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CENTERS FOR DISEASE AND CONTROL AND PREVENTION (CDC)

GRANT FINAL PROGRESS REPORT

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Agriculture

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LIST OF TERMS AND ABBREVIATIONS

CDC	Centers for Disease Control and Prevention
DOL	Department of Labor
IRR	Incidence Rate Ratio
LPR+	Legal Permanent Residents plus other non-US Citizen foreign-born with work authorization
MSD	Musculoskeletal disorders
NAWS	National Agricultural Workers Survey
NBR	Negative binomial regression
NIOSH	National Institute for Occupational Safety and Health
NORA	National Occupational Research Agenda
OR	Odds Ratio
Unauthorized	Foreign-born lacking valid US work authorization
USC	United States Citizen (including naturalized foreign-born)

ABSTRACT

Unauthorized immigrants are hypothesized to be particularly vulnerable to occupational injuries and illnesses, and less likely to report their workplace injuries or illnesses to their employers. If unauthorized workers are both *more* likely to be injured at work and *less* likely to report such injuries, this may render the dangerous conditions at their workplaces less visible to existing surveillance efforts. Past analysis suggests that unauthorized farmworkers were *less* likely to have been injured on the job than legally-authorized farmworkers. However, the present analysis finds that this apparent difference is due to differences in exposure, that is, weeks spent in US farmwork. Analysis of exposure-adjusted occupational injury *rates* shows no significant differences between work-authorized and unauthorized farmworkers. However, we do find that rates of reported musculoskeletal disorder (MSD) pain are significantly *lower* for unauthorized farmworkers relative to work-authorized non-US citizens. It remains unknown whether this difference is due to a lower true rate of MSDs or differences in reporting behavior.

SECTION 1: EXECUTIVE SUMMARY

SIGNIFICANT (KEY) FINDINGS

We summarize our key findings and lessons learned by each of the specific aims of the project

Aim 1: To compare differences in self-reported occupational injury and illness counts and exposure-adjusted rates between unauthorized immigrant, legal immigrant and native-born farmworkers. The team successfully implemented this part of the analysis. During the analysis we learned that most of the respondents reported only one injury. We found that using methods which calculate differences in injury rates show no significant differences in reported occupational injuries between farmworker of differing work-authorization and citizenship. We did find significantly lower reported rates of musculoskeletal disorder pain for unauthorized farmworkers relative to work-authorized non-citizens. In addition, we combined legal immigrants with native-born farmworkers into one category and compared our results with those stated in this aim. We found that combining native-born and legal migrant workers into one category can mask some of the underlying differences in reporting associated with immigration status and other factors that are important determinants of reporting and exposure to occupational risks.

Aim 2: To evaluate approaches to address potential bias in survey-based estimates of occupational injury rates caused by differences in reporting behavior. We did not find evidence of widespread differences across work authorization and citizenship in reporting by the severity of injuries or of memory decay. However, we did find evidence of such differences in reporting among specific sub-samples of the farmworker population.

Aim 3: To explore the relationships between demographic, human capital and occupational risk factors and legal immigration status differentials in occupational injury and illness rates. The team estimated all the model specifications with a set of controls aimed at capturing demographics, human capital and occupational risk factors that affect occupational injury and illness rates. Specifically, we considered three separate sets of controls that were added individually and combined into four separate specifications. One set of controls was aimed at capturing basic demographic and work-related information such as gender, marital status, current job task and crop, migrant type, and human capital. The second set of controls capturing a respondent's ability or willingness to move such as having a nuclear family in the household. The third set of controls included information intended to capture networks, e.g. farm work referrals. Our findings showed that the importance of these variables varied by the outcome under consideration. Early models also included employer type, housing location (on farm vs. off farm), housing ownership, and housing type, but given the small sample size in injuries we maintained a parsimonious model that included variables that were statistically significant. In the course of our investigation, the team also found that a variable indicating the

respondent's self-reported country of permanent residence was an important factor explaining injury and illness rates. However, this variable was not collected by NAWS for all the survey years under study.

TRANSLATION OF FINDINGS

Our study findings are highly relevant to the strategic goal of the National Occupation Research Agenda (NORA) to improve surveillance within the Agriculture, Forestry, and Fishing sector, and of worker populations at risk for adverse health outcomes. Unauthorized farmworkers experience a variety of adverse working conditions, which combined with their precarious legal status, alter their ability or willingness to report occupational injuries and illnesses. The literature review indicated that unauthorized farmworkers are a particularly vulnerable population, yet existing studies of injuries either find no evidence of higher injury rates among unauthorized farmworkers, or in one case, find lower risk of occupational injury compared to work-authorized farmworkers. The results of this study indicate that unauthorized farmworkers are not, in fact, at a significantly lower risk of occupational injury. Specifically, we found that estimates of injury rates for unauthorized farmworkers are underestimated when duration of US farm work is not considered. However, we did find that unauthorized farmworkers do report significantly lower rates of musculoskeletal disorder (MSD) related pain. Because it remains unclear whether this results from differences in reporting behavior or true rates of MSD pain, we suggest further research that supplements self-reports of MSD pain with the collection of biomarkers of inflammation.

OUTCOMES/IMPACT

In this study we determined that there are differences in reporting of occupational injuries across a set of dimensions, and that not accounting for these differences may lead to incorrect conclusions about the state of occupational health in farm work. However, some of the findings are not statistically significant and this could be in part to small sample sizes. This highlights the importance of continued surveillance of this population.

SECTION 2: SCIENTIFIC REPORT

1. INTRODUCTION

Immigrant workers lacking legal authorization to be employed in the United States ("unauthorized" or "work-unauthorized" immigrants) may be particularly vulnerable to dangerous working conditions. Such vulnerability may be compounded by multiple factors, such as limited English language ability, low levels of literacy (in the worker's native language), limited social support from nearby kin, pressing economic need to support family in the US or abroad and willingness to take greater risks. Moreover, the same precarious legal status which may render work-unauthorized immigrants more vulnerable to dangerous working conditions may also reduce the likelihood of injured workers reporting their occupational injuries and illnesses to their employers or even seeking medical treatment. Because occupational health surveillance systems rely heavily on employee reports to employers and clinicians (and subsequent workers' compensation claims) to identify non-fatal injuries, a negative correlation between workers' risk of occupational injuries and willingness to report such injuries to employers or medical providers has the potential to obscure the increased risk of occupational injuries in certain workplaces, occupations, and industries.

While a number of researchers and advocates have postulated that work-unauthorized immigrants are especially vulnerable to occupational injuries and illnesses, little empirical research has been done to analyze differences in occupational injury rates by legal immigration status. Even among this set of studies, the findings are puzzling and inconclusive. For example, Mehta *et al.* (2002) found no statistically significant differences in self-reports of ever having a serious occupational injury between work-unauthorized and work-authorized immigrants in the United States. Similar findings were reported by Villarejo (2009) when comparing work injuries within the past 12 months but focusing on farmworkers in California. Mines *et al.* (2004) found that work-unauthorized farmworkers reported fewer occupational injuries than legal farmworkers, which they hypothesized may be due to differing rates of underreporting on the survey. Ethnographic research by Brown *et al.* (2002) found that low-wage immigrant workers underreported occupational injuries to researchers for many of the same reasons they were reluctant to report such injuries to their employers. Differential underreporting of nonfatal injuries may also explain why research has consistently shown that foreign-born Hispanics (work-authorized and work-unauthorized immigrants together) experience the highest rates of occupational fatalities (Loh and Richardson 2004; Richardson *et al.* 2003; Cierpich *et al.* 2008), but do not consistently report higher rates of nonfatal occupational injuries on surveys (Orrenius and Zavodny 2008; Dembe *et al.* 2004; Zhang *et al.* 2009). In addition to differential underreporting, comparisons of occupational injuries between work-authorized and work-unauthorized agricultural workers may be biased by

differences in the period of time during which workers are engaged in US farm work and thereby face a different risk of occupational injury. This is particularly important given the seasonal nature of farm work and the cyclical nature of migration between the US and immigrant-sending countries. None of the studies of non-fatal occupational injuries cited above address these potential differences by calculating exposure adjusted injury rates.

There is one more potential source of bias which may or may not play a role in the counterintuitive findings of past research on differences in occupational injuries by legal immigration status. Specifically, we are referring to recall bias due to memory decay (Schedit, Harel, Trumble *et al.* 1994; Mock, Acheampong, Adjei, and Koepsell 1999). On the one hand, if work-unauthorized immigrants' US farm work experience is, on average, more recent, then they may be more likely to recall their occupational injuries than legally authorized workers who may have worked more of the past 12 months but forgotten injuries which occurred earlier in the period. On the other hand, research has found potent effects of stress on memory processes (Sandi and Pinelo-Nava 2010), thus we might expect that the higher levels of acculturative stress experienced by work-unauthorized immigrants (Arbona, Olvera, Rodriguez *et al.* 2010) could lead to recall difficulties and greater memory decay. Whether or not there is any differential impact of memory decay, research has shown that injury rates calculated on 12-month reporting periods are biased downward due to memory decay (Mock, Acheampong, Adjei, and Koepsell 1999; Landen and Hendricks 1995) and thus we believe that estimating occupational injury and illness rates as accurately as possible requires addressing this potential source of bias.

The present study contributes to the small but growing literature comparing occupational injury or illness rates between work-unauthorized immigrants and legally authorized workers. One of the primary reasons for the paucity of research on this topic is that few surveys or sources of data collect any information on legal immigration status, and fewer still collect reliable information (Schenker 2010). The study used a data source, the National Agricultural Workers Survey (NAWS), which we believe has been underutilized in occupational health research. The NAWS is a national, face-to-face survey of workers in agricultural crop field work, a population which is over 75% foreign-born Latinos and over 50% work-unauthorized (DOL 2005). The survey methodology is specifically designed to address the challenges of surveying this population (Villarejo 1999; Baron *et al.*. 2009). NIOSH specifically chose NAWS as the survey in which to include its Occupational Health and Occupational Injury Supplements because of NAWS's strengths in overcoming barriers to reaching the farm worker population (NIOSH 1998; Baron *et al.* 2009). The NAWS is the only nationally representative US survey of employees in any industry with data regarding both respondents' legal immigration status and experience of occupational injuries and illnesses.

Lastly, our study contributes to the existing research on legal immigration status differentials in occupational injuries through the use of statistical methods to address the

potential sources of bias discussed above: differences in time worked in US farm work, multiple injuries to the same respondents, differences in recall/memory decay, and differential underreporting of injuries and illnesses. As described below in the "Methodology" section, our study improves over existing studies which use a dichotomous "any occupational injury in the past year" measure by comparing exposure-adjusted injury and illness rates, both in bivariate comparisons and in multivariate negative binomial regression models. We also assessed potential biases due to differences in memory decay by comparing rates of injuries reported for the past year to annualized rates for the periods three months, and six months prior to the survey. Lastly, we exploited the variation in the severity of occupational injuries to assess differences in the underreporting of such injuries on the survey.

