

Immigrant Legal Status and Health: Legal Status Disparities in Chronic Conditions and Musculoskeletal Pain Among Mexican-Born Farm Workers in the United States

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RUNNING HEAD: Immigrant Legal Status and Health

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Abstract Immigrant legal status determines access to the rights and privileges of U.S. society. Legal status may be conceived of as a fundamental cause of health, producing a health disparity whereby unauthorized immigrants are disadvantaged relative to authorized immigrants, a perspective that is supported by research on legal status disparities in self-rated health and mental health. We conducted a systematic review of the literature on legal status disparities in physical health and examined whether a legal status disparity exists in chronic conditions and musculoskeletal pain among 17,462 Mexican-born immigrants employed as farm workers in the United States and surveyed in the National Agricultural Workers Survey between 2000 and 2015. We found that unauthorized, Mexican-born farm workers have a lower incidence of chronic conditions and lower prevalence of pain compared with authorized farm workers.

Furthermore, we found a legal status gradient in health whereby naturalized U.S. citizens report the worst health, followed by legal permanent residents and unauthorized immigrants. Although inconsistent with fundamental cause theory, our results were robust to alternative specifications and consistent with a small body of existing research on legal status disparities in physical health. Although it is well known that Mexican immigrants have better-than-expected health outcomes given their social disadvantage, we suggest that an epidemiologic paradox may also apply to within-immigrant disparities by legal status. We offer several explanations for the counterintuitive result.

Keywords Health, Immigration, Legal status, Mexico–United States, Farm workers

Introduction

There were an estimated 11 million unauthorized immigrants in the United States in 2015, representing 3.4 % of the U.S. population and 25 % of immigrants in the United States (Krogstad et al. 2017; López et al. 2018). Although unauthorized immigrants do not hold legal documents to live and work in the United States, two-thirds have lived in the United States for more than 10 years (Krogstad et al. 2017). Unauthorized immigrants lack basic rights associated with citizenship and legal immigrant status, face the threat of detention and deportation, and experience discrimination in the workplace and beyond (Waters and Pineau 2016).

The cumulative disadvantage that unauthorized immigrants face, combined with mounting evidence that unauthorized immigrants are disadvantaged in terms of access to health care, mental health, and general health status, has led scholars to argue that legal immigration status should be considered a fundamental cause of health (Asad and Clair 2016; Castañeda et al. 2015; Martinez et al. 2013; Torres and Young 2016). Fundamental cause theory argues that certain social conditions are fundamental causes of health and illness because they provide

access to power, resources, and information that individuals apply to achieve good health (Link and Phelan 1995). Yet, strikingly few studies have examined this proposition using measures of physical health, perhaps owing to the fact that few population health data sources measure immigrant legal status. We conducted a systematic review of the literature on physical health disparities by legal status among immigrants in the United States and uncovered only 12 such studies. Surprisingly, this research suggests that there is no consistent disparity in physical health among immigrants by legal status, raising the question of why that would be the case given good theoretical reason to expect one.

One reason may simply be the methodological limitations of prior studies. Many studies used small and/or nonrandom samples that may not represent the broader population, and studies using administrative or representative survey data relied on indirect measurement of immigrant legal status. Furthermore, most of the existing research has not investigated whether immigrant legal status disparities are mediated by time in the United States, an important confounder in the relationship between legal status and health. We use data from the National Agricultural Workers Survey (NAWS), a national survey of Mexican-born immigrants employed as farm workers in the United States (U.S. Department of Labor 2017). The NAWS includes questions regarding immigrant legal status and time in the United States. We thereby address several limitations of prior research in our analysis. However, new concerns are introduced because we analyze a unique population of immigrants—namely, farm workers—and because the data collection procedures and measurement of health in the NAWS introduce questions about internal validity. We take measures to address these issues empirically. In addition, we interpret our results in light of our systematic review of the literature on legal status disparities in physical health, giving us somewhat greater confidence in the observed empirical pattern of physical health

disparities among immigrants by legal status.

Background

Immigrant Legal Status as a Fundamental Cause of Health

Unauthorized immigrants in the United States are subject to multiple forms of disadvantage by virtue of their legal status. Most basically, unauthorized immigrants do not have access to the same legal rights and protections as citizens or visa holders, including the right to work, travel back and forth across the border, and receive most publicly funded social services. Unlike citizens, but similar to visa holders, unauthorized immigrants may be detained and deported as a result of certain criminal convictions. Unlike visa holders, however, they may also be detained and deported as a result of their unauthorized status—a situation that makes interactions with law enforcement agents fraught, particularly after several federal programs were created in the 2000s to facilitate collaboration between local law enforcement and federal immigration agents (Hagan et al. 2011). Unauthorized immigrants are also subject to discrimination and stigmatization (Gonzales and Chavez 2012). The consequences of this legal precariousness and social exclusion for unauthorized immigrants have been documented in the form of lower wages, harsher work conditions, more poverty, lower educational attainment, reduced access to health care, greater stress and mental health problems, behavioral problems among children, forced family separations, and more (Bean et al. 2011; Berk and Schur 2001; Dreby 2015; Gonzales et al. 2013; Hall and Greenman 2015; Hall et al. 2010).

The implications of these disadvantages for health appear straightforward when considered in light of *fundamental cause theory*, the leading theory explaining persistent social inequalities in health (Link and Phelan 1995). This theory argues that certain social conditions are fundamental causes of health and illness because they structure access to transferable social

resources—such as money, power, knowledge, and freedom—which empower people to prevent and treat illness and disease through a variety of mechanisms. Because these social resources are transferable, the fundamental cause relationship persists across contexts and disease environments. Socioeconomic status is the social condition most clearly supported in the fundamental cause literature, but racism has also been identified as a fundamental cause of health (Phelan and Link 2015). Like racism and socioeconomic status, immigrant legal status also structures access to transferable social resources by law but also through exclusion, stigmatization, and discrimination. As a result, those immigrants who have authorized legal status have greater ability than those who are unauthorized to take action to improve their health and prevent and treat disease. The implication of the fundamental cause approach for the expected relationship between immigrant legal status and health is that legal status disparities in health should reflect the disadvantages of precarious legal status, with worse health among the unauthorized and better health among immigrants with more secure and integrated legal status.

Several recent articles argued that immigrant status should be conceived of as a fundamental cause of health, similar to socioeconomic status or racism (Asad and Clair 2016; Castañeda et al. 2015; Martinez et al. 2013; Torres and Young 2016). These articles reviewed a large research literature documenting that unauthorized immigrants have worse mental health, worse self-reported health, and less access to health care than authorized immigrants. If immigrant legal status is a fundamental cause of health, we should also expect a similar immigrant legal status disparity in physical measures of health, such as in chronic conditions, birth outcomes, disability, and mortality. However, the reviews noted that few studies have examined immigrant legal status disparities in physical health.

The broader research on immigrant legal status and well-being has argued that legal

status should not be conceived as a binary variable—authorized/unauthorized—but rather as a hierarchy of varying degrees of rights, privilege, and incorporation (Bean et al. 2011; Patler 2017). This hierarchy ranges from naturalized citizens, who are the most privileged and socially integrated; downward to permanent residents; to temporary visa holders; to those in quasi-protected, discretionary, and temporary statuses (e.g., participants in the Deferred Action for Childhood Arrivals (DACA) program); and finally to unauthorized immigrants, who are the most legally vulnerable and socially excluded. If immigrant legal status affects health by restricting immigrants’ access to transferrable social resources, then we might expect not just an authorized/unauthorized disparity in health but a health disparity that spans the full immigrant legal status hierarchy.

Empirical Evidence on Legal Status Disparities in Physical Health

Given the paucity of research on legal status disparities in physical health, we attempted to identify all such existing studies through a systematic review of the literature. We searched three scholarly databases (PubMed, Sociological Abstracts via ProQuest, and Agricola) on key search terms related to migration, legal status, and health. These searches produced 792 articles on PubMed, 268 articles on Sociological Abstracts, and 61 articles on Agricola. We screened all article titles, and, when necessary, abstracts and full text, for studies that examined at least one physical health outcome, that compared unauthorized immigrants with authorized immigrants, and that were set in the United States. We identified 12 studies that met our criteria. As a check on our process, we compared our results against a recently published systematic literature review of measurement of immigrant legal status in health research; our results were consistent with the previous review (De Trinidad Young and Madrigal 2017). We provide a full description of the steps we took to conduct the search and a table reporting the key details of each study in the

online appendix, section A.

