health behaviors implies that even with increases in social status, the population's health or health behavior will fail to improve. For example, long-stay Mexican men have both a flat education gradient for obesity and high prevalence. This is a significant concern for policy makers and health practitioners because, if cross-sectional rates persist over time, the Mexican-origin population in the US may continue to experience a high prevalence of obesity even as the educational attainment of this group improves. In the case of men's smoking, on the other hand, the low smoking prevalence among immigrants makes weak gradients less of a concern. However, smoking rates are higher for US-born Mexicans than Mexican migrants, suggesting that policy makers and practitioners need to understand what happens to second and subsequent generations.

More generally, our work highlights the salience of nativity and duration of residence in the receiving country for understanding racial/ethnic differences in health. Much of the research on social disparities in health has categorized populations into broad racial and ethnic groups but has ignored ethnic subgroups, generational effects, and migration-related social capital (McLafferty & Chakrabarti, 2009). Recent studies that do pay careful attention to these moderators have yielded complex and nuanced findings. For example, higher generational status is associated with increased obesity prevalence for some Asian and Latino ethnic subgroups (Chinese, Mexican) but with decreased prevalence for other groups (Filipino, Puerto Rican) (Bates, Acevedo-Garcia, Alegria, & Krieger, 2008). Within race/ethnic groups, foreign-born status has been shown to be significantly associated with reduced mortality risk (Singh & Siahpush, 2002). The relationship of foreign-born status to low birthweight, however, appears to vary by race/ethnicity: For black and Latino women, foreign-born status is associated with reduced prevalence of low birthweight; for Asian women, the opposite is true (Acevedo-Garcia et al., 2005b). In addition, this same study finds that the educational gradient in prevalence of low-birthweight varies within race/ethnic group by nativity, results that are consistent with our own findings of significantly different education gradients in obesity for US-born vs. foreign-born Mexican women.

Results here and in other studies suggesting that social gradients vary across different subpopulations raise important issues for the design and targeting of health promotion programs and health-related policies. As has been well-documented, tobacco companies employ ethnic-based targeted marketing efforts built on their keen understanding of different patterns of tobacco use and tobacco-related attitudes among immigrant populations (Acevedo-Garcia, Barbeau, Bishop, Pan, & Emmons, 2004). To counter these efforts, smoking prevention and cessation programs targeted at immigrant populations should be designed with equally detailed information. For example, Mexican-origin adults may not respond to tobacco control policies, such as taxes and smoke-free workplace regulations, in the same way that white or black populations do, given the different regulatory environment

and attitudes towards smoking in Mexico (Martinez-Donate, Hovell, Hofstetter, Gonzalez-Perez, Adams, & Kotay, 2007; Martinez-Donate, Melbourne, Hofstetter, Gonzalez-Perez, Kotay, & Adams, 2008) as well as the different social patterns in health behavior shown here.

Paying close attention to differences in the patterning of health behaviors across borders and across ethnic subgroups seems particularly important in addressing our finding of a much higher smoking prevalence for Mexican men in high-migration regions than for short-stay Mexican men in the US. We suggest three potential reasons for this gap. First, it may be due to differences in the definition of current smoking in NHIS vs. ENSA—ENSA has a broader definition that does not require having ever smoked 100 cigarettes, and does not specify smoking “every day” or “some days.” A second reason may be selective migration, with smokers less likely than non-smokers to move from Mexico to the US. Although previous work has found little selection on general health measures for Mexican migrants (Rubalcava et al., 2008), selection has not been evaluated for smoking or other health behaviors *per se*.

A third potential source is that, after moving to the US, Mexican men may be less likely to smoke regardless of level of schooling, perhaps because of more restrictive anti-smoking regulations in the US (e.g., smoke-free workplaces), the need to present an ID to purchase cigarettes if the buyer looks young, or the difficulty of purchasing individual cigarettes (a common practice in Mexico). A study of smoking behavior among Mexican-origin adults in San Diego, California compared to Tijuana and Guadalajara, Mexico found that the tobacco control environment in the US leads to lower smoking rates for Mexican-origin adults in the US relative to Mexicans in Mexico (Martinez-Donate et al., 2008). Migrant smokers of all education levels may also respond to higher relative prices of cigarettes in the US by smoking less. For example, when expressed in purchasing power parity units pegged to the price of a Big Mac, cigarettes are more than twice as expensive in the US relative to Mexico (Guindon, Tobin, & Yach, 2002). Smokers in high-migration areas of Mexico, meanwhile, may enjoy relatively high incomes due to remittances from the US. The gap in smoking prevalence between these two groups warrants additional research.

Our study has several limitations. First, while height and weight were measured in ENSA, they were self-reported in NHIS. Obesity prevalence may therefore be underestimated in the NHIS data. Second, a three- or five-year cutoff rather than the 10-year cutoff used to identify short-stay Mexicans would have provided a better definition of recent arrivals, but sample sizes associated with this shorter period were too small. Third, we use cross-sectional rather than longitudinal data. Ideally, we would like to observe pre-migration health behavior of the Mexican immigrants in the US and follow the behavior of the ENSA respondents as some of them migrate to the US. Our use of a community-level measure of migration in Mexico is an admittedly rough proxy for these dynamic processes.