Our findings suggest that not accounting for the potential sources of bias can lead to incorrect conclusions. Consistent with previous studies we found that simply comparing the incidence of occupational injuries among work-authorized and work-unauthorized workers led to estimates that indicated work-unauthorized workers experience fewer occupational injuries compared to work-authorized workers. However, our results differed when we controlled for demographic characteristics and explored injuries and MSDs along a host of dimensions, including, severity, type of body part affected, work tenure with current employer. One of our salient findings was that work-unauthorized workers experienced higher rates of severe injuries and MSD illnesses in their first year of work. This finding highlights the importance of adequate training. While findings for the full sample did not show statistically significant differences, the magnitude of the estimates suggested that memory recall bias plays a role in measures of the incidence of occupational injuries.

2. Specific Aims

As noted in the 2008 National Occupational Research Agenda (NORA) for the Agriculture, Forestry, and Fishing (AgFF) Sector, recent immigrants are likely to be vulnerable to occupational injuries and illnesses due to a number of factors which constrain their abilities to safeguard their own safety and health. Occupational fatality rates among the foreign-born have been steadily increasing even while the overall occupational fatality rate has declined (Loh and Richardson 2004; Orrenius and Zavodny 2009; Pritchard 2004). Immigrant workers lacking legal authorization to be employed in the United States ("unauthorized immigrants") may be particularly vulnerable to dangerous working conditions. Such vulnerability may be compounded by other factors, such as limited English language ability, low levels of literacy (in the worker's native language), limited social support from nearby kin, and pressing economic need to support family in the US or abroad. However, while a number of researchers and advocates have postulated that work-unauthorized immigrants are especially vulnerable to occupational

injuries and illnesses; little empirical research has been done to analyze differences in occupational injury rates by legal immigration status.

The same precarious legal status which is hypothesized to render work-unauthorized immigrants more vulnerable to dangerous working conditions is also frequently hypothesized to inhibit injured workers from reporting their occupational injuries and illnesses to their employers or even seeking medical treatment. Because occupational health surveillance systems rely heavily on employee reports to employers and clinicians (and subsequent workers' compensation claims) to identify non-fatal injuries, a negative correlation between workers' risk of occupational injuries and willingness to report such injuries to employers or medical providers has the potential to obscure the dangerous work environment of certain workplaces, occupations, and industries. Survey research has the potential to help fill such gaps in occupational health surveillance and improve the targeting of interventions.

Toward this end, NIOSH has partnered with the Department of Labor (DOL) to field occupational health and occupational injury supplements to DOL's National Agricultural Worker Survey (NAWS). To date, these novel sources of data have not been utilized to their full potential. We are aware of only one study which has analyzed the NAWS occupational injury supplement data to explore differences in occupational injuries by legal immigration status (work-unauthorized vs. legally authorized). Mines and co-authors found that work-unauthorized farmworkers reported fewer occupational injuries than legal farmworkers, which they hypothesized may be due to differing rates of underreporting on the survey (Mines *et al.* 2004). Ethnographic research by Brown and co-authors found that low-wage immigrant workers underreported occupational injuries to researchers for many of the same reasons they were reluctant to report such injuries to their employers (Brown *et al.* 2011). Differential underreporting of nonfatal injuries may also explain why research has consistently shown that foreign-born Hispanics (work-authorized and work-unauthorized immigrants together) experience the highest rates of occupational fatalities (Loh and Richardson 2004; Richardson *et al.* 2003; Cierpich *et al.* 2004), but do not consistently report higher rates of nonfatal occupational injuries on surveys (Orrenius and Zavodny 2009; Dembe *et al.* 2004; Zhang *et al.* 2009).

In this study, we tested the hypothesis that work-unauthorized immigrants experience higher rates of occupational injuries as measured by reported injuries and musculoskeletal illnesses/disorders (MSDs) using a variety of methods to address potential sources of bias. Unlike other studies, our methodology uses exposure-adjusted injury rates to address potential sources of bias that may arise from any differences in the number of injuries sustained by workers injured during the study period, or by differences in duration in US farm work. We also exploit the variation in the severity of occupational injuries and MSDs and exposure to risk to assess the differences in the reporting of occupational injuries by immigration status. The specific aims of this study were:

1) To compare differences in self-reported occupational injury and illness counts and exposure-adjusted rates between work-unauthorized immigrant, legal immigrant and native-born farmworkers;
2) To evaluate approaches to address potential bias in survey-based estimates of occupational injury rates caused by differences in reporting behavior;
3) To explore the relationships between demographic, human capital and occupational risk factors and legal immigration status differentials in occupational injury and illness rates.

3. METHODS

Data

Our study used multiple restricted-access data files from the National Agricultural Workers Survey (NAWS) made available by the Department of Labor. The NAWS is the only nationally representative US survey of employees in any industry with data regarding both respondents' legal immigration status and experience of occupational injuries and illnesses. The survey also collects information on socio-demographic characteristics such as age, gender, income, marital status, asset ownership, and household composition. The NAWS survey methodology is specifically designed to address the challenges of surveying this population (Villarejo and Baron 1999; Baron, Chen and Steege 1999), which involves asking respondents about their legal status at the end of the interview, and probing about the programs under which their status was granted to validate their claims (see Appendix A in Baron *et al.*.1999). Specifically, NAWS interviewers are either monolingual Spanish speakers or bilingual Spanish-English speakers with previous experience with or knowledge of farm worker populations. New interviewers are trained and mentored by experienced NAWS interviewers. NAWS uses a multistage sampling method to sample workers employed at farms. The probability of sampling a farm is weighted to the size of seasonal agricultural payroll. NAWS interviews during three 10- to 12-week cycles, designed to account for seasonal variations in employment. Interviewers contact farmworkers at work and arrange a face-to-face interview at a location of the worker's choice, such as the worker's home. This approach allows for a sample which is representative of employed farmworkers, but offers the privacy of reporting on work-related issues away from the employer's premises. As such it may reduce fears of reprisal for reporting occupational injuries or illnesses. NIOSH specifically chose NAWS as the survey in which to include its Occupational Health and Occupational Injury Supplements because of NAWS's strengths in overcoming barriers to reaching the farm worker population (NIOSH 1998; Baron *et al.* 2009). For fiscal year 1999, 71% of growers contacted agreed to allow access to their employees, and 76% of such employees approached agreed to participate in the NAWS (Baron *et al.* 2009). Recent estimates report 66% and 94% response rate for growers and employees, respectively, for 2008-2010 (Layne and Tonozi 2014).

The survey instrument is designed to reserve sensitive questions for later in the survey, when interviewers have had more opportunity to build rapport with respondents. The particular item designed to collect legal status information begins by asking if the respondent is a US-born citizen. If the respondent answers "no," she is asked if she is a naturalized citizen. If she answers "no" to this question, she is then asked if she is a permanent resident, has a border-crossing card, or has an application pending. After exhausting other possibilities, respondents are asked if they are undocumented. Respondents who claim to have a documented immigration status are then asked about the particular programs and provisions through which they gained status, in order to validate their claim (see Appendix A in Baron *et al.* 2009)

While NAWS has been administered annually since 1989, the restricted-use supplements have not. Following the recommendations of the NIOSH Workgroup on Priorities for Farm worker Occupational Health Surveillance and Research (NIOSH 1998), the pilot NAWS Occupational Health and Occupational Injury Supplements were first fielded in fiscal year 1998. After revisions, the Occupational Health Supplement was fielded in fiscal years 1999-2004, 2008-2010 and the Occupation Injury Supplement Supplement (NLAIN) was fielded in 1999-2004, and 2008-2012.

The Occupational Health Supplement asks a separate set of detailed questions regarding musculoskeletal pain/discomfort (MSD) during the past 12 months. This section asks about pain or discomfort in the back, shoulder, elbow/arm, hand/wrist, legs/feet, or other body parts. For any body part in which the respondent reports having experienced pain or discomfort, s/he was asked about the activity at onset (farm work/nonfarm work/non-work), whether the pain/discomfort lasted at least a week, severity of pain/discomfort (no pain, bearable pain, or unbearable pain), and days unable to work normally due to pain/discomfort (Baron *et al.* 1999).

The NAWS NLAIN contains information about whether the respondent experienced any injuries on (or commuting to or from) a US farm which rendered them unable to work normally without taking strong medication for at least four hours. The Occupational Injury Supplement begins with a screener, which asks respondents if, in the last 12 months, they have had any injuries on or travelling to or from a US farm which rendered them unable to work normally without taking "strong" (i.e., not over-the-counter) medication for at least four hours. Respondents who initially answer "no" are probed about nine types of injuries (and an open-ended "other" category). Respondents who report one or more such injuries on the screener are then asked a series of questions for each injury, including the affected body part, the type of injury, the date of the injury, where the injury occurred, a general narrative covering how and why the injury occurred and any machinery or tools involved, whether the injury occurred at the current job, whether it occurred doing farm work, which crop and task the respondent was employed in when the injury occurred, whether the respondent was using protective equipment, the

number of days not able to work normally, where (if) treated, how treatment was paid for, and outcome of treatment (Baron *et al.* 2009).

The NAWS public-release dataset has information on the number of weeks worked in US farm work during the last 12 months, as well as information regarding the crop and task at the current job. The restricted dataset has a complete 12-month work history for all respondents, detailing the crop, task, and start and end date of each job in the Work History Grid file. Our analyses also used the restricted Work History Grid data file which is available for 1989-2010. The Work Grid was used to estimate the length of time between the injury and the survey date.

The NAWS also has publicly-available information regarding other factors which may affect workers' risk of injury or MSD illness, we refer to this information as the core file. These variables include: age, gender, language skills/ability, marital status, task, crop type, migrant type, whether respondent attended college in the US, age entered the US, age first did farm work, highest degree attained, whether nuclear family lives with respondent in the US, whether individual has dwelling abroad, whether individual has kids, whether individual own a vehicle in the US, whether respondent expected to be doing farm work in the next 5 years, type of referral to farm work (e.g., friend, relative), whether individual lives in employer-owned housing, and whether the individual indicated that she or he can get non-farm work within a month.

Because the Occupational Health and Injury Supplements cover different periods of time, we created and analyzed separate analytical files. In creating the analytical file containing injuries, we first merged the core file with the injuries supplement to identify individuals reporting injuries or accidents. Using information about the place of injury we excluded those were not related to farm-related work. We then merged this file with the Work Grid file to obtain information about the length of the injury, and the injury date. While NAWS LAIN collected data for 2000 and 2001, our analysis excludes these two years of data because the data were not consistently captured for these years. Combined, this exclusion includes 14 individuals who reported an occupational injury; 1 individual in 2000 and 13 in 20101. The final sample contains 18,426 observations covering 1999, 2002-2004, and 2008-2010. Similarly, the analytical file containing the MSD information was created by merging the Occupational Health Supplement with the core file, and the Work Grid file. This sample includes 24,736 observations. Both analytical samples excluded observations with missing values.

Table 1 and Table 2 show demographic characteristics as well as other factors that may affect occupational risk based on workers' legal status for the sample of occupational injuries and MSDs, respectively. The first column presents the demographic and work profile of farmworkers who reported to be US citizens, this group includes native-born and foreign-born naturalized citizens. The second column, "LPR+", refers to farmworkers who reported to be legal permanent residents (e.g., green card holders) plus

other non-US Citizen foreign-born with work authorization. The third column, "unauthorized", includes foreign-born farmworkers lacking valid US work authorization.