The 12 studies varied in the type of data used, the sample, the method of identifying unauthorized immigrants, and the measures of health studied. Seven studies used survey data, four used administrative data, and one used data from birth certificates. Although none of the studies used a national probability sample, several used population-based, representative samples or complete records in administrative sources from large cities or states. In studies using survey data, respondents who said they were not citizens or legal permanent residents (and in some cases, also not temporary visa holders) were identified as unauthorized. In studies of administrative data sources, unauthorized immigrants were identified in indirect ways, such as by the absence of a Social Security number on administrative forms or by the use of certain social programs designated for unauthorized immigrants. A wide variety of health outcomes were examined, including self-reports of diagnoses and symptoms, obesity, clinical measures including blood pressure and inflammation, and birth outcomes.

The 12 studies presented a total of 45 comparisons of physical health outcomes of unauthorized immigrants and authorized immigrants. On three outcomes (7 %), unauthorized immigrants fared worse than authorized immigrants. On 10 outcomes (22 %), unauthorized immigrants fared better than authorized immigrants. On the remaining 32 (71 %), unauthorized and authorized immigrants did not differ significantly. In other words, on the large majority (93 %) of comparisons, the research found either no difference in physical health by legal status or better physical health for unauthorized immigrants than for their authorized counterparts.

Explanations for the Pattern

We can identify at least three possible reasons why research has found little support for the expected pattern of physical health disparities by immigrant legal status. The first is related to the

methodological limitations of prior studies: namely, that most studies relied on small or nonrepresentative samples or used proxies for legal status, raising the question of whether a different result would be found in a large, nationally representative sample with direct measurement of legal status. In this study, we use data from the National Agricultural Workers Survey (NAWS), which is nationally representative of U.S. farm workers and directly measures legal status.

A second reason is that most studies of legal status disparities in physical health have not accounted for time spent in the United States. Unauthorized immigrants have been in the United States less time, on average, than authorized immigrants (Krogstad et al. 2017; López and Radford 2017). Longer time in the United States is associated with worse health outcomes, likely as a result of cumulative disadvantage, stress, and acculturation to unhealthy behaviors prevalent in the United States (Riosmena et al. 2014)—factors that unauthorized immigrants may experience to a greater extent (Torres and Young 2016). It is possible that the literature found few differences between authorized and unauthorized immigrants because it compared a more recently arrived, unauthorized population with an earlier-arrived, authorized population. However, two studies did not find that time spent in the United States made a difference for the physical health of unauthorized immigrants (De Trinidad Young and Pebley 2017; Iten et al. 2014). In the present study, we investigate whether time spent in the United States and other indicators of integration mediate the observed association between immigrant legal status and health.

A third reason for the absence of physical health differences between unauthorized and authorized immigrants involves *immigrant health selectivity*, which refers to how immigrants differ from nonmigrants in observable and nonobservable ways because of the costs and benefits

of migration. In terms of health, the argument is that the costs and benefits of migration select on good health as well as on other characteristics that might be associated with good health, such as self-efficacy (Palloni and Morenoff 2001; Riosmena et al. 2017). This process involves the multiple determinants of migration, including individual information, resources, networks, opportunities, and abilities, which interact with social, economic, and demographic conditions and state policies. Given this complexity, the scarce and inconsistent evidence for positive immigrant health selectivity is perhaps not surprising (Riosmena et al. 2017; Rubalcava et al. 2008). Some of the most convincing evidence of health selectivity involves negative selection among return migrants (Arenas et al. 2015). Selectivity into a particular legal status is even more complex because it involves selectivity into immigration and emigration, as well as into and out of different immigrant legal statuses.

Nevertheless, positive health selectivity into unauthorized status in the United States might account for the absence of a health disparity between authorized and unauthorized immigrants. Unauthorized immigrants may be more positively selected on health than authorized immigrants because the costs of migrating and living without legal documents are greater than the costs of migrating and living with legal documents. We take several steps to address selectivity in our analysis. First, we consider two distinct health outcomes that may capture different health mechanisms: (1) the lifetime diagnosis of chronic health conditions, which may better capture selectivity given that chronic conditions result from complex etiologies that unfold over the life course; and (2) musculoskeletal pain, an outcome that is arguably more affected by contemporary social conditions, which may more closely reflect the disadvantages faced by unauthorized immigrants. By this logic, we might expect to see the fundamental cause perspective supported in an analysis of musculoskeletal pain but not of chronic conditions.

We also take two analytical steps to address selectivity. One is the use of inverse probability of treatment weights (IPTWs), a statistical strategy through which we can account for selectivity into legal statuses on measured characteristics more precisely than regression adjustment (Williamson et al. 2014). The second involves incorporating characteristics of the migration process, specifically the region of origin in Mexico and the period of migration, under the assumptions that the costs of migration are lower with access to migrant social networks and that migrant social networks are embedded in time and place (Lindstrom and Lopez Ramirez 2010; Massey et al. 1994). We might expect that variation among farm workers in the time and place of migration will capture variation in selection processes and therefore mediate the association between legal status and health. However, given the complexity of the process of selectivity, empirical analyses with the available data cannot adequately address this issue, and we return to a discussion of selectivity in the conclusion.

Farm Workers as a Case Study

We focus on farm workers in this study because the NAWS includes direct measurement of immigrant legal status and several measures of physical health. In 2013, 87 % of farm workers in the NAWS were immigrants, and 47 % were unauthorized (U.S. Department of Labor 2017). Farm workers also experience high rates of injury and illness, so we may expect to find more variation on physical health outcomes among farm workers than we would within other occupations (Davis and Kotowski 2007; Guarnaccia et al. 1992; Mills et al. 2009).

We find no quantitative estimates of legal status disparities in health among immigrant farm workers. However, scholars have speculated that unauthorized immigrant farm workers experience more work-related health problems (Arcury et al. 2013; Snipes et al. 2017). In his ethnography, Holmes (2013) showed how indigenous, unauthorized farm workers experience

disproportionate physical hardships by virtue of their social status. Following this literature, we expect unauthorized farm workers to have worse health than their authorized counterparts.

Data and Methods

Data

The NAWS is an annual, cross-sectional survey of hired crop workers collected by the U.S. Department of Labor (DOL) from 1989 to the present.¹ The NAWS draws a national, multistage probability sample stratified by region of interview, crop cycle, farming clusters, counties, and agricultural employers.² In 2008-2009, sixty-two percent of sampled employers agreed to participate, and 92 % of sampled farm workers agreed to participate (U.S. Department of Labor 2009). Respondents are provided a small honorarium (in recent years, of \$20). Because of data sharing agreements with the agencies administering temporary visa programs for farm workers, the NAWS excludes farm workers with H-2A temporary (agriculture) work visas but includes

¹ In addition to the publicly available data, the DOL granted us use of restricted data containing detailed reports of musculoskeletal pain.

² The DOL uses a worksite survey in order to obtain a nationally representative sample of farm workers. No universal lists of U.S. farm workers exist, and telephone and address frames exclude farm workers who live in irregular housing or in housing for short periods. The NAWS uses the U.S. Bureau of Labor Statistics agricultural employer census as its sampling frame. Employers are randomly selected, and workers are randomly drawn from a sampling frame of farmworkers developed at each sampled site. Although farmworkers are selected at the worksite, interviewers do their best to interview farm workers off the work site, before or after the workday, or during lunch or a break. All interviews are completely voluntary and confidentiality is strictly maintained.

workers with other temporary visas.³ Farm workers are interviewed in person on work sites over three cycles within each year to account for the seasonal nature of farm work. Between 1,500 and 3,600 farm workers are interviewed each year.