Lastly, our use of education as the marker of socioeconomic status in a cross-national comparison highlights challenges in studying the social patterning of health behavior. Gradients vary depending on the measure of SES used, as discussed above. For example, smoking is associated positively with household income but negatively with education for men in Mexico (Buttenheim et al., in press); a similar pattern has been observed for obesity among Brazilian women (Monteiro et al., 2001). Thus, our results for educational attainment are only one piece of a larger picture.

A related challenge is comparing educational attainment among the US non-immigrants, US immigrants, and Mexicans. Differences in economic returns to education between the US and Mexico, and particularly for Mexican immigrants in the US (Jackson, Pebley, & Goldman, 2008), complicate our interpretation of education gradients in health behaviors.

Mexican immigrants with high levels of Mexican schooling may end up in the same type of low-status, low-earnings jobs in the US as those held by less-educated Mexican immigrants. If labor conditions or work-related status are detrimental to health, then even highly-educated Mexican immigrants may exhibit poor health, thus flattening education gradients.

Our results, which provide at least partial support for the imported gradients hypothesis, suggest that the social patterns of health for Mexican-Americans will continue to reflect the complex SES-health relationship in Mexico. As Mexico experiences epidemiological and socioeconomic change, patterns in the US will likely change as well. At the same time, selective migration from Mexico and integration processes once migrants reach the US will continue to shape the SES-health behavior relationship for Mexican Americans. Successful behavioral and structural interventions to improve health and reduce chronic disease burden in the US must account for this complex web of social determinants of health and be sensitive to the health patterns that accompany migrants across borders.

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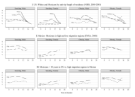

Figure 1.
Predicted probability of poor health behaviors by education and ethnicity/nativity
Source: Authors calculations based on National Health Interview Survey (US) and ENSA (Mexican National Health Survey).

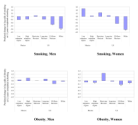

Figure 2.

Predicted change in the log odds of smoking/obesity around completion of high school, Mexican and US adults ages 25–64, 2000–2005.

Source: Authors calculations based on National Health Interview Survey (US) and ENSA (Mexican National Health Survey).

Bars show the predicted change in the log odds of smoking/obesity associated with a year of schooling at completion of high school (12 years).

Asterisks show results from pairwise Wald tests of the equivalence of the change in the log odds of smoking/obesity for short-stay Mexican vs. all other groups. ** Significantly different from short-stay Mexican at $p < .001$. * Significantly different from short-stay Mexican at $p < .01$.

Table 1

Descriptive statistics, US and Mexican adults ages 25–64, 2000–2005.

1A. Men

	US (NHIS 2000–2005)				Mexico (ENSA 2000)	
	US-Born NHW	**US-Born Mexican- origin**	**Mexican- born, ≥10 years in US**	**Mexican- born, <10 years in US**	**Residents of high-migration regions**	**Residents of low-migration regions**
Age in years (mean) [Standard error]	43.9 [.071]	39.9 [.244]	40.5 [.235]	33.2 [.316]	39.1 [.195]	39.5 [.249]
Completed schooling in years (mean) [Standard error]	13.8 [.026]	12.4 [.068]	8.8 [.101]	8.5 [.143]	8.6 [.100]	6.25 [.128]
Current smoker (%)	27	26	22	21	40	31
Unweighted N	36,690	2,566	2,806	1,267	6,214	3,568
Obese (BMI ≥30) (%)	25	37	24	15	22	16
Unweighted N	35,857	2,470	2,702	1,156	6,026	3,477

1B. Women

	US (NHIS 2000–2005)				Mexico (ENSA 2000)	
	US-Born NHW	**US-Born Mexican- origin**	**Mexican- born, ≥10 years in US**	**Mexican- born, < 10 years in US**	**Residents of high-migration regions**	**Residents of low-migration regions**
Age in years (mean) [Standard error]	44.1 [.064]	40.5 [.232]	41.3 [.206]	34.0 [.279]	39.1 [.137]	39.2 [.196]
Completed schooling in years (mean) [Standard error]	13.8 [.024]	12.5 [.063]	8.8 [.094]	8.5 [.145]	7.5 [.081]	5.1 [.112]
Current smoker, %	25	16	7	6	14	5
Unweighted N	42,721	3,529	3,056	1,320	14,426	8,221
Obese (BMI≥30 kg/m^2), %	21	36	30	21	32	28
Unweighted N	38,618	3,119	2,793	1,082	13,837	7,983

Table 2

Results (p-values) from Wald tests of the equality of coefficients on education spline terms from models predicting the log odds of smoking/obesity, Mexican and US adults ages 25–64, 2000–2005.

	Smoking		Obesity	
	Men	**Women**	**Men**	**Women**
I. Do gradients differ by ethnicity/nativity in the US?				
A. White vs. US-Born Mexican	.003	<.001	.051	.183
B. White vs. Long-stay Mexican	<.001	<.001	.233	.029
C. White vs. Short-stay Mexican	<.001	<.001	.171	<.001
D. US-Born Mexican vs. Short-Stay Mexican	.018	.084	.637	.001
II. Do gradients differ by level of migration in Mexico?				
E. High-migration regions vs. Low-migration regions	.475	.119	.779	.093
III. Is the imported gradients hypothesis supported?				
F. Short-stay Mexican (US) vs. High-migration regions (Mexico)	.289	.025	.740	.031

Source: Authors calculations based on National Health Interview Survey (US) and ENSA (Mexican National Health Survey).