In the occupational injuries sample (Table 1), more than 50 percent of the respondents reported to be unauthorized, with U.S citizens and other LPR+ representing about 25 percent each. The socio-demographic characteristics of unauthorized workers differs from that of LPR+ and US citizens (Table 1). Specifically, unauthorized workers are younger than their legally authorized immigrant counterparts, more likely to be male, less likely to speak English at all, more likely to be single, more likely to have under 12 years of schooling, and more likely to have a child or a spouse living abroad. In terms of asset ownership, unauthorized workers are less likely to own a home or automobile, more likely to live on-the-farm, and more likely to be in housing arrangements that are mobile (mobile home, without shelter, and car). While unauthorized workers are less likely to have had any non-farm work experience in the last 12 months, they were more likely to be referred to their first job in US farm work by a friend or relative.

According to the results of Table 1, the work experience profile of unauthorized workers is also different than that of LPR+ and US citizen workers along a host of dimensions. First, though, on average, unauthorized workers are younger, they are older when they first begin farm work in the US relative to US citizens and LPR+ workers, and they are also more likely to have the fewest years of experience in FW. While both unauthorized and LPR+ farmworkers are also more likely to work in fruits and nuts crops US citizens are more likely to work in field crops and horticulture. There appear to also be differences with respect to tasks; unauthorized workers are more (less) likely to be involved in harvest-related (semi-skilled) tasks. Unauthorized workers are more likely to be follow-the-crop and newcomers, or shuttle migrants, while LPR+ and US citizens are more likely to be settled migrant workers.

While the magnitude of the means and percentages differ, qualitatively, the pattern of demographic characteristics and work profile of farmworkers in the MSD illnesses sample is similar (Table 2) to that of farmworkers in the occupational injuries sample (Table 1).

Table 1.- Demographic Characteristics of Farmworkers: Occupational Injuries

Description	USC	LPR+	Unauthorized
Age (years, mean)	37.55	41.25	30.02
US farm work experience (years, mean)	14.77	17.48	6.14
Age first started farm work (years, mean)	20.99	22.45	23.71
Educational attainment			
<12 years	40.60%	89.20%	91.30%
12 years	42.00%	8.20%	7.20%

Description	USC	LPR+	Unauthorized
13-16 years	17.40%	2.60%	1.40%
Has had some education in the US	96.90%	31.10%	15.60%
Does not speak English	2.10%	34.10%	59.10%
Female	28.60%	26.70%	20.40%
Married	48.30%	78.60%	54.10%
Have kids	34.90%	55.80%	29.20%
Co-resident spouse	46.80%	64.30%	31.20%
Lives with nuclear family	55.30%	70.30%	35.30%
US car/truck ownership	75.80%	72.60%	35.40%
Home ownership	54.20%	33.60%	6.10%
Lives in Employer-owned housing	16.40%	18.70%	19.70%
Housing type (Attached)	83.60%	79.20%	72.50%
Housing location (off-farm)	86.80%	86.30%	85.00%
Type of Crop			
Field Crops	32.40%	12.10%	9.60%
Fruits & nuts	14.70%	40.90%	40.80%
Horticulture	31.70%	14.60%	16.90%
Vegetables	15.90%	28.70%	30.10%
Miscellaneous/Multiple	5.30%	3.70%	2.70%
Task			
Pre-harvest	14.50%	25.60%	32.70%
Harvest	14.60%	15.30%	11.30%
Postharvest	25.20%	25.70%	18.10%
Semi-skilled	0.10%	0.20%	0.00%
Supervisor	22.30%	13.70%	12.20%
Other	14.50%	25.60%	32.70%
Migrant type			
Follow-the-crop	2.40%	6.90%	9.30%
Newcomer	0.00%	0.50%	23.80%
Settled	87.70%	67.70%	52.20%
Shuttle	9.90%	24.90%	14.70%
Employed by Farm Labor Contractor	6.10%	20.00%	23.30%
Any non-farm work in US in past 12 months	30.20%	15.00%	14.80%

Description	USC	LPR+	Unauthorized
Can get non-farm work in 1 month	66.70%	33.60%	20.70%
Relative/friend referred to first job in farm work	51.60%	66.20%	77.70%
N (unweighted)	4,648 (25%)	4,469 (24%)	9,309 (51%)

Note: "LPR+", "USC", and "Unauthorized" are mutually exclusive categories. LPR+ includes foreign-born workers that self-reported to be permanent legal residents of the US, or have other valid work authorization, USC includes native-born US citizens and naturalized US citizens.
Source: NAWS and Occupational Injury Supplement, 1999, 2002-2004, 2008-2012

Table 2.- Demographic Characteristics of Farmworkers: MSD Illnesses

Description	USC	LPR+	Unauthorized
Age (years, mean)	37.9	40.96	29.69
US farm work experience (years, mean)	15.26	17.15	5.86
Age first started farm work (years, mean)	20.88	22.48	23.68
Educational attainment			
<12 years	40.60%	87.90%	91.20%
12 years	42.30%	9.50%	7.20%
13-16 years	17.10%	2.70%	1.60%
Has had some education in the US	97.10%	32.20%	14.60%
Does not speak English	1.80%	32.90%	60.60%
Female	28.00%	29.40%	19.70%
Married	51.00%	79.60%	53.90%
Have kids	35.60%	57.20%	28.70%
Co-resident spouse	49.20%	66.40%	30.30%
Lives with nuclear family	56.80%	72.50%	34.60%
US car/truck ownership	77.70%	74.50%	35.00%
Home ownership	57.20%	36.80%	6.20%
Lives in Employer-owned housing	15.30%	18.10%	19.30%
Housing type (Attached)	75.20%	65.80%	60.00%
Housing location (off-farm)	87.60%	86.40%	84.90%
Type of Crop			
Field Crops	31.70%	12.20%	10.30%
Fruits & nuts	12.10%	41.10%	42.70%
Horticulture	33.50%	13.90%	15.70%
Vegetables	16.50%	28.60%	28.60%
Miscellaneous/Multiple	6.20%	4.20%	2.70%
Task			
Pre-harvest	24.30%	18.70%	24.80%
Harvest	11.30%	25.10%	33.60%
Postharvest	14.00%	16.50%	11.00%
Semi-skilled	25.50%	25.80%	17.40%
Supervisor	0.10%	0.20%	0.00%
Other	24.80%	13.70%	13.10%

Description	USC	LPR+	Unauthorized
Migrant type			
Follow-the-crop	1.70%	6.60%	9.70%
Newcomer	0.00%	0.40%	24.20%
Settled	89.70%	68.50%	50.40%
Shuttle	8.60%	24.50%	15.70%
Employed by Farm Labor Contractor	6.60%	20.50%	23.80%
Any non-farm work in US in past 12 months	26.20%	15.10%	15.90%
Can get non-farm work in 1 month	66.30%	35.20%	21.80%
Relative/friend referred to first job in farm work	50.10%	67.00%	79.20%
N (unweighted)	5,941 (24%)	6,157 (25%)	12,638 (51%)

Note: "LPR+", "USC", and "Unauthorized" are mutually exclusive categories. LPR+ includes foreign-born workers that self-reported to be permanent legal residents of the US, or have other valid work authorization, USC includes native-born US citizens and naturalized US citizens.
Source: NAWS and NIOSH Occupational Health Supplement, 1999-2004, and 2008-2010.

Methodology

Our study was conducted in three phases. The first phase of the analysis compared counts of traumatic injuries and, separately, reports of musculoskeletal pain/discomfort (henceforth "musculoskeletal disorders" or MSDs) and average number of injuries and MSDs per respondent (accounting for complex survey design and weights). Our focus was limited to injuries and MSDs which the respondent reported occurred, or symptoms began while engaged in farm work in the United States. We focused primarily on comparisons between work-unauthorized immigrants and legally resident, work-authorized foreign-born farmworkers, which we believe is the most valid comparison for understanding the effects of legal immigration status. However, we also estimated rates for US citizen farmworkers in the NAWS sample.

Specifically, we first estimated the model following the approach of the existing literature, i.e., estimated a logit model where the outcome variable is categorical variable and included the dummy variables for legal immigration status without other predictors, as denoted by equation (1). Equation (1) is estimated separately for injuries and MSDs. y_i denotes a categorical variable that is equal to one if the respondent reported having an

injury (or MSD), and zero otherwise. U_i is a dummy variable for unauthorized status, and USC_i is a dummy variable for US Citizens as defined above (reference is LPR+ immigrants).

$$(1) \ \ln(y_i) = \beta_0 + \beta_u U_i + \beta_n USC_i$$

We estimated the model using Poisson regression, which is more appropriate for dependent variables which measure counts of rare discrete events and which also allows modeling differences in *rates* by specifying an offset, or exposure, variable for the denominator of the rate (Gannon *et al.*. 2008) using the Stata statistical package (Long & Freese 2005). We estimated Poisson regression models without and with an exposure offset taking the form of equation (2).

$$(2) \ \ln(y_i) = \ln(t_i) + \beta_0 + \beta_u U_i + \beta_n USC_i$$

Here y_i is the count of injuries (or body parts experiencing an injury or MSD illness for individual i. The exposure variable (t_i) is the time that individual i worked in US farm work during the period being analyzed, expressed in years to give annualized rates. These values are calculated based on reported weeks in US farm work during the past year. Note that the term $\ln(t_i)$ has a coefficient constrained to equal one, and that equation (1) can be rearranged to express the natural logarithm of a rate on the left-hand side (Long and Freese 2006).

Corresponding to Aim 3, we modeled differences in occupational injury and musculoskeletal disorder (MSD) rates by legal immigration status in multivariate models, controlling for other likely risk factors, as denoted by equation (3). In equation (3) X_1 through X_n are other factors associated with a risk of MSD (or injury/accident). We controlled for other predictors (*X's*) available in the NAWS, including English language ability, native language (Spanish, Indigenous, other), sex, marital status, number of minor children, whether spouse and/or children are co-resident in the US or living abroad, educational attainment, whether individual had had any education in the US, age when began farm work, vehicle ownership in the US, whether individual can find non-farm work within a month, whether individual lives in employer-owned housing, whether friend or relative referred individual to farm work, and expectation of doing farm work in the next five years. We also controlled for migrant type (shuttle worker, settled, migrant, follow-the-crop), type of tasks, crop risk, and whether the respondent lives in employer-owned housing. Where data and sample size allowed, these multivariate models were also used to address potential sources of bias described in more detail below.

$$(3) \ \ln(y_i) = \ln(t_i) + \beta_0 + \beta_u U_i + \beta_n USC_i + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i} + \ldots + \beta_n X_{ni}$$

Furthermore, we also estimated equation (3) using negative binomial regression (NBR), as denoted by equation (4). NBR is appropriate for dependent variables which measure counts of rare discrete events and which also allows modeling differences in *rates* by specifying an offset, or exposure, variable for the denominator of the rate (Hilbe 2011). NBR can be understood as a generalization of Poisson regression which relaxes the assumption that the mean and variance are equal, allowing unbiased estimation of coefficients' standard errors when the variance is greater than the mean ("overdispersion") (Long and Freese 2006). The error term is ε_i, where $\exp(\varepsilon_i)$ is assumed to be drawn from a gamma distribution (Long and Freese 2006). The exposure variable (t_i) is the time that individual i worked in US farm work during the period being analyzed, expressed in years to give annualized rates. These values are calculated based on reported weeks in US farm work during the past year. Note that the term $\ln(t_i)$ has a coefficient constrained to equal one, and that equation (4) can be rearranged to express the natural logarithm of a rate on the left-hand side (Long and Freese 2006):

$$(4) \ \ln(y_i) = \ln(t_i) + \beta_0 + \beta_u U_i + \beta_n USC_i + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i} + \ldots + \beta_n X_{ni} + \varepsilon_i$$

We addressed the potential sources of bias in injury and MSD illnesses (corresponding to Aim 2) by investigating differences in underreporting due to differences in memory recall, and by severity of the injury or MSD illness. "Memory decay" biases reporting of injuries and calculations of injury rates when injuries which occurred earlier in the period of study (12 months in the NAWS) are less likely to be reported than more recent injuries (Harel *et al.* 1994; Jenkins *et al.* 2002). Researchers have found differences in memory decay across subgroups of respondents (male/female; rural/urban; age groups) and by severity of injuries (Harel *et al.* 1994; Landen and Hendricks 1995; Scheidt *et al.* 1995). To address possible differences in memory decay between work-unauthorized immigrants and their legal counterparts, we relied on the date of each injury, which is recorded in the NAWS Occupational Injury Supplement, to calculate annualized injury rates based on injuries in the periods two month, three months, and six months prior to the survey, and compared these to the injury rates calculated based on the 12-month reporting period (Harel *et al.* 1994; Jenkins *et al.* 2002)[1]. Recognizing that we do not know the true injury rates, we tested for statistically significant differences in rates (and ratios of rates by legal status) for the 12-month reporting period and shorter periods. Any such significant change in rates (or ratios of rates) would be evidence consistent with memory decay (or differential memory decay).