Sample

Beginning in 2000, the NAWS incorporated two modules on health. The first, on lifetime diagnosis of six chronic and acute health conditions, was asked in each year since 2000. The second, a National Institute of Occupational Safety and Health (NIOSH) module on musculoskeletal health, was asked in a subset of years during the same period. We limit our analytic sample to data from the years in which the NIOSH modules were incorporated (2000, 2001, 2002, 2003, 2004, 2008, 2009, 2010, 2014, and 2015).⁴ We further restrict our sample to Mexican-born respondents under age 65; the samples from other national origins were too small

³ Approximately 10 % of U.S. agricultural workers are estimated to hold H-2A visas (Wilson 2013). Estimating the size of the H-2A population is complicated by the nature of data on the H-2A program. The Department of Homeland Security reports H-2A admissions, and some H-2A farm workers enter the United States more than once per year; the State Department reports H-2A job certifications, and some H-2A farm workers hold multiple jobs (Martin 2017). In the NAWS data, farm workers who hold temporary visas include refugees, asylees, and immigrants with temporary protective status, U visas, T visas, border crossing cards, and some student visas. Excluding H-2A visa holders makes our analysis of temporary visa holders nongeneralizable to all temporary visa-holding farm workers but should not bias our results for other legal status categories.

⁴ We compared our results for health conditions for all years (2000 to 2015) with the NIOSH years, and results were similar.

to analyze separately. Family income is the only variable with more than 1 % missing responses (6.5 %). Farm workers who are missing on family's income but report personal income report significantly lower personal income and are 40 % more likely to be below the federal poverty line, suggesting that missingness may be associated with lower family income. Missingness on family income is also associated with legal status but not with either health outcome. Therefore, we use listwise deletion, which is more robust to violations of missing at random than other approaches (Allison 2009).⁵ Missingness on other variables is 1 % or less, and chi-square and regression tests show that missingness on other covariates is not associated with legal status or the outcome measures. Using listwise deletion results in a final analytic sample of 17,462.

Variables

Our key independent variable is the farm worker's immigrant legal status. The NAWS survey directly asks about immigrant legal status at the end of the survey, with the assurance that the information will not be shared.⁶ The question is, "What is your current legal status in the U.S.?" The survey provides the following response options: naturalized U.S. citizen, legal permanent

⁵ Results are consistent when we use multiple imputation for all missing values.

⁶ Although we are not aware of studies that have directly assessed the validity of the NAWS questions on legal status, the NAWS data have been used as the standard-bearer for the development of other techniques for identifying the legal status of respondents in survey data, such as the "three-card method" proposed by the Government Accountability Office (GAO) (2006). A recent study assessed the validity of direct measurement of immigrant legal status in the Survey of Income and Program Participation and the Los Angeles Family and Neighborhood Survey and found that the questions did not discourage participation and appeared to be answered accurately (Bachmeier et al. 2014).

resident/green card holder, border crossing card/commuter, pending status, unauthorized, temporary resident on a nonimmigrant visa, and other. A follow-up question is asked to respondents claiming a permanent or temporary visa regarding the specific program through which they obtained the visa. The DOL then recodes the data to correct for two potential response errors: farm workers whose responses to other questions suggest that they do not qualify for the visa they report having, and farm workers who report having a temporary visa that does not provide work authorization. The first correction provides greater confidence that the population of temporary and legal visa holders is correctly identified.⁷ The second correction means that the variable we use to identify the unauthorized in fact captures those who are unauthorized to work, which means that it includes farm workers who may be legally in the United States but whose visa does not provide work authorization. Because immigrants who violate the terms of a temporary visa are subject to deportation, they may be more similar to immigrants who are unauthorized to be in the United States than to temporary visa holders who have work authorization. In the NAWS data from 1989–2006, 17,356 respondents claimed unauthorized status, and 1,299 respondents were recoded because of these two errors; thus, 7 % of the unauthorized sample in the NAWS during that period was recoded.⁸

In some analyses, we treat all authorized immigrants as one category. In others, we

⁷ Giving greater credence to the person's response on period of entry or other information over their reported legal status reflects the assumption that respondents will be more likely to misreport sensitive information.

⁸ Personal correspondence with Daniel Carroll at the DOL. More recent estimates of the recoding are not available. We were not able to identify farm workers who were recoded.

disaggregate authorized immigrants into three categories: naturalized U.S. citizens, legal permanent residents (LPRs), and temporary residents with authorization to work.

We analyze two main dependent variables: (1) lifetime, diagnosed chronic conditions and (2) musculoskeletal pain. The survey asked respondents whether they had ever been told by a doctor or nurse that they have asthma, diabetes, heart disease, high blood pressure, tuberculosis, a urinary tract infection, or “other health condition,” which is unspecified. Because of the low frequency of reports of any single condition, we analyze a binary outcome equal to 1 if the respondent reports a diagnosis of any chronic condition, including asthma, diabetes, heart disease, and/or high blood pressure. We also analyze a binary for any condition, which includes chronic conditions plus tuberculosis, urinary tract infections, and “other,” and binary variables for each condition by itself.

The survey also asked respondents whether they had pain or discomfort in their back, shoulder/neck, elbow/arm, hand/wrist/finger, legs/feet/toes, or other area in the 12 months preceding the survey. The primary pain variable we analyze is a binary outcome equal to 1 if the farm worker reported any pain in any area in the past 12 months. Among those reporting pain (3,120), the survey further asked whether the pain lasted for five or more consecutive days; if so, for how long; and among those reporting a certain duration, how severe the pain was. Among those reporting pain, we analyze duration (a week or more of pain) and severity (whether a lot or unbearable, as opposed to a little).

[place Table 1 about here]

We incorporate covariates measuring demographic, geographic, farm work, and socioeconomic characteristics that vary by immigrant legal status. Descriptive statistics are shown in Table 1. To control for time trends, we included dummy variables for each survey year.

Demographic controls include age in years (centered on age 30), marital status (married versus not), gender, and whether the respondent is indigenous (i.e., speaks Mixtec, Kanjobal, Zapotec, or another indigenous language). Region in the United States includes the Northeast, Southeast, Midwest, Southwest, Northwest, and California. Research has suggested that the risk of musculoskeletal injury and chronic conditions among farm workers may vary by geographic region because of topography (Davis and Kotowski 2007), soil (Donham and Thelin 2016), employment practices (Stoeklin-Marois et al. 2011), pesticide use (Tonozzi and Layne 2016), and the quality of health care (Arcury et al. 2013).

We control for two characteristics of farm work. First, we control whether the farm worker “follows the crop” (i.e., has at least two farm work locations greater than 75 miles apart). Second, we control for the farm worker’s primary crop at the time of the interview (field crops, fruits and nuts, horticulture, vegetables, or miscellaneous/multiple), which captures exposure to repetitive motion injuries, rashes, and other diseases (Connor et al. 2010); the extent to which individuals work in a stooped position (Davis and Kotowski 2007); and other physical demands and environmental considerations (Swanberg et al. 2012).

We control for two measures of socioeconomic status: completed education (less than high school versus some high school or higher) and family income (<\$10,000, \$10,000–\$14,999, \$15,000–\$19,999, \$20,000–\$29,999, and \geq \$30,000). Table 1 shows that unauthorized farm workers are younger, less likely to be female and married, more likely to be indigenous, more likely to live in the Northeast, more likely to follow the crop, and more likely to work in fruits and vegetables. Unauthorized farm workers have lower family incomes, but a greater percentage have completed high school—a result of their younger mean age.⁹

⁹ Among those under age 40, authorized farm workers have higher levels of education.

Because the NAWS measures of chronic conditions specify a doctor or nurse diagnosis, and unauthorized immigrants have less access to health care than authorized immigrants (Villarejo et al. 2010), we control for access to health care with the only measure of access to health care available in the data: namely, current insurance coverage, which differentiates between farm workers with no insurance, publicly funded insurance, or private insurance.¹⁰ Table 1 shows that 87 % of unauthorized farm workers in our data have no health insurance, compared with 60 % of authorized farm workers. We return to the issue of this limited control in the discussion.

We also control for several measures of integration into the United States. We differentiate between farm workers who have been in the United States 4 or fewer years, 5 to 9 years, or 10 or more years, which is estimated by the difference between the year of the survey and the year the migrant first entered the United States.¹¹ Authorized and unauthorized farm workers vary significantly on this measure: whereas 59 % of unauthorized farm workers have been in the United States for 9 or fewer years, 90 % of authorized farm workers have been in the United States for 10 or more years. English proficiency defines farm workers as proficient in English if their average of self-reported ability in speaking and reading English falls at or

¹⁰ The survey asks whether the farm worker has seen a health care provider in the past two years, but this question captures both access to and need for health care.

¹¹ This is an imprecise measure of duration in the United States because it does not account for periods of return to Mexico. However, the variable is highly correlated with a variable measuring how long the farm worker has been employed in farm work in the United States ($\rho = .87$), and we find that English language proficiency, property ownership, and insurance coverage all increase with years in the United States, as expected.

between “somewhat well” and “well” on a 4-point Likert scale. We control for property ownership in the United States using a variable equal to 1 if the farm worker reports that they own land, a house, or a mobile home. Authorized farm workers are more likely to be proficient in English and to own property in the United States than unauthorized farm workers.

In an analysis attempting to account for selection into unauthorized versus authorized migration, we analyze legal status differences in health controlling for period of migration and region of origin in Mexico, plus their interaction, among farm workers who migrated after 1989 ($n = 10,668$, 61 % of our sample). We cannot incorporate farm workers migrating prior to 1990 because earlier periods of migration are too collinear with authorization status ($r = .79$ for the whole sample vs. $r = .25$ for the period 1990–2015). Period of migration defines those who first migrated to the United States in the following periods: 1990–1995 (the post–Immigration Reform and Control Act (IRCA) period), 1996–2001 (period of large-scale unauthorized migration), 2002–2007 (period of increased enforcement), and 2008–2015 (Great Recession and after). The measure of region of origin follows Durand et al. (2001) and defines farm workers as originating from the following regions in Mexico based on the state where they lived prior to migration: historic migrant-sending region, border, center, and periphery.

Analysis

We estimate logistic regression models to assess the association between chronic conditions and musculoskeletal pain and authorized/unauthorized status as well as the four-category legal status variable, using nested models. For each outcome and legal status predictor, we present a base model that adjusts only for survey year and age as well as full models that adjust for all covariates. Finally, we limit the sample to migrants arriving in the United States after 1989 and incorporate controls for period of entry, region of origin in Mexico, and their interaction.

We use IPTWs to address selectivity on observed characteristics. IPTWs are often used to account for selection bias because they disrupt the link between covariates that affect selectivity into a “treatment” (here, legal status) and the outcome (Bean et al. 2011; Robins 1986; Rosenbaum 1984). Farm workers of different legal statuses have different distributions of observed characteristics, such as age and time in the United States (see Table 1), characteristics that are also associated with health. When the covariate structure is nonoverlapping or poorly overlapping among treatment groups, using simple covariate adjustment is likely to lead to biased results (Li et al. 2014; Thoemmes and Ong 2016). IPTWs account for these imbalances in the distribution of the confounders across treatment groups more effectively than regression adjustment by creating a pseudo-population that could have been sampled from a population in which the observed covariates do not affect probability of treatment.

To generate the IPTWs, we use the following procedure for both outcomes, modeling authorized/unauthorized with a binary logistic regression model and four-category legal status with multinomial logit. We estimate both unconditional models and models that are conditional on the covariates in our full models, including interactions. We use the sampling weights provided by the DOL to account for complex survey design, as well as robust sandwich standard errors to account for sampling variability in the estimated weights. We then calculate the predicted probability of treatment, conditional on the covariates, as well as the unconditional probability of treatment based on the unadjusted models. We stabilize the IPTWs by using the unconditional probability of treatment as the numerator so that the IPTWs are proportional to selection into the treatment (Thoemmes and Ong 2016). We use multiple methods to check for balance across legal status, including graphical comparisons and the Stata command “pbalchk,” which checks standardized differences across treatment groups (Austin and Stuart 2015). Finally,

we truncate the weights at the tails of the distributions (Xiao et al. 2013).

Several assumptions are involved in estimating IPTWs. First, every respondent must have a nonzero probability of being authorized or unauthorized conditional on the covariates, which is the case. Second, the IPTW model must be correctly specified. We compare multiple models, using several goodness-of-fit test statistics to select our final IPTW models. Finally, to make causal inferences from the estimates, the IPTW models should have no unmeasured confounding (the “ignorability assumption”). We do not assume that there is no unmeasured confounding, and we return to a discussion of selectivity on unmeasured characteristics in the Discussion section.

Results

Table 1 shows that the incidence of chronic conditions and the prevalence of musculoskeletal pain (hereafter “pain”) are lower among unauthorized farm workers than among authorized farm workers. Although 6.4 % of unauthorized farm workers reported a lifetime diagnosis of at least one chronic condition, more than twice as many (16.8 %) authorized farm workers did. Fifteen percent of unauthorized farm workers reported pain during the past year, compared with 21 % of authorized farm workers. The basic models in Table 2 (Models 1 and 3) show that these differences are not explained by age or survey year. In the full models (Models 2 and 4), unauthorized farm workers have 34 % lower odds of reporting a chronic condition and 19 % lower odds of reporting pain than authorized farm workers, controlling for all other factors. Comparison of average marginal effects (not shown) suggests that these differences across outcomes are similar. Farm workers who had been in the United States for fewer years were more likely to report pain than those who have been in the United States longer, inconsistent with the typical pattern of worse health outcomes with longer duration of stay in the United States but possibly reflecting harsher working conditions among less-experienced farm workers.

[place Table 2 & Figure 1 about here]

Figure 1 shows the probability of chronic conditions and pain for authorized and unauthorized farm workers from a model with only survey weights, controlling age and survey year, and the full model with IPTWs. The figure makes clear that the legal status disparity in chronic conditions and pain are not completely explained by the covariates.

We next analyze the four-category measure of legal status. Models 5–8 in Table 2 present odds ratios comparing unauthorized farm workers, temporary residents, and LPRs with naturalized U.S. citizens. In the full models (6 and 8), unauthorized farm workers have 41 % lower odds of reporting chronic conditions and 25 % lower odds of reporting pain than citizens, net of controls. LPRs have marginally significant lower odds of chronic conditions but are not different in terms of pain. Wald tests show that the coefficients for LPRs and unauthorized farm workers are significantly different for both outcomes. Temporary residents are not different from any group, but because of the small sample of temporary residents in the data, we have low power to detect differences for that group.

[place Figure 2 about here]

Figure 2 shows predicted probabilities of chronic conditions and pain across the four categories of legal status. The pattern suggests that LPRs take an intermediate position between naturalized citizens and unauthorized farm workers in terms of health. This means that the binary measure of legal status suppresses the difference between unauthorized status and citizenship.

[place Table 3 about here]

In Table 3, we control for the period of migration and region of origin in Mexico, as well as their interaction, among Mexican-born farm workers migrating after 1989. A similar disparity of lower odds of chronic conditions is observed among this subsample, and Models 2–4 show that controlling for the period and place of migrant origin does not account for the differences by

authorization.

[place Figure 3 about here]

We analyze a number of alternative specifications of the dependent variable to ensure that our results are not sensitive to these choices. The results are summarized in Fig. 3; full results are reported in the online appendix, section B. Figure 3 shows that similar results—of lower odds of the health outcome for unauthorized immigrants or of nonsignificant differences by legal status—are observed for this set of outcomes.

Discussion

Using data from a national sample of Mexican-born immigrants employed as farm workers in the United States between 2000 and 2015, we found that unauthorized farm workers are less likely to report chronic conditions and pain than authorized farm workers. Furthermore, we found evidence suggestive of a legal status hierarchy whereby naturalized citizens report higher rates of chronic conditions than LPRs, who in turn report higher rates of chronic conditions than unauthorized immigrants. These findings are inconsistent with the view that immigrant legal status is a fundamental cause of health, which argues that the freedom, rights, knowledge, and resources denied to unauthorized immigrants undermine their health relative to the health of authorized immigrants. Although research has shown that unauthorized immigrants are disadvantaged in terms of mental health, self-rated health, and access to health care (Martinez et al. 2013), we did not observe a similar pattern in self-reported chronic conditions and pain among Mexican-born farm workers—nor did 12 existing studies of legal status disparities in a wide variety of physical health outcomes among diverse samples of immigrants in the United States. Like our study, this small body of research found few legal status disparities in physical health outcomes and, in fact, reported more instances in which unauthorized immigrants fared

better on physical health outcomes than authorized immigrants.