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[1] We also considered one month prior to the survey but sample size did not permit this analysis.

Research into the reporting of occupational injuries has found that one primary reason that immigrant workers do not report their occupational injuries to interviewers prior to probing is that they do not believe the injury was serious enough (Brown *et al.* 2002). Conceptually, one might consider that in the case of an injury severe enough to require hospitalization, the worker has considerably less discretion in determining the number of days s/he misses work than in the case of a more minor injury. Thus, while workers of different immigration status may have different preferences or thresholds about missing work, in the case of more severe injuries the number of days lost may be determined more by doctors and hospitals discharge decisions than individual preferences. Thus we expect that injuries requiring higher numbers of days away from work are likely to represent similar underlying levels of severity, while at the margin between zero and one day the primary factor may be the individual's preferences, and thus there may be considerable differences in the underlying severity represented by one day of lost work. Recall that Mines *et al.* (2004) found that given reporting an injury, less settled workers (follow-the-crop migrants who spoke English poorly) reported more severe injuries (as measured by days lost). Also, as noted above, research has shown that more severe injuries (as proxied by days lost) are less subject to memory decay than minor injuries (Harel *et al.* 1994; Scheidt *et al.* 1995). As such, we would expect that differences in reported rates of injuries or MSDs resulting in more lost days are more likely to reflect true differences in the rates of such injuries, while differences in the reported rates of injuries or MSDs resulting in fewer lost days are more likely to be biased due to differences in reporting.

We categorized severity of injuries and MSDs reported on the NAWS into groups based on the reported days of work lost and compared injury and MSD rates across legal immigration status within these severity categories. Specifically, we categorized "severe injuries" as those injuries for which the agricultural worker sought treatment in an hospital, emergency department; minor injuries are classified as those for which the respondent sought at migrant clinic or physician's office. By contrast, we categorized severe MSDs by the level of pain the respondent described was associated with the MSD illness. Severe MSDs were deemed severe if the respondent indicated the pain was "unbearable" or "a lot"; we classified minor MSDs if the respondent indicated the associated pain was "little", or "none". We also investigated differences in our estimates based on the number of work days lost associated with these injuries. Based on the observed distribution of days lost due to occupational injuries or MSDs, we classified "low" work days lost as those injuries or MSDs that were below the 50th percentile of the distribution, "high" work days lost was based on observations at or above the 75th percentiles. These percentiles seemed adequate in providing an evenly distributed number of observations. For injuries "work days lost" is the self-reported number of days the respondent indicated was out of work due to the associated injury. For MSDs, we used two measures: 1) self-reported work days lost, and 2) self-reported number of days the respondent had difficulty working. The second measure may capture underlying behavior

that may affect reporting, e.g., workers' ability to work beyond pain (Thierry and Snipes 2015). Again, we would expect that differences in the rates of severe injuries or MSDs would reflect relatively unbiased estimates of the differences by immigration status, since severe injuries are less likely to be forgotten or regarded as unimportant to report. If the relationship between immigration status and injury or MSD rates differs significantly for minor injuries relative to severe injuries, this would be consistent with bias due to differential underreporting of minor injuries.

4. RESULTS

a. Baseline Specifications

We begin by presenting the results of the approach used in the existing literature (column 1 of Table 3) as denoted by equation (1). This approach includes estimating a logit model where dummy variables denoting immigration status as the independent variables are regressed on a dummy variable that is equal to one if the respondent reported an injury, and zero otherwise. We note that the estimates presented in column 1 denote odds ratios (ORs) and that those from the Poisson and the NBR are Incidence Rate Ratios (IRRs). An odds ratio captures the association between an exposure and an outcome. In this case, the OR represents the odds that an injury or illness occurs among work-unauthorized farmworkers relative to the odds of the injury or illness occurring among work-authorized migrant workers. A value greater than 1 denotes that injuries or illnesses are higher among work-unauthorized workers, compared to work-authorized migrants. By contrast, a value less than 1 suggests that injuries and illnesses are lower among work-authorized workers, relative to work-authorized migrants. Specifically, an OR=1.2 would indicate that work-unauthorized workers experience 1.2 more injuries or illnesses than their counterparts, work-authorized immigrant workers. The IRR is interpreted in a similar fashion. The IRR represents the change in the dependent variable in terms of a percentage increase or decrease, with the precise percentage determined by the amount the IRR is either above or below 1. For example, an IRR of 1.5 for the coefficient of work-authorized would suggests that injuries counts is 50% higher for work-authorized than the missing category, work-authorized immigrant workers. Conversely, an IRR reporting a 32% decrease would be written as 0.68 (a value 0.32 less than 1).

We found that work-unauthorized immigrants are significantly less likely to report occupational injuries (logit OR=0.602, $p < 0.05$). We find similar results when we estimate equation (2) which is a Poisson regression without adjusting for exposure (column 2). However, when we address differences in exposure by using Poisson regression models with proportion of last year working in U.S. farm work as an exposure variable (equation 3), the estimates suggest that there are no significant statistically differences in the occupational injury rates (IRR =0.686) (column 3).

The results remain relatively unchanged and statistically insignificant when we control for a host of demographic variables described in the methodology section (columns 4-7). The variables in column 4, represent measure of risk associated with experience and job characteristics. In column 5 we considered variables that are associated with an individual's mobility such as having children, or having a nuclear family in the US. In column 6, we controlled for factors such as networks that can affect an individual's decision to work in agriculture. Column 7 presents the estimates of equation (4) where we controlled for all the factors considered in columns 4-6. For the rest of our analysis we consider the specification in column 7 to be our preferred specification. The results from columns 4-7 consistently show that speaking another language other than English or Spanish is associated with lower occupations injuries, and this association is statistically significant at the 5 percent level (IRR is 0.09). Individuals that work in Task 3 (post-harvest) are more likely to report injuries compared to those that are in Task 2 (Harvest), but this association is only marginally statistically significant (IRR= 1.694). In columns 4 and(7 we added a variable collapsing NAWS's 5 crop variables into one dichotomy (which preliminary analysis indicated had similar relationships to the injury and MSD outcomes. This dummy variable is coded one for those working in fruits & nuts, vegetables, and miscellaneous or multiple crops (at the same employer). The reference category is field crops and horticulture. In the specification represented by column 7 we found that individuals working in fruits, nuts, vegetables or miscellaneous/multiple crops are less likely to report injuries (IRR=0.675, p<0.05), and the association is statistically significant at the 5 percent level.

When we examined the association between injuries and type of migrant (follow-the-crop workers being the omitted category), we found shuttled workers are more likely to report an injury than follow-the-crop workers. This association is marginally statistically significant (IRR= 1.846, p <0.10). Interestingly, the estimates indicate that those individuals who expected to be working in agricultural work within the next five years are more likely to report an injury than their counterparts (IRR=1.12, p <0.05). Our qualitative and quantitative estimates and findings remain unchanged when we estimate the model using a negative binomial regression (NBR) (column 8).

Table 4 below presents our estimates when we conduct a similar exercise but where the outcome variable is an indicator equal to one if the respondent had any type of MSD illness afflicting any body part during the 12 months preceding the survey (column 1), or the total number of body parts afflicted (columns 2-7). The results from this set of specifications suggest that work-unauthorized workers are less likely to report an MSD illness than their work-authorized foreign-born counterparts, and this association is statistically significant at the 1 percent level. This association is robust irrespective of the distribution and controls examined. Although not statistically significant, the magnitude of the estimate for US Citizens suggests that US Citizens are more likely to report an injury than their work-authorized foreign-born counterparts. Interestingly, individuals who speak Spanish or an indigenous language are more likely to report suffering an MSD injury than their English speaking counterparts. Age seems to also be associated with

higher MSD illness rates, but this association is marginally statistically significant. Other factors that increase MSD illness rates and that are strongly statistically significant (p < 0.01) include being female (IRR=1.7), being involved in supervisory tasks (IRR=1.5), being involved in fruits, nuts, vegetables or miscellaneous crops (IRR=1.5), being a newcomer worker (IRR=3.3), being able to get non-farm work (IRR=1.02), and having performed any kind of non-farm work (IRR=1.7).   By contrast, having children (IRR=0.8) or having attended college (IRR=0.6) are negatively associated with MSD illness rates, and the association is statistically significant at the 5 percent level.

The findings so far highlight that language skills, gender, networks, and work experience are associated with occupational injuries and MSD illnesses. Moreover, we found that certain characteristics matter for some type of injuries but not for MSD illnesses. These findings point to potential sources of bias in occupational health in the agricultural sector. We investigate the potential sources of bias in the subsequent sections. Specifically, we investigate potential bias due to differential underreporting of severe vs less severe injuries, as well as differences in reporting due to memory recall.

For the rest of the report our discussion focuses on the immigration status variables, US Citizen and Work-unauthorized, and on the specification that controls for all the variables as shown in column 7. Results from any of the specifications discussed here but not shown in tables contained in this report are available upon request.

Table 3.- Baseline Specification: Outcome is Occupational Injuries

Variables	(1) Logit	(2) Poisson	(3) Poisson	(4) Poisson	(5) Poisson	(6) Poisson	(7) Poisson	(8) NBR
USC	0.967	0.973	1.043	1.236	0.987	1.113	1.351	1.352
	(0.261)	(0.255)	(0.276)	(0.366)	(0.231)	(0.273)	(0.363)	(0.364)
Unauthorized	0.602**	0.608**	0.686	0.793	0.685	0.681	0.746	0.748
	(0.150)	(0.147)	(0.168)	(0.205)	(0.166)	(0.164)	(0.188)	(0.187)
Age				0.998			0.990	0.990
				(0.008)			(0.009)	(0.009)
Female				0.703			0.656	0.658
				(0.193)			(0.176)	(0.174)
Speak Spanish				1.381			1.382	1.391
				(0.414)			(0.449)	(0.446)
Speak Indigenous language				1.041			1.156	1.159
				(0.786)			(0.870)	(0.868)
Speak other language				0.095***			0.093***	0.093***
				(0.080)			(0.0782)	(0.0782)
Do not speak English				0.724			0.702	0.689
				(0.186)			(0.187)	(0.181)
Married				1.160			1.102	1.113
				(0.251)			(0.340)	(0.348)
Task 1 (Pre-Harvest)				0.718			0.677	0.673
				(0.190)			(0.180)	(0.178)
Task 3 (Post-Harvest)				1.730*			1.694*	1.694*
				(0.518)			(0.517)	(0.518)
Task 4 (Semi-Skilled)				1.102			1.059	1.058
				(0.292)			(0.282)	(0.281)
Task 5 (Supervisor/Other)				1.453			1.333	1.319
				(0.375)			(0.323)	(0.321)
Crop: Fruits/Nuts/Vegetables/Misc				0.668*			0.675**	0.673**
(reference= Field Crops & Horticulture)				(0.138)			(0.132)	(0.133)
Migrant type 2 (Newcomer)				1.584			1.512	1.513
				(0.858)			(0.800)	(0.797)

				Yes (A)	Yes (B)	Yes (C)	Yes (D)	Yes (D)
Migrant Type 3 (Settled)				0.798			0.847	0.844
				(0.246)			(0.241)	(0.239)
Migrant type 4 (Shuttled)				1.883*			1.846*	1.852*
				(0.662)			(0.604)	(0.608)
Attended college				1.115			1.021	1.027
				(0.342)			(0.317)	(0.313)
Age first did any farm work in the US					1.015		1.024*	1.024
					(0.011)		(0.015)	(0.015)
Have children					1.110		1.035	1.027
					(0.300)		(0.260)	(0.253)
Live with nuclear family in the US					0.791		1.014	1.001
					(0.234)		(0.332)	(0.327)
Have any education in the US					1.082		0.983	0.979
					(0.221)		(0.212)	(0.212)
Own vehicle in the US					1.191		1.176	1.177
					(0.208)		(0.221)	(0.220)
Can get non-farm work in 2 months						1.011	1.015	1.015
						(0.027)	(0.026)	(0.027)
Expect to do farm work within next 5 years						1.133***	1.121***	1.122***
						(0.043)	(0.043)	(0.043)
Referred to farm work by friend or relative						1.148	1.153	1.152
						(0.188)	(0.180)	(0.179)
Performed any kind of non-farm work						1.473*	1.230	1.221
						(0.323)	(0.287)	(0.279)
Lives in employer-owned housing						1.395	1.101	1.103
						(0.313)	(0.231)	(0.228)
Off-set	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Controls	No	No	No	Yes (A)	Yes (B)	Yes (C)	Yes (D)	Yes (D)

Note: N=56,823. Outcome is indicator variable if respondent had any injury (column 1), or count of injuries (columns 2-8).
Source: NAWS and NIOSH Occupational Injuries Supplement.

Table 4.- Baseline Specification: Outcome is Any MSD Illness

Variables	(1) Logit	(2) Poisson	(3) Poisson	(4) Poisson	(5) Poisson	(6) Poisson	(7) Poisson	(8) NBR
USC	0.841	0.865	0.965	1.283**	0.991	0.943	1.200*	1.195
	(0.0992)	(0.0858)	(0.0939)	(0.145)	(0.104)	(0.0888)	(0.133)	(0.135)
Unauthorized	0.679***	0.718***	0.797***	0.686***	0.728***	0.763***	0.670***	0.658***
	(0.0616)	(0.0555)	(0.0621)	(0.0575)	(0.0564)	(0.0603)	(0.0573)	(0.0587)
Age				1.003			1.005	1.005
				(0.00279)			(0.00371)	(0.00396)
Female				1.608***			1.660***	1.699***
				(0.122)			(0.128)	(0.139)
Speak Spanish				1.060			1.149	1.143
				(0.150)			(0.167)	(0.172)
Speak Indigenous language				1.977***			2.155***	2.130***
				(0.400)			(0.447)	(0.430)
Speak other language				0.744			0.747	0.769
				(0.209)			(0.208)	(0.212)
Do not speak English				1.006			1.058	1.056
				(0.0790)			(0.0875)	(0.0916)
Married				1.018			1.069	1.072
				(0.0739)			(0.0947)	(0.101)
Task 1 (Pre-Harvest)				0.846			0.840	0.838
				(0.0938)			(0.0920)	(0.0966)
Task 3 (Post-Harvest)				0.954			0.923	0.917
				(0.103)			(0.101)	(0.103)
Task 4 (Semi-Skilled)				0.878			0.884	0.882
				(0.0891)			(0.0882)	(0.0923)
Task 5 (Supervisor/Other)				1.513***			1.550***	1.584***
				(0.168)			(0.174)	(0.190)
Crop: Fruits/Nuts/Vegetables/Misc				1.393***			1.434***	1.454***
(reference= Field Crops & Horticulture)				(0.141)			(0.144)	(0.153)
Migrant type 2 (Newcomer)				2.782***			2.779***	2.961***
				(0.410)			(0.393)	(0.442)
Migrant Type 3 (Settled)				0.747***			0.785**	0.785**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
				(0.0775)			(0.0808)	(0.0834)
Migrant type 4 (Shuttled)				1.260*			1.185	1.205
				(0.174)			(0.164)	(0.175)
Attended college				0.697***			0.692***	0.671***
				(0.0929)			(0.0909)	(0.0915)
Age first did any farm work in the US					1.007**		0.999	0.999
					(0.00305)		(0.00456)	(0.00488)
Have children					0.821**		0.824*	0.823*
					(0.0791)		(0.0846)	(0.0902)
Live with nuclear family in the US					1.088		1.070	1.069
					(0.104)		(0.122)	(0.131)
Have any education in the US					0.957		1.100	1.103
					(0.0830)		(0.0954)	(0.0993)
Own vehicle in the US					0.840**		0.992	0.985
					(0.0584)		(0.0710)	(0.0744)
Can get non-farm work in 2 months						1.029***	1.024**	1.025**
						(0.0101)	(0.00992)	(0.0104)
Expect to do farm work within next 5 years						0.981	0.981	0.980
						(0.0238)	(0.0224)	(0.0231)
Referred to farm work by friend or relative						1.252***	1.122	1.137*
						(0.0848)	(0.0785)	(0.0834)
Performed any kind of non-farm work						1.609***	1.802***	1.833***
						(0.163)	(0.167)	(0.178)
Lives in employer-owned housing						1.078	1.024	1.023
						(0.116)	(0.0908)	(0.0925)
Off-set	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Controls	No	No	No	Yes (A)	Yes (B)	Yes (C)	Yes (D)	Yes (D)

Note: Outcome is any body part afflicted by MSD pain or discomfort.
Source: NAWS and NIOSH Occupational Health Supplement, 1999-2004, 2008-2010.

b. Severity of Occupational Injuries and MSD Illnesses

In this section we investigate whether there are potential biases due to differential underreporting of injuries. We expect that severe injuries are least likely to be forgotten or considered too minor to report, and as such, estimates of the differences in severe injury rates by legal immigration status, controlling for other important predictors, should be least likely to be biased due to differential underreporting. Estimates of differences by immigration status in rates of minor injuries that vary significantly from the estimates for severe injury rates would be consistent with differential underreporting of minor injuries. We discuss the results where the outcome variable is occupational injuries, followed by MSD illnesses.

<u>Occupational Injuries</u>

Our approach is as follows. For occupational injuries we estimated the model (equation 4) under two separate definitions: 1) conditional on getting medical treatment, minor injuries are those for which individuals reported having seen a doctor for treatment, and severe injuries are those that required hospitalization or the emergency department. Table 5 presents the results of our estimated model, including the baseline for ease of comparison. We note that in this table, specifications with controls refer to the more comprehensive set of controls, that is, the set of controls that are included in column 7 and 8 of Tables 3 and 4.

The estimated IRRs for the Work-unauthorized and US Citizens who were treated for by a doctor are larger than 1 and less than 1, respectively. However, the IRRs are not statistically significant. This suggests that there is no statistical evidence that US Citizens or Work-unauthorized workers reported higher or lower occupational injuries. These results are similar to those of Table 3, the baseline. When we examine Severe Injuries the overall results differ. First, the typical logit model provides an OR equal to 1.43, suggesting that US Citizens report higher rates of occupational injuries than work-authorized workers (column 1 of Table 5). However, this is not statistically significant. For Work-unauthorized workers the OR is 0.656, which if it were statistically significant would suggest that Work-unauthorized workers are less likely to report occupational injuries than work-authorized workers (column 1 of Table 5). Reading across from columns 1 to 5, we can observe that moving from results are similar between the Logit and the Poisson models, which is not surprising given that there is little variation in the number of injuries an individual report. Controlling for factors that are correlated with risk and immigration status, however, seems to matter the most as the IRR for US Citizens becomes statistically significant at the 5 percent, and it is 2.24, which indicates that the occupational injury rate is higher for US Citizens workers than work-authorized

workers. While controlling for the full set of socio-demographic factors (column 3) results in an IRR that is larger and closer to one, the IRR is not statistically significant.

Table 5.- Legal Immigration Status and Reporting of Occupational Injuries

	Logit (1)	Poisson (2)	Poisson (3)	Poisson (4)	NB (5)
Panel A:Baseline					
USC	0.967	0.973	1.043	1.351	1.352
	(0.261	(0.255)	(0.276)	(0.363)	(0.364
Unauthorized	0.602	0.608*	0.686	0.746	0.748
	(0.150	(0.147)	(0.168)	(0.188)	(0.187
Panel B: Minor Injuries					
USC	0.767	0.769	0.824	1.238	1.247
	(0.307	(0.305)	(0.331)	(0.583)	(0.583)
Unauthorized	0.706	0.708	0.798	0.861	0.865
	(0.287	(0.286)	(0.324)	(0.408)	(0.402)
Panel C: Severe Injuries					
USC	1.436	1.428	1.531	2.240*	2.216**
	(0.509	(0.499)	(0.539)	(0.856)	(0.835)
Unauthorized	0.656	0.658	0.742	0.952	0.945
	(0.226	(0.225)	(0.255)	(0.414)	(0.409)
Exposure-	N	N	Y	Y	Y
Controls[a]	N	N	N	Y (D)	Y (D)

Notes: Standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$. The omitted category includes individuals who are legally authorized to work in the U.S. Each cell represents a separate regression, where the estimate denotes the incidence rate ratio (IRR) (columns 2-5) from a negative binomial regression or the odds ratio (OR) (column 1) of a logit regression of injuries for a given type of injury on two dummy variables denoting native-born or work-authorized status, and a set of controls (D). Severe injuries are those that were treated at a hospital or urgent care center, minor injuries are those that were treated at a physician's office, or migrant clinic. The set of controls (D) are listed in Appendix Table A1. Period includes 1999, 2002-2004, and 2008-2010.