We addressed two problems with the literature on immigrant legal status disparities in physical health: we used nationally representative data (of farm workers) and direct measurement of immigrant legal status. The consistency between our results and the literature suggests that nonrandom sampling and the use of proxies for legal status do not explain why previous studies have not observed a disadvantage in the physical health of unauthorized immigrants compared with authorized immigrants.

Although unauthorized immigrants have been in the United States for less time and are, on average, less integrated than authorized immigrants, we found that controlling for time in the United States, English language ability, and property ownership does not explain the result, nor does incorporating IPTWs to account for selection into unauthorized status on observed characteristics. We suspect that there are unobserved differences between those who migrate in unauthorized status, remain in unauthorized status once in the United States, and become unauthorized after entering in the United States, versus those who migrate in or adjust to authorized status; and that these differences relate to the physical health of authorized and unauthorized immigrants. We did not find evidence that the legal status disparity varied significantly by health outcome, which might have suggested unique processes leading to disparities in conditions that unfold over the life course (leading to chronic conditions) versus those that reflect contemporary differences in work and living conditions (affecting recent experiences of musculoskeletal pain).

Specifically, unauthorized immigrants may be more positively selected on health than authorized immigrants because of the greater costs and hardship of unauthorized migration and living in unauthorized status. In addition to using IPTWs, we attempted to test the role of health

selectivity empirically by controlling for region of origin in Mexico and period of entry among Mexican farm workers who entered the United States after 1989, under the assumption that the costs of migrating vary systematically by time and place of migration as a result of the spatial and temporal embeddedness of migrant networks. We did not find support for the selectivity hypothesis. Our test, however, was limited for a variety of reasons, including that access to networks varies within a particular period and place of migration, costs of unauthorized migration vary among migrants within a network, and selectivity occurs for reasons other than costs. Ideally, tests of migrant selectivity should compare the health and other characteristics of migrants with nonmigrants at the time of migration (see, e.g., Rubalcava et al. 2008). However, in this case, selectivity occurs not just at the time of migration but also across the migrant trajectory: some immigrants enter with visas and become unauthorized after the visa's expiration (visa overstayers), and some unauthorized immigrants adjust status. Selectivity on return migration is also an issue, particularly in the current era in which authorized immigrants have greater facility to migrate circularly than unauthorized immigrants (Massey et al. 2015). To our knowledge, no data set contains detailed migrant trajectory information and adult physical health measures. It would be a major contribution to our understanding of immigrant health disparities to collect data that capture migration and health trajectories.

It is well known that immigrant health deteriorates over time in the United States, which is theorized to reflect the cumulative disadvantage and stress of immigrant life in the United States and/or acculturation to unhealthy U.S. health behaviors and norms (Riosmena et al. 2014). Immigrant legal status may be a proxy for a variety of mechanisms that link immigrants to U.S. society, including cultural assimilation, economic mobility, social networks and family ties, identity and feeling of belonging, and permanence or settlement. Although we controlled for

various measures of integration, we were unable to control for mechanisms through which this process may unfold, such as stress and health behaviors. Insofar as immigrant health deteriorates with integration to U.S. society but improves with secure legal status, the findings that authorized and unauthorized immigrants have similar health outcomes may reflect the balance of these divergent effects.

At least three concerns specific to the NAWS data are worth mentioning. One involves the NAWS measurement of chronic conditions, which relies on lifetime diagnosis. Given that unauthorized immigrants have less access to health care than authorized immigrants, the former may be no less likely to have a health condition but less likely to have had it diagnosed. In our data, unauthorized farm workers are indeed less likely to have health insurance coverage than their authorized counterparts. Controlling for this difference, we still found lower reports of chronic conditions among unauthorized farm workers, but current health insurance coverage is an admittedly poor proxy for differences in access to care across the life course. Reports of pain, however, should not be affected by this source of bias because farm workers with different access to health care should be equally able to report pain. In other words, access to care cannot be the whole story given that we found a similar pattern across two measures of health that differed in their sensitivity to access to health care.

A different data issue involves the willingness of unauthorized and authorized farm workers to report health problems. The NAWS is collected on the worksite. If unauthorized immigrants have greater fear of retaliation by their field supervisors, they may be less likely to report a health problem that could mark them as less able or suggest they are complaining (Flynn et al. 2015; Lee et al. 2014; Leigh et al. 2001; Liebman et al. 2016). Greater underreporting of health problems by unauthorized farm workers in the NAWS could explain our results.

A third issue regards who remains in farm work. Authorized immigrants have greater ability to search for jobs outside of agriculture than unauthorized immigrants. Negative selection on remaining in farm work may be greater among authorized immigrants; they may have lower human capital, fewer skills, or more limited networks than authorized immigrants who leave farm work. One study of selectivity out of farm work following the IRCA Special Agricultural Workers legalization found no differences in the pattern of who exits farm work by legal status (Tran and Perloff 2002), but this may have changed in the post-IRCA period we studied.

We suspect that some combination of these issues affected our results. On the one hand, two issues of internal validity—underdiagnosis and underreporting—may have biased our estimates in the direction of finding that unauthorized farm workers report better health. There may also have been negative selection on authorized farm workers who remain in farm work. Measurement problems and selectivity on remaining in farm work may produce an unauthorized health advantage in data on Mexican farm workers that would not be observed in other groups of immigrants.

On the other hand, the consistency between our study of Mexican-born farm workers and 12 studies of different populations of immigrants—using different data sources, techniques for identifying unauthorized immigrants, and measures of health—suggests that the characteristics of the NAWS data do not fully explain our results. Rather, positive selectivity into unauthorized immigrant status and differential changes to health as immigrants integrate into U.S. society may explain why we observed few differences in the health of unauthorized and authorized immigrants in the United States. We expect that studies that can adequately account for selectivity and control for integration to U.S. society would find the relationship predicted by fundamental cause theory as applied to immigrant legal status: depleted health among the legally

vulnerable.

It is also possible that the harmful impacts of unauthorized status unfold over the longer term, perhaps even across generations, as suggested by Torres and Young (2016), who argued that a life course perspective on this issue is essential. Perhaps the impacts of legal status will be most clearly observed among the 1.5 generation—children who grew up unauthorized—and the second generation—U.S.-citizen children of unauthorized parents.

Although we have known for more than three decades that immigrants as a whole—and Mexican immigrants in particular—have better-than-expected health outcomes given their social disadvantage (Markides and Coreil 1986; Riosmena et al. 2014), we suggest that an epidemiologic paradox may also apply to within-immigrant disparities by legal status. Despite their greater social disadvantage, unauthorized immigrants may not have worse physical health than their authorized counterparts. More and better data on the physical health and mortality of immigrants, combined with life course data on immigration and legal status trajectories, is needed to confirm the pattern we observed here and to understand its origins.

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Table 1 Characteristics of Mexican-born farm workers in the United States, by immigrant legal status

	Unauthorized	Authorized	Total
Chronic Condition (%)***	6.4	16.8	10.1
Musculoskeletal Pain (%)***	15.1	21.2	17.3
Age (mean in years)***	31.8	42.2	35.6
Female (%)***	21.4	27.0	23.4
Indigenous (%)***	12.4	6.6	10.4
Married (%)***	60.3	80.6	67.5
Interview Region (%)***			
Northeast	11.5	6.7	9.8
Southeast	9.7	5.9	8.3
Midwest	10.9	9.7	10.5
Southwest	4.8	12.1	7.4
Northwest	16.1	15	15.7
California	47	50.6	48.3
Follows the Crop (%)***	11.7	6.6	9.8
Crop (%)***			
Field crops	7.8	11.9	9.3
Fruits and nuts	46.6	44.7	45.9
Horticulture	13.7	13.2	13.5
Vegetables	29.4	26.5	28.4
Miscellaneous/multiple	2.5	3.7	2.9
Some High School or More (%)***	32.7	28.8	31.3
Family Income (%)***			
<\$10K	35.6	9.8	26.4
\$10K–14,999	17.7	16.2	17.2
\$15K–19,999	14.6	17.2	15.5
\$20K–29,999	17.7	23.0	19.5
\$30,000+	8.8	28.7	15.8
Type of Insurance (%)***			
None	84.6	59.6	75.7
Private	10.7	26.5	16.4
Public	4.7	13.9	8
Years in United States (%)***			
0–4	34.4	1.8	22.8
5–9	24.8	5.4	17.9
10+	40.7	92.8	59.3
Proficient With English (%)***	5.6	18.5	10.2
Owns U.S. Property (%)***	6.1	39.5	17.7
Number of Observations	10,851	6,611	17,462