We also examined the heterogeneity in the estimates by the duration of work days lost, where days lost is defined in three categories: fewer than 5 days, 5-16 days, and more than 16 days. These categories were based on the 50th, and 75th percentiles of work days lost due to injury. For brevity, we only present the results of the model under a negative binomial distribution with a fully-loaded set of controls in Figure 1, but all other estimates are available upon request. As a means of comparison, we present the estimates when the outcome variable is the count of any kind of injury, Minor Injuries, and Severe Injuries. The IRRs are presented in Figure 1. Albeit most of these results are not

statistically significant, these results point to potential differences in the type of injury reported and work days lost due to the injury by immigration status.

Figure 1.- Occupational Injuries by Days Lost and Type of Injury
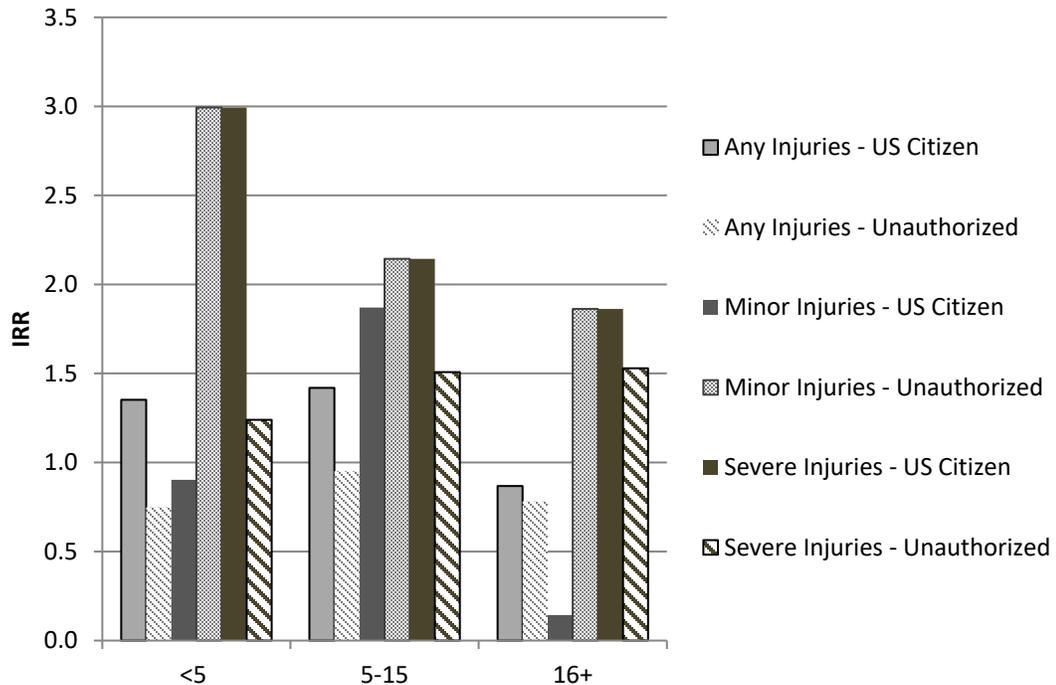
Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Each cell/bar represents a separate regression, where the estimate denotes the incidence rate ratio (IRR) from a negative binomial regression of injuries two dummy variables denoting native-born or work-authorized status, and a set of controls (D) for the given duration of work days lost. The omitted category is work-authorized. The set of controls (D) are listed in Appendix Table A1. Severe injuries are those that were treated at a hospital or urgent care center, minor injuries are those that were treated at a physician's office, or migrant clinic. Period includes 1999, 2002-2004, and 2008-2010.

MSD Illnesses

The data provide us with information regarding the type of body part that was affected by MSD pain, the number of work days lost as well as the number of days the individual had difficulty working. NAWS also asks respondents to self-rate the severity of the pain (no pain, bearable, unbearable), so we use this information to investigate if there are differences in the MSD rates.

In Table 6 Panel A below, we present the estimates where the outcome variable is the count of body parts affected by MSD pain. Panel B shows the estimates where the outcome variable is the count of body parts affected by severe pain, where severe pain is defined by pain being reported as "unbearable". The results from Table 6 suggest that the work-unauthorized workers are less likely than work-authorized workers to report MSD-related injuries. This result is robust across the models under consideration.

Table 6.- Legal Immigration Status and Reporting of MSD Illnesses

	Logit	Poisson	Poisson	Poisson	NB
	(1)	(2)	(3)	(4)	(5)
Panel A: Outcome: Any Body Part Afflicted by MSD Pain					
USC	0.841	0.865	0.965	1.200*	1.195
	(0.0992)	(0.0858)	(0.0939)	(0.133)	(0.135)
Unauthorized	0.679***	0.718***	0.797***	0.670***	0.658***
	(0.0616)	(0.0555)	(0.0621)	(0.0573)	(0.0587)
Panel B: Outcome: Any Body Part Afflicted by Severe MSD Pain					
USC	0.742	0.754	0.842	1.163	1.166
	(0.137)	(0.132)	(0.147)	(0.219)	(0.227)
Unauthorized	0.565***	0.580***	0.643***	0.524***	0.520***
	(0.0711)	(0.0692)	(0.0761)	(0.0916)	(0.0927)
Exposure-adjusted	No	No	Yes	Yes	Yes
Controls	No	No	No	Yes (D)	Yes (D)

Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The omitted category includes individuals who are legally authorized to work in the U.S. Each cell represents a separate regression, where the estimate denotes the incidence rate ratio (IRR) (columns 2-5) from a negative binomial regression or the odds ratio (OR) (column 1) of a logit regression of injuries for a given type of MSD on two dummy variables denoting US citizen or work-authorized status, and a set of controls (D). Severe MSDs are those that were associated with "unbearable" or "a lot" of pain. The set of controls (D) are listed in Appendix Table A1. Period includes 1999-2004, and 2008-2010.

Some studies (Thierry and Snipes 2015) suggest that treatment-seeking decisions may be specific to isolated injury contexts. Recognizing these studies we examine differences in injury rates by body type. Column 1 of Table 7 below presents estimated IRRs based on MSD-related injuries that were considered severe based on self-reported pain levels. Each panel represents a separate outcome denoting severe pain in a given body part. All specifications control for the full-set of socio-demographic characteristics, and they are estimated under the negative binomial distribution. The estimated IRRs vary in magnitude by the type of body part affected, but in some cases, the IRR is not statistically

significant. For example, there is no statistical evidence that US Citizens or Work-unauthorized workers report more or less back-related MSD illnesses. US Citizens are more likely than work-authorized workers to report neck or should pain, and this association is statistically significant at the 5 percent. While the magnitude of the IRRs (IRR=1.906 for US Citizens and IRR=1.379 for Work-unauthorized) would suggest higher incidence of MSD pain associated with the hands or wrists for both US Citizens and Work-unauthorized workers (relative to work-authorized), this estimate is not statistically significant.

We also examined whether there was differential reporting of MSD injuries based on the number of days that the individual was unable to work due to the injury, and separately, based on the number of days that the individual reported having difficulty working. We did this by distinguishing between Low (columns 2-3 of Table 7) and High (columns 4-5 of Table 7) duration of exposure to the injury. Specifically, "Low" number of days was based on the number of days that were below the 50th percentile, and "High" was based on the number of days that fell above the 75th percentile of the distribution..

Comparing the results from columns (2) and (4), the IRRs indicate that Work-unauthorized workers experience higher rates of injuries associated with hands/wrists, and arms/elbows when the injury results in fewer lost work days. This difference is statistically significant at the 1%. On the other hand, when we looked at High lost work days, we found that relative to work-authorized workers, US Citizens have higher rates of injuries associated with arms/elbows (see column 4). While the magnitude of the IRR related to Work-unauthorized workers would suggest that Work-unauthorized workers have higher rates of injuries relative to work-authorized workers, this difference is not statistically significant. We do not find a clear patter when we examine the IRRs based on days an individual reported having difficulty working.   We anticipated that injuries requiring higher numbers of days away from work are likely to represent similar underlying levels of severity. However, the results do not provide a clear pattern that would lead us to this conclusion for MSD injuries.

Table 7.- Legal Immigration Status and Reporting of MSD Illnesses: By Severity and Body Part Affected

		Low Number of Days		High Number of Days	
	Severe Pain (1)	Work Days Lost (2)	Days Difficulty Working (3)	Work Days Lost (4)	Days Difficulty Working (5)
Panel A: Outcome: Had Pain in Back					
USC	0.872	1.244	1.092	0.713	1.210
	(0.237)	(0.697)	(0.33)	(0.193)	(0.395)

Unauthorized	0.749	0.643	0.774	0.774	0.832
	(0.135)	(0.271)	(0.152)	(0.152)	(0.286)
Panel B: Outcome: Had Pain in Neck, Shoulder					
USC	1.838*	2.503	1.512	1.832	1.150
	(0.631)	(1.591)	(0.814)	(0.777)	(0.542)
Unauthorized	0.912	1.208	0.366**	0.922	1.404
	(0.237)	(0.624)	(0.162)	(0.255)	(0.587)
Panel C: Outcome: Had Pain in Arm, Elbow					
USC	2.722**	0.263	7.219***	4.606***	11.60***
	(1.163)	(0.32)	(4.998)	(2.273)	(10.46)
Unauthorized	1.21	14.17***	1.712	1.276	0.957
	(0.377)	(10.38)	(0.889)	(0.445)	(0.671)
Panel D: Outcome: Had Pain in Hands, Wrists					
USC	1.906	4.215**	1.428	2.241	4.582**
	(0.872)	(2.541)	(0.922)	(1.212)	(2.782)
Unauthorized	1.379	82.43***	1.699	0.977	1.802
	(0.381)	(89.46)	(0.946)	(0.257)	(0.894)
Panel E: Outcome: Had Pain in Legs, Toes, Other					
USC	1.184	0.442	0.976	0.972	0.794
	(0.516)	(0.231	(0.492)	(0.433)	(0.381)
Unauthorized	0.939	1.512	2.044**	1.479	0.885
	(0.354)	(0.668)	(0.655)	(0.536)	(0.323)
Off-set	No	No	Yes	Yes	Yes
Controls	No	No	No	Yes (D)	Yes (D)

Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The omitted category includes individuals who are legally authorized to work in the U.S. Each cell represents a separate regression, where the estimate denotes the incidence rate ratio (IRR) from a negative binomial of MSDs associated with specific body parts on two dummy variables denoting US citizen or work-authorized status, and a set of controls (D). The set of controls (D) are listed in Appendix Table A1.   All models include the exposure adjusted MSD rates. Period includes 1999-2004, and 2008-2010.

c. Recall Bias

Another potential source of bias which may or may not play a role in our findings is recall bias due to memory decay. On the one hand, if work-unauthorized immigrants' US farm work experience is, on average, more recent, then they may be more likely to recall their occupational injuries than legally authorized workers who may have worked more of the past 12 months but forgotten injuries which occurred earlier in the period. On the other hand, research has found potent effects of stress on memory processes, thus we might expect that the higher levels of acculturative stress experienced by work-unauthorized immigrants could lead to recall difficulties and greater memory decay. Whether or not there is any differential impact of memory decay, research has shown that injury rates calculated on 12-month reporting periods are biased downward due to memory decay, and thus in this section we address this potential source of bias.

Specifically, we compare differences in annualized injury rates using counts of injuries based on 90-, 120-, and 180-day recall. These measures were adjusted using the proportion of the last month worked in US farm work based on the restricted Work History data file. We note that sample sizes did not permit us to estimate this for 30- or 60-day recall for all outcome measures examined. Furthermore, we were unable to estimate these models for MSD injuries.

In Figure 2 below we present the results under the negative binomial distribution and comparing severe injuries (those treated at a hospital or emergency department) against mior injuries (those treated by a doctor). IRRs that are statistically significant are identified by an asterisk. Figure 2 shows three interesting patterns. First, the magnitude of the IRRs between US Citizens and work-authorized workers is larger than the IRRs between Work-unauthorized and work-authorized workers. Second, the magnitude of the IRRs is larger for severe injuries when compared to that of minor injuries. Third, the IRR becomes larger as the length of the number of days between the occurrence of the injury and the survey date shortens. For example, the estimated difference in injury rates that occurred 180 days since the survey date is 2.159 and statistically insignificant for US Citizens. The estimate becomes 2.806 and statistically significant at the 10 % level when estimate the injury rate based on injuries that occurred 120 days prior to the survey date. At 90 days, the difference in injury rates doubles (4.47) and it becomes statistically significant at the 5% level. At 60 days, the difference in injury rates becomes larger (5.35) and statistically significant at the 10% level. For work-unauthorized workers the pattern is less clear, but we still observe that the magnitude of the IRR increased as we moved from 180-day recall to a 60-day recall when we examine severe injuries but it is not observed for minor injuries. These finding are supportive of our hypothesis regarding memory recall; injuries that occurred closer to the interview date are more likely to be remembered than those that occurred further in the past.

Figure 2.- MSD Illnesses and Differential Recall Bias (Relative to Work-Authorized Foreign born)
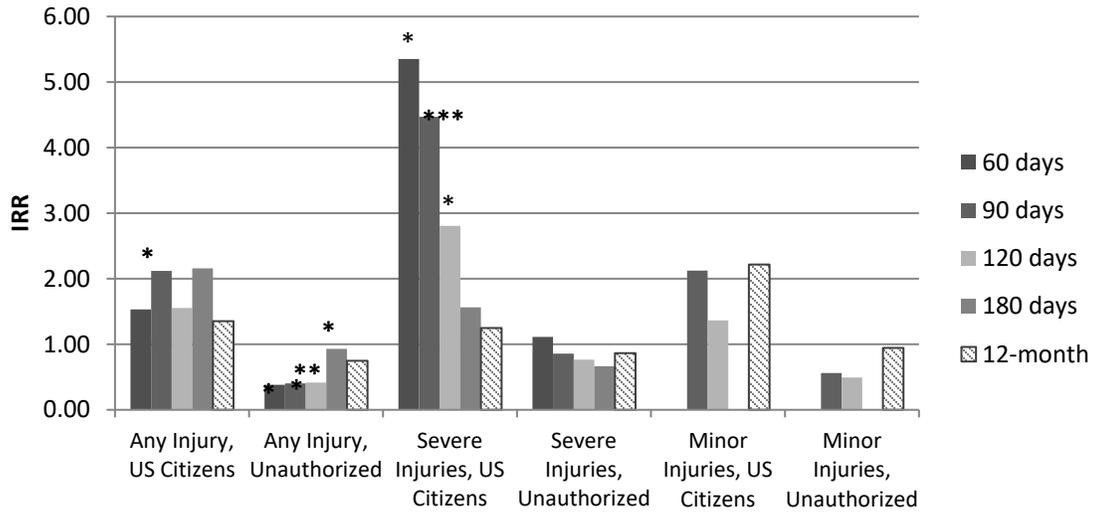
Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Each cell/bar represents a separate regression, where the estimate denotes the incidence rate ratio (IRR) from a negative binomial regression of injuries two dummy variables denoting US citizen or work-authorized status, and a set of controls (D). The omitted category is work-authorized. The set of controls (D) are listed in Appendix Table A1. Severe injuries are those that were treated at an emergency room, hospital or health center, minor injuries are those that were treated at a physician's office, or migrant clinic. Number of days used to examine memory recall is the length of time between the reported injury date and the survey date. Period includes 1999, 2002-2004, and 2008-2010.

d. Incidence of Injuries and MSDs and Tenure with Employer

In addition to the specified aims, we conducted additional analyses that examined differences in injury or MSD prevalence by duration of employment with current employer. This measure is self-reported, and the models were estimated separately for "0-1 years" (determined by those observations below the 50th percentile of the distribution), "2-3 years" (determined by those observations between the 50th and 75th percentile), and "4 or more years" (determined by those observations at or above the 75th percentile).

Figure 3 present the estimated IRRs for Unauthorized and USC, comparing them across all injuries, severe and minor injuries. The omitted category is foreign-born agricultural workers that are work-authorized, LPR+. The incidence of injuries for USC workers is higher compared to foreign-born workers, with the difference being statistically significant for those who have been with their current employers for 2-3 years (IRR=1.394). The incidence rate of injuries for work-unauthorized workers is higher relative to LPR+, for 0-1 years but this difference is not statistically significant (IRR=1.352). Unlike the estimated IRR for US citizens, the estimated IRR indicates that

the incidence rate for work-unauthorized workers is lower compared to LPR+ workers who have been with their current employer for 2-3 years—a result that is statistically significant at the 5 percent level. When we examine workers whose tenure with current employer is 4 or more years, we do not find statistical evidence that the incidence rates are different across the groups.

So far, we have found that incidence rates may also depend on the severity of the injury. To examine this further, we estimate the models separately by severe and minor injuries across the 0-1, 2-3, and 4+ years of tenure with current employer (presented in Figure 3). The results show that US citizens and work-unauthorized workers have higher rates of severe injuries compared to LPR+ workers. The difference is statistically significant at the 5 percent level for US citizens whose tenure with their employer is 2-3 years (IRR=3.13) and 4 or more years (IRR=2.58). For work-unauthorized workers, the difference is statistically significant only for those that have 1 year or less of work experience with their current employer (IRR=2.839). There is no statistically significant evidence that there are differences in incidence rates for workers who experience minor injuries—a finding that is consistent independent of the duration of employment with current employer.

We also investigated whether there were differences in the incidence of MSD illnesses by duration of employment with current employer, estimating the models separately by type of body part affected. The estimated IRRs of these specifications are presented in Figure 4, with the statistical significance denoted by the asterisks above the bars. The IRRs for work-unauthorized workers suggest lower incidence rates than work-authorized workers for MSD illnesses that affected the back (0-1 years, and 4+ years), neck or shoulder (4+ years), arms and elbows (4+ years), and legs or toes (4+ years). The IRRs suggest there is difference in the incidence rate of MSD illnesses between US citizens and work-authorized workers except for MSD illness afflicting the hands and wrists; this finding is statistically significant at the five percent level for workers with tenure in the 2-3 years category, and only marginally statistically significant for workers in the 0-1 employer tenure category. Similarly, the estimates suggest that the incidence rate of MSD illnesses that affect the hands and wrists is greater among work-unauthorized workers than work-authorized workers (IRR=6.651) whose work tenure with current employer is less than year 1 year.

Figure 3.- Occupational Injuries by Tenure with Employer
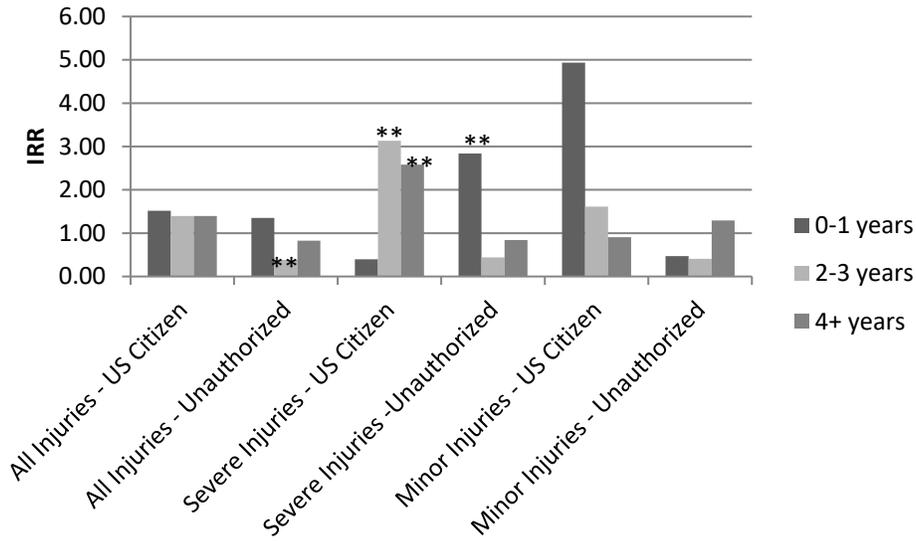
Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Each cell/bar represents a separate regression, where the estimate denotes the incidence rate ratio (IRR) from a negative binomial regression of injuries two dummy variables denoting US citizen or work-authorized status, and a set of controls (D). The omitted category is work-authorized. The set of controls (D) are listed in Appendix Table A1. Severe injuries are those that were treated at a emergency room, hospital or health center, minor injuries are those that were treated at a physician's office, or migrant clinic. Tenure denotes duration of employment (which can be non-consecutive) with current employer at the time of survey interview date. Period includes 1999, 2002-2004, and 2008-2010

Figure 4.- MSD Illnesses by Employer Tenure
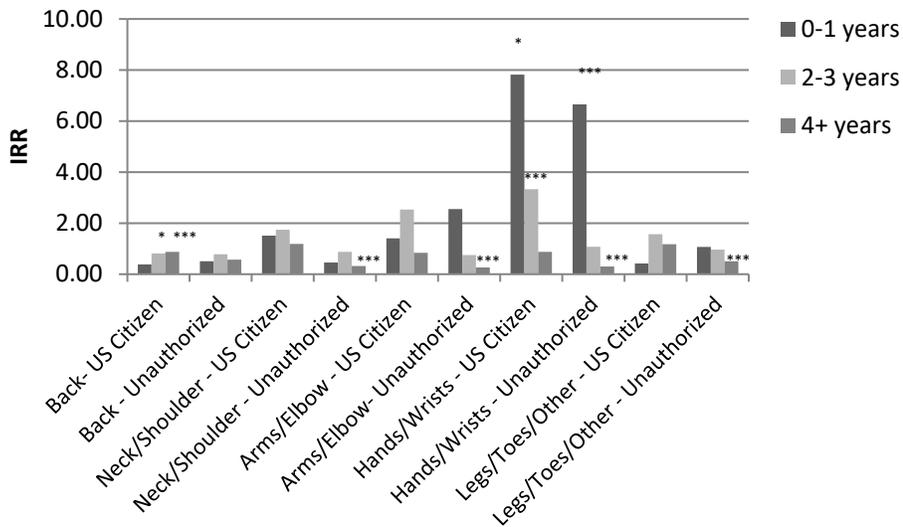
Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Each cell/bar represents a separate regression, where the estimate denotes the incidence rate ratio (IRR) from a negative binomial regression of injuries two dummy variables denoting US citizen or work-authorized status, and a set of controls (D). The omitted category is work-authorized. The set of controls (D) are listed in Appendix Table A1. Tenure denotes duration of employment (which can be non-consecutive) with current employer at the time of survey interview date. Period includes 1999-2004, and 2008-2010.

e. Alternative Specification: Combining Immigration Status

In the analyses that we have presented thus far, we considered the differences in incidence rate between US citizens LPR+ farmworkers and between unauthorized and LPR+ farmworkers. We did because we believed that LPR+ workers are a more appropriate comparison group. The existing literature typically compares unauthorized workers with all work-authorized (foreign-born and native-born US citizens combined). In this subsection, we present the results of re-estimating our specifications with a dummy variable that is equal to one when the agricultural worker is unauthorized and zero if the worker is either LPR+ or US citizen. The results where the outcome variable is occupational injuries are presented in Table 8 (baseline specifications as well as estimates by severity of injury and number of days lost), Table 9 (memory recall), and Table 10 (severe and minor injuries by tenure of employment with current employer). Tables 11 and 12 present select specifications where the outcome is MSD illnesses.