*** $p < .001$ for two-sided t tests of equal means or chi-square tests for equal distributions

Table 2 Odds ratios from logistic regressions of chronic conditions and musculoskeletal pain among Mexican-born farm workers, by immigrant legal status in two and four categories

	Chronic Condition		Musculoskeletal Pain		Chronic Condition		Musculoskeletal Pain	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Legal Status (ref. = Authorized/Citizen)								
Unauthorized	0.59***	0.66***	0.78**	0.81*	0.43***	0.59***	0.55***	0.75*
Temporary					0.67	0.63	0.65	1.09
Legal permanent resident					0.70*	0.82 [†]	0.69*	0.88
Age	1.06***	1.06***	1.01***	1.01***	1.06***	1.06***	1.01***	1.01***
Female		1.41**		1.57***		1.63***		1.64***
Indigenous		1.63**		2.28***		1.38**		2.17***
Married		0.92		1.12		0.93		1.09
Follows the Crop		0.67**		1.08		0.81		1.10
Education <8 Years		1.05		1.01		1.06		1.02
Family income (ref. = <\$10K)								
\$10K–14,999		1.10		1.01		1.10		0.94
\$15K–19,999		1.35 [†]		1.05		1.08		0.99
\$20K–29,999		1.31 [†]		1.33*		1.19		1.11
\$30,000+		1.67**		1.68***		1.32*		1.28*
Insurance (ref. = None)								
Private		1.08		1.06		1.14		0.98
Public		1.57**		1.31 [†]		1.64***		1.39**
Years in United States (ref. = 10+ years)								
0–4		0.82		1.33**		0.73*		1.22**
5–9		1.02		1.30**		1.00		1.16*
Proficient in English		0.95		1.03		1.07		1.10
Owens U.S. Property		0.99		0.86		1.08		0.92
Constant	0.11***	0.06***	0.28***	0.11***	0.16***	0.07***	0.40***	0.18***
Number of Observations	17,462	17,462	17,462	17,462	17,462	17,462	17,462	17,462

Note: All models adjusted for survey year; Models 2, 4, 6, and 8 additionally adjusted for region of interview and type of crop.

[†] $p < .10$; * $p < .05$; ** $p < .01$; *** $p < .001$ (two-sided tests)

Table 3. Odds ratios from logistic regressions of chronic condition and musculoskeletal pain among Mexican-born farm workers who arrived in the U.S. after 1989, controlling for region of origin and period of migration

	Chronic Condition				Musculoskeletal Pain			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Unauthorized	0.65**	0.75*	0.74*	0.75*	0.95	0.93	0.92	0.65**
Period of Entry Into United States (ref. = 1990–1995)								
1996–2001		0.68**		0.51***	1.10		0.92	
2002–2007		0.60**		0.65†	1.02		0.89	
2008–2015		0.99		0.28*	0.98		0.70	
Mexican Origin Region (ref. = historic)								
Border			1.56†	1.13		0.93	0.56*	1.56†
Center			0.98	0.84		1.36**	1.18	0.98
Periphery			0.77	0.34†		1.54*	1.66	0.77
Period Entry × Mexican Origin (ref. = 1990–1995 × historic)								
1996–2001 ×								
Border				2.64*				2.09*
Center				1.43				1.26
Periphery				3.45†				1.09
2002–2008 ×								
Border				0.43				1.71
Center				0.90				1.24
Periphery				3.42†				0.81
2009–2015 ×								
Border				0.73				6.23*
Center				7.86*				1.38
Periphery				4.75				0.55
Constant	0.08***	0.05***	0.03***	0.05***	0.22***	0.17***	0.15***	0.16***
Number of Observations	10,668	10,668	10,668	10,668	10,668	10,668	10,668	10,668

Note: All models adjusted for age and survey year; Models 2–4 and 6–8 additionally adjusted for gender, indigenous, married, interview region, follows crop, crop type, education, family income, type of insurance, English proficiency, and owns U.S. property.

† $p < .10$; * $p < .05$; ** $p < .01$; *** $p < .001$ (two-sided tests)

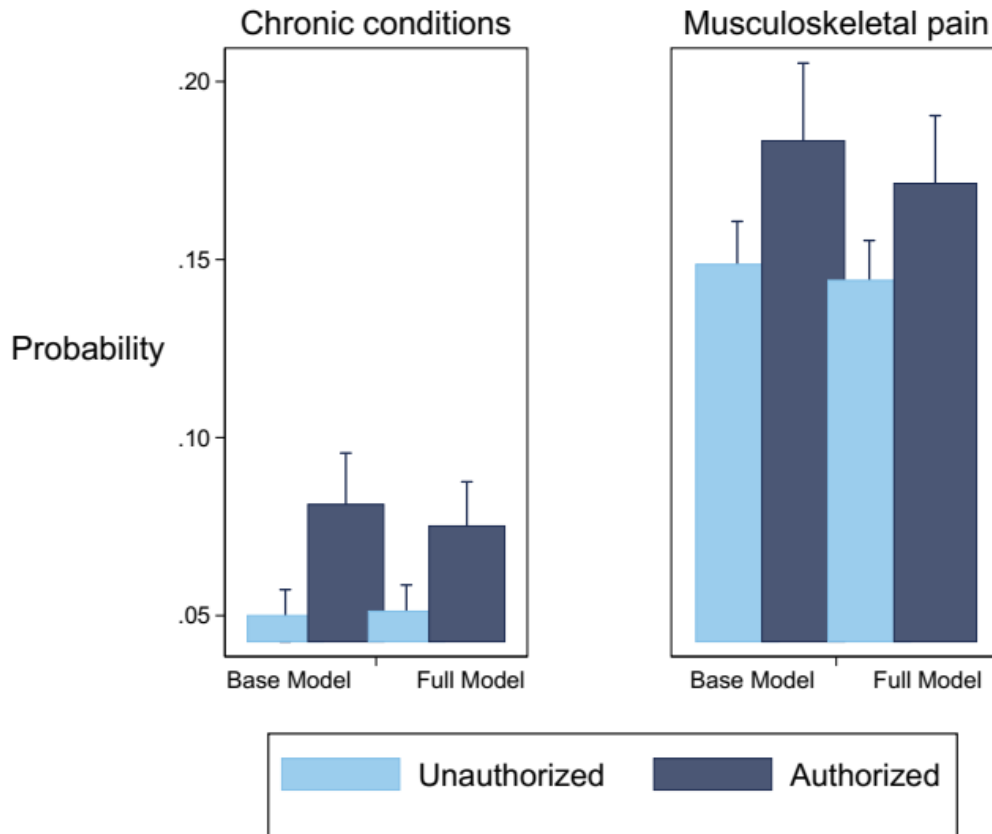


Fig. 1 The probability of chronic conditions and musculoskeletal pain for authorized and unauthorized Mexican-born farm workers in the U.S. across two models. The base models refer to Model 1 (chronic) and Model 5 (pain), and the full models refer to Model 4 (chronic) and Model 8 (pain) from Table 2. All covariates are held at their means.

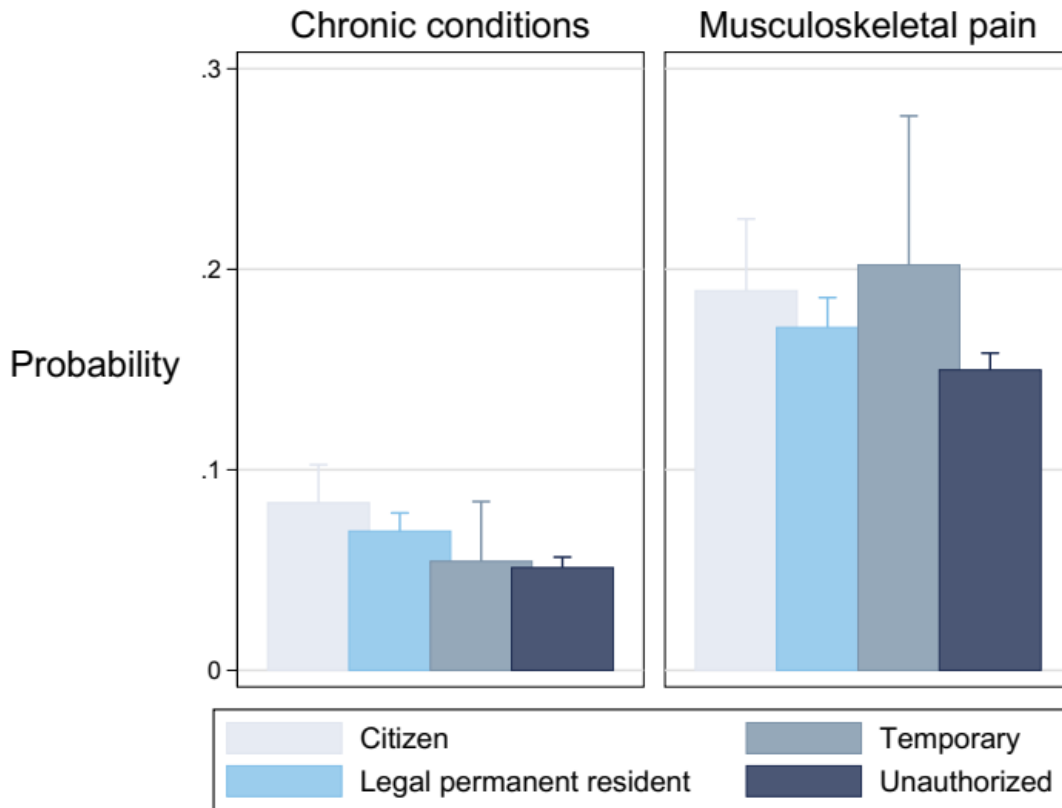


Fig. 2 The probability of chronic conditions and musculoskeletal pain for Mexican-born farm workers in the U.S. by categories of legal status. Probabilities are estimated from Models 6 (chronic) and 8 (pain) in Table 2. All covariates are held at their means.

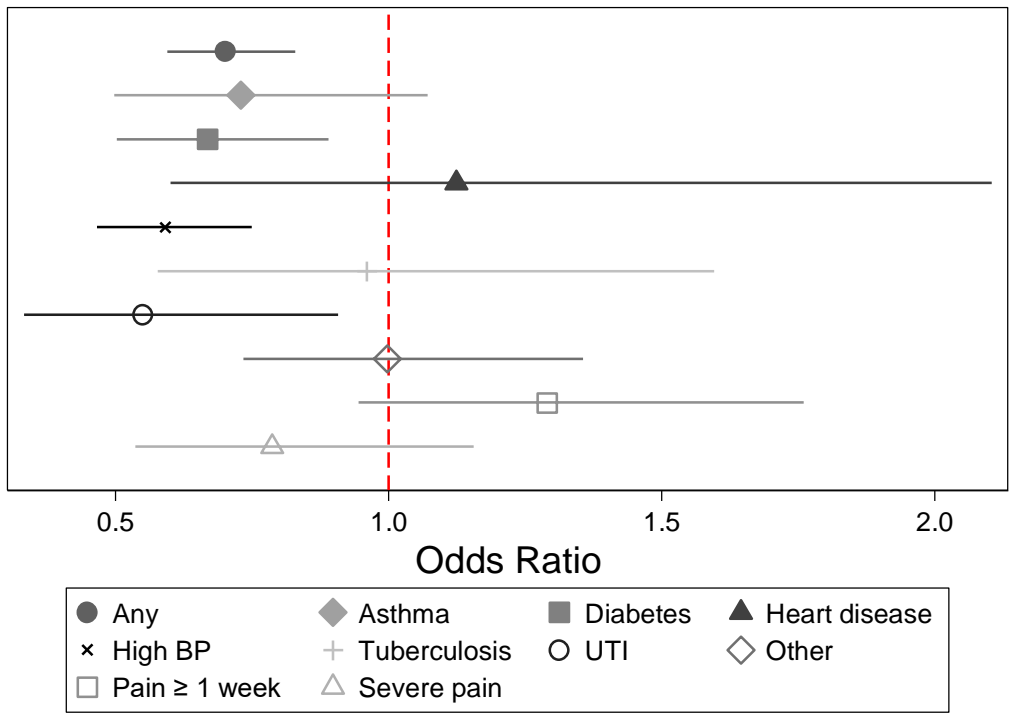


Fig. 3 Odds ratios for unauthorized immigrants compared with authorized immigrants for 10 health outcomes. Full regression results are presented in Table B1 of the online appendix.

Appendix A

We searched three scholarly databases: PubMed, Sociological Abstracts via ProQuest, and Agricola. PubMed includes mostly health and biomedical journals held by the U.S. National Library of Medicine at the National Institute of Health. Sociological Abstracts via ProQuest includes articles published in 90 sociology and social work journals from 1952 to present. Agricola is the database of the National Agricultural Library at the U.S. Department of Agriculture. We used the following search terms:

- “migrant” or “immigrant” or “emigrant” or “immigration” or “foreign-born” in the title or abstract

AND

- “legal status” or “undocumented” or “documented” or “authorized” or “unauthorized” or “illegal” in the title or abstract

AND

- “health” in the text

AND

- “United States” or “US” or “U.S.” in the text

These searches produced 792 articles on PubMed, 268 articles on Sociological Abstracts, and 61 articles on Agricola. We screened all article titles, and, when necessary, abstracts and full text, for the following criteria: that they focus on immigrants within the United States and compare unauthorized immigrants to authorized immigrants on at least one physical health measure. We excluded all articles on mental health, stress, and global health ratings (such as self-rated health and health-related quality of life); on health behaviors, health knowledge, or health risks; and on access to, utilization of, and quality of health care, including screening and

treatment studies. We also excluded articles that focused solely on the health experiences of unauthorized immigrants with no comparison group and research on the U.S.-born children of unauthorized immigrants.

Our search of PubMed resulted in 7 unique articles that fit our criteria (Achkar et al. 2008; De Trinidad Young and Pebley 2017; Holmes and Marcelli 2012; Iten et al. 2014; Marshall et al. 2005; Swartz et al. 2017; Wen and Maloney 2014). One article appeared on both PubMed and Sociological Abstracts (Kelaher and Jessop 2002) and one additional article appeared on Sociological Abstracts only (Gelatt 2016). Agricola produced no articles that met our criteria.

As a check on our process, we compared our results to the recently published systematic literature review of measurement of immigrant legal status in health research, which searched similar key terms in articles published between 2004-2014 using PubMed (De Trinidad Young and Madrigal 2017, hereafter DTY&M). Our results were similar. Through the use of a slightly broader set of search terms on PubMed, we uncovered two additional articles that met our criteria and were published between 2004-2014 (Iten et al. 2014; Wen and Maloney 2014). Comparing our results to this earlier, published review of the literature gives us confidence that our search was as comprehensive as possible.

We took two additional steps. First, we conducted a similar key term search on Google Scholar. We reviewed the first 200 titles of Google Scholar's search results to find articles published in non-peer reviewed outlets or in journals not included in the three databases. We also searched Google Scholar specifically for articles using data sets that include measures of health and of immigrant legal status, including the California Health Interview Study and the L.A.

Family and Neighborhood Survey. These final steps produced three additional articles that met our criteria (Bitler and Shi 2006; Flores et al. 2012; Wallace et al. 2013).

Table A1 provides a summary of the main details of the twelve studies. We focused on the unadjusted comparison between unauthorized and authorized immigrants in making determinations about the paper's findings. Some studies also presented regression-adjusted estimates, but the models varied widely in terms of the number and type of covariates included. Many of the articles estimated statistical tests comparing outcomes for unauthorized and authorized immigrants to U.S.-born citizens, but not to each other. In some of these instances, the text referred to supplemental tests of differences between authorized and unauthorized immigrants. In others, we used reported means and standard deviations to calculate t-tests. In cases where statistical tests were not reported or estimable, we gauged differences based on sample means or distributions and, when possible, the result of the statistical test comparing the group difference or the pairwise differences (authorized to U.S.-born and unauthorized to U.S.-born). These cases are starred in the table.

Two articles nearly met our criteria but compared immigrants to a population including U.S. born individuals (Dang et al. 2011; Reed et al. 2005).¹² Because the comparison groups in

¹² Dang et al. (2011) examined insurance claims paid for by the Children's Health Insurance Program (CHIP) or Medicaid for all singleton births in six counties in Texas between January and August of 2008. Births to unauthorized women were identified by CHIP payment among Medicaid-eligible women. CHIP births were compared to all births paid for by Medicaid and all births to Hispanic women paid for by Medicaid. The study found that births to unauthorized women had a lower rate of low birthweight and a lower rate of preterm birth than births in the comparison group, which includes low-income, authorized immigrant women and U.S.-born women. Reed et al. (2005) examined birth certificates of all singleton births in Colorado in 1998 and 1999. Births to unauthorized women were identified by the use of Emergency Medicaid, and they were compared to all births. Births to unauthorized mothers had a lower rate of low birthweight and of preterm birth than births to all other mothers. There were no differences in terms of very low birthweight, premature rupture, or congenital defects. Births to unauthorized women had a higher rate of meconium staining, excessive bleeding, precipitous labor,

these studies include authorized immigrants and U.S.-born individuals, the analyses confound legal status with other group differences related to immigration, race, and socioeconomic status. However, if we considered the results of these two studies, the tallies of differences would change but our conclusions would not. Including the two additional studies, a total of 64 comparisons were made. On 15 outcomes (23 %), unauthorized immigrants fared worse than authorized immigrants and on 14 outcomes (22 %), unauthorized immigrants fared better than authorized immigrants. On the remaining 35 (55 %), there was no significant difference between unauthorized and authorized immigrants. Thus, including these two studies, we still find that there is no difference by legal status or that unauthorized immigrants fare better on the majority of comparisons.

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Table A1. Results of systematic literature review of published studies of legal status disparities in physical health among immigrants in the United States

Authors	Year	Data source	Sample	Measurement of legal status	Health outcome	0 = no difference + = Unauth. better - = Unauth. worse
Achkar et al.	2008	Medical records	All patients with active TB at Bellevue Hospital Center, NYC, 1999 and 2005 (n=194)	Self-report as noted in medical records by social worker	Multilobar or miliary infiltrates Presence of cavitary lesions Positive smear result Cough Fever Night sweats Weight loss Hemoptysis Symptom duration	0* 0* 0* -* 0* 0* 0* 0* -* -*
Bitler and Shi	2006	Los Angeles Family and Neighborhood Survey, Wave 1	Stratified random sample of households in LA County, 2000-2001 (n=2,500)	Self-report by process of elimination	Asthma Diabetes	0 0*
De Trinidad Young and Pebley	2017	Los Angeles Family and Neighborhood Survey, Wave 3	Stratified random sample of households in LA County, 2007-2008, limited to Latinos (n=1,396)	Self-report by process of elimination	Systolic blood pressure -- <=15 yrs Systolic blood pressure -- >15 yrs Hypertension -- <=15 yrs Hypertension -- >15 yrs	0 + 0* +*
Flores et al.	2012	Birth certificates	Births to white and Latina women in	No SSN reported	Low birthweight Preterm birth	0 0

			Utah, 2004-2007 (n=196,617)		Small for gestational age	0
Holmes and Marcelli	2012	Boston Metropolitan Immigrant Health and Legal Status Survey	Random sample of Brazilian immigrants living in Boston, 2007 (n=307)	Self-report	High C-reactive protein	0
Iten et al.	2014	Immigration, Culture, and Health Care Study (survey and medical records)	Non-random sample of diabetes patients in San Francisco and Chicago, 2008-2009 (n=317)	Self-report by process of elimination	Comorbidities Poor A1C control High systolic blood pressure High low-density lipoprotein	+ 0 0 0
Kelaher and Jessop	2002	Hospital intake data	All Latina women receiving prenatal care at MIC-Women's Health Services in NYC, 1996-1997 (n=4,975)	No SSN or residency card presented	History of low birthweight	0
Marshall et al.	2005	Survey	Non-random sample of immigrants from Spanish-speaking countries in Ft. Worth, TX, 2002 (n=197)	Self-report by process of elimination	Vision problems Backache Dental problems Flu/cold Allergies High blood pressure Other	0 0 0 0 0 0 0
Swartz et al.	2017	Insurance claims	All singleton births paid for by	Use of Emergency	Low birth weight Very low birth weight	+ +

			Medicaid, Emergency Medicaid, and Emergency Medicaid Plus in Oregon, 2003-2015 (n=213,746)	Medicaid or Emergency Medicaid Plus	Ext. low birth weight Preterm birth Infant mortality	+ + +
Wallace et al.	2012	CA Health Interview Survey	Random sample adults in CA, 2009 (n not reported)	Self-report by process of elimination	Asthma Diabetes High blood pressure Heart disease	+ 0 0 0
Wen and Maloney	2014	Utah Population Database	Driver's license records of white and Latino 25-64 year olds in Utah, 1999-2008 (n=742,948)	Use of an Individual Taxpayer Identification Number	Obesity - women Obesity - men	0 +

*The article did not report statistical tests of difference between unauthorized and authorized immigrants.

Appendix B. Table B1. Regression results for ten health outcomes among Mexican-born farm workers in the U.S.

VARIABLES	Any condi- tion	Asthma	Dia- betes	Heart Disease	High BP	TB	UTI	Other	MSK pain ≥week	Severe MSK Pain
Unauthorized	0.7***	0.7	0.7**	1.1	0.6***	1.0	0.5*	1.0	1.3	0.8
Age	1.0***	1.0+	1.1***	1.0	1.1***	1.0*	1.0	1.0***	1.0**	1.0
Female	2.0***	1.8**	1.1	1.4	1.4**	1.6+	12.9***	1.6*	1.6**	1.6*
Indigenous	1.6***	0.9	1.6+	2.1+	1.8**	3.5***	1.8+	1.1	3.9***	1.1
Married	0.9	0.7	0.9	1.0	1.0	1.0	1.3	0.7+	1.1	0.8
Follows the crop	0.7**	0.9	0.6*	0.7	0.7	1.2	1.4	0.5**	0.4***	0.8
Some High School or more	1.0	0.8	1.6*	1.0	1.0	1.2	0.8	1.0	1.1	1.2
\$10K-14,999	1.0	1.2	1.1	0.7	1.1	0.7	1.6	0.9	1.0	1.0
\$15K-19,999	1.1	1.5	1.4	0.7	1.1	0.9	1.0	0.9	1.0	0.8
\$20K-29,999	1.2	1.3	1.2	0.5	1.3	1.5	1.4	1.0	1.2	1.0
\$30,000+	1.6**	1.8+	1.9*	0.5	1.5+	1.3	1.7	1.4	1.8*	0.8
Private	1.2+	0.7	1.2	2.4*	1.2	1.4	1.4	1.0	1.0	1.2
Public	1.2	1.3	1.7*	3.2*	1.4+	0.9	0.8	1.2	1.1	0.8
0-4	0.9	0.4***	0.6	0.5	1.1	0.6	1.8+	0.7	1.1	1.0
5-9	1.1	1.2	0.7	1.0	1.1	1.1	1.4	0.9	1.1	1.0
English Proficient	1.1	1.0	0.9	2.4*	0.8	1.2	1.5	1.1	1.1	0.8
Owns U.S. property	0.9	1.3	0.7+	2.8*	1.0	0.7	0.6	0.9	1.0	0.6*
Constant	0.1***	0.0***	0.0***	0.0***	0.0***	0.0***	0.0***	0.0***	0.6	0.8
Observations	17,462	17,462	17,462	17,462	17,462	17,461	17,462	17,462	3,120	2,015

*** p<0.001, ** p<0.01, * p<0.05, + p<0.1

Note: All models adjusted for survey year, region of interview, and type of crop.