Alternative Specifications: Occupational Injuries

When we look at the results for the baseline specifications, the estimates suggest there is no difference in the incidence of injuries between work-unauthorized and work-authorized workers (row 1 of table 8) once we control for demographic characteristics and estimate the NBR model. This result remains when we examine the results for minor (row 2 of Table 8), and severe injuries (row 3 of Table 8). (Rows 1-3 of Table 8 can be compared with the results of Table 6.) Under the preferred specification (the NBR model), the specifications that combine foreign-born and US-born citizens into one category and examines differences in incidence rates by the number of days lost due to an injury (rows 4-6 of Table 8), the magnitude of the coefficients increase as the number of days lost due to an injury increase, e.g., the IRR for losing less than 5 days is 0.921, while the IRR for losing more than 16 days is 1.372. This increase in the magnitude of the IRRs would be expected if more severe injuries are associated with greater number of days lost. However, we caution against making that conclusion since the estimates are not statistically significant.(Similar estimates of the specifications that include two dummy variables to compare US-born workers with foreign-born, and then foreign-work with work-unauthorized, are presented in Figure 1).

Table 9 presents the results of the specifications that examine whether there is evidence of memory recall by including the indicator variable that defines work-authorized

workers independent of worker's nativity. The results suggest there is no statistical evidence of memory recall between work-unauthorized and work-authorized workers. The coefficients increase as the duration of the injury increases from the survey date, a finding that is consistent with memory recall, albeit the results under the preferred specification are not statistically significant. (Parallel specifications including two dummies are presented in Figure 2).

Consistent with the previous analyses, in Table 10 we present the results of the specifications which estimate the incidence of injuries between work-unauthorized workers and work-authorized workers by duration of tenure with current employer. Specifically, we compared the incidence rates by severity of the injury. Rows 1-3 present the estimates of severe injuries separately for tenure that is 0-1 years, 2-3 years and 4+ years. Similarly, the estimates for minor injuries are presented in rows 4-6. Column 1 of Table 10 represents the typical specification that is estimated, a logit regression without the off-set and demographic controls.

We note the following from the results presented in Table 10. First, the magnitude of the coefficients is larger than one for severe injuries of workers that have less than 1 year with current employer—suggesting that work-unauthorized migrants have greater incidence rates than work-authorized workers, but it is not statistically significant for most specifications. Second, except for minor injuries of workers whose tenure with employer is 4 or more years, the magnitude of the coefficients for minor injuries is less than one but it is not statistically significant. A coefficient that is less than 1 would suggest that the injury rate of work-unauthorized workers is not different than those of work-authorized migrants. This conclusion remains as we revise the specifications by first moving to a Poisson model (column 2), then adding an offset (column 3). Once the models control for demographic characteristics (column4), one of the results becomes statistically significant at the 5 percent level (row 1, column 4). Under the preferred specification (the NBR), the results suggest that the injury rates of severe injuries of workers whose tenure is less than 1 year is higher than that of work-authorized workers (column 8). This association is statistically significant at the 5 percent. These findings suggest there are differences arising not only by immigration status, but also by severity of the injury and duration of tenure with current employer.

Alternative Specifications: MSD Illnesses

Table 11 presents the results of running the baseline specifications where the outcome variable is Any MSD (row 1) and, separately, for Any Severe MSD (row 2). Rows 3 and 4 of Table 11 show the results of the specifications that focus on severe injuries that have low and high days of work days lost. All the specifications are presented under the different eight models discussed above. The results show an estimate that is less than one for the coefficient of interest. The results are also statistically significant at least at the 5

percent level of significance. Combined these results suggest that the incidence of MSDs is lower for unauthorized workers than it is for the omitted category (LPR+ and USC). The results are qualitatively similar when we examine the same outcome but focus on the duration of employment with current employer (Table 12).

f. Alternative Specification: Country of Residence

During review of the data we found a variable that we believed captured important information about an individual's acculturation or assimilation. This variable captured individual's responses to the country that the respondent considered to be his or her permanent country of residence. This variable was captured until 2002, but beginning in 2003 this variable was no longer part of NAWS. We conducted an analysis on the subset of the data that contained this variable and ran the specifications using occupational injuries as the outcome measure. In Appendix Table A2 we present the results of the negative binomial distribution where the model includes two dummies that capture the incidence rate of occupational injuries between USC and LPR+ and Unauthorized and LPR+, separately. When the outcome is "Any Injuries" (column 1), the IRRs of USC and Unauthorized are both greater than one, suggesting that the incidence rate of each of these groups is greater than the missing category, LPR+. However, the IRRs are not statistically significant. The coefficient of the variable indicating whether the respondent considered the US to be his or her permanent country of resident is greater than 3.0 and it is statistically significant at the 1 percent level. This result suggests that the incidence rate is greater among those who report that their country of permanent residence is not the US. Column (2) of Table A2 shows the same specification but focusing on minor injuries (those that were treated in clinic or at a physicians' office). The IRRs of USC and Unauthorized are greater than 1, and in this case, the IRR for Unauthorized in statistically significant at the 5 percent (IRR=2.717). Unlike the results of column (1), the coefficient of whether the US is the respondent's country of residence is not statistically significant, albeit it is greater than 1. Finally, when we examined these specifications for severe injuries, the IRRs remain greater than one and statistically insignificant, but the coefficient indicating whether the US is the respondent's country of residence is statistically significant.

Table 8.- Alternative Specification: Occupational Injuries and Unauthorized Workers vs LPR+ and US Citizens

Row/Outcome Measure	(1) Logit	(2) Poisson	(3) Poisson	(4) Poisson	(5) Poisson	(6) Poisson	(7) Poisson	(8) NBR
1: Unauthorized-Baseline	0.613***	0.617***	0.670**	0.755	0.688*	0.646**	0.708	0.710
	(0.115)	(0.112)	(0.123)	(0.179)	(0.154)	(0.118)	(0.171)	(0.171)
2: Unauthorized-Minor Injuries	0.809	0.810	0.880	0.843	0.969	0.862	0.820	0.821
	(0.267)	(0.265)	(0.292)	(0.341)	(0.408)	(0.268)	(0.403)	(0.395)
3: Unauthorized-Severe Injuries	0.530***	0.533***	0.579**	0.786	0.711	0.570**	0.815	0.812
	(0.129)	(0.129)	(0.140)	(0.308)	(0.222)	(0.142)	(0.306)	(0.305)
4: Days Lost - <5 Days	0.379***	0.381***	0.414***	0.764	0.635	0.404***	0.904	0.921
	(0.131)	(0.131)	(0.141)	(0.306)	(0.214)	(0.138)	(0.361)	(0.355)
5: Days Lost - 6-15 Days	0.553**	0.556**	0.603*	1.099	0.892	0.587**	1.246	1.254
	(0.150)	(0.150)	(0.162)	(0.347)	(0.259)	(0.148)	(0.409)	(0.404)
6: Days Lost - 16+ Days	1.436	1.158	1.388	1.537	1.187	1.072	1.330	1.372
	(0.988)	(0.310)	(0.442)	(0.452)	(0.462)	(0.369)	(0.417)	(0.522)
Off-set	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Controls	No	No	No	Yes (A)	Yes (B)	Yes (C)	Yes (D)	Yes (D)

Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Each cell represents a separate regression, where the coefficient estimate denotes the incidence rate ratio (column 2-8) or the odds ratio (column 1) of the dummy variable that is equal to 1 if the respondent is "work-unauthorized" and 0 if the respondent is either a "LPR+" or "USC" farm worker. The set of controls (D) are listed in Appendix Table A1. Severe injuries are those that were treated at a hospital or urgent care center, minor injuries are those that were treated at a physician's office, or migrant clinic. Days Lost are self-reported and denote the number of days farm worker reported to be unable to work due to farm work related injury. Period includes 1999, 2002-2004, and 2008-2010.

Table 9.- Alternative Specification: Memory Recall Bias in Occupational Injuries

Row/Outcome Measure	(1) Logit	(2) Poisson	(3) Poisson	(4) Poisson	(5) Poisson	(6) Poisson	(7) Poisson	(8) NBR
1: Severe Injuries - 90 Days	0.365**	0.366**	0.479*	0.474	0.696	0.460*	0.521	0.515
	(0.152)	(0.152)	(0.202)	(0.241)	(0.311)	(0.184)	(0.293)	(0.285)
2: Severe Injuries - 120 Days	0.260***	0.262***	0.341***	0.464	0.549*	0.351***	0.536	0.535
	(0.0965)	(0.0967)	(0.128)	(0.220)	(0.199)	(0.124)	(0.270)	(0.266)
3: Severe Injuries - 180 Days	0.417***	0.419***	0.547*	0.757	0.714	0.530**	0.748	0.763
	(0.135)	(0.135)	(0.179)	(0.318)	(0.256)	(0.162)	(0.334)	(0.335)
Off-set	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Controls	No	No	No	Yes (A)	Yes (B)	Yes (C)	Yes (D)	Yes (D)

Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Each cell represents a separate regression, where the coefficient estimate denotes the incidence rate ratio (column 2-8) or the odds ratio (column 1) of the dummy variable that is equal to 1 if the respondent is "work-unauthorized" and 0 if the respondent is either a "LPR+" or "USC" farm worker. The set of controls (D) are listed in Appendix Table A1. Severe injuries are those that were treated at an emergency room, hospital or health center, minor injuries are those that were treated at a physician's office, or migrant clinic. Memory recall is examined by calculating the length of time between the reported injury date and the survey date. Period includes 1999, 2002-2004, and 2008-2010.

Table 10.- Alternative Specification: Examine Association between Injuries, Work-Authorized Status and Duration of Employment with Current Employer

Row/Outcome Measure	(1) Logit	(2) Poisson	(3) Poisson	(4) Poisson	(5) Poisson	(6) Poisson	(7) Poisson	(8) NBR
1: Severe Injuries - Tenure 0-1 years	1.420	1.417	1.139	3.575**	1.579	1.302	3.085**	3.038**
	(0.663)	(0.656)	(0.520)	(2.028)	(0.690)	(0.558)	(1.587)	(1.524)
2: Severe Injuries - Tenure 2-3 years	0.221***	0.224***	0.203***	0.460	0.313***	0.212***	0.357**	0.359**
	(0.100)	(0.100)	(0.0906)	(0.250)	(0.106)	(0.0844)	(0.184)	(0.178)
3: Severe Injuries - Tenure 4+ years	0.644	0.648	0.612	0.624	0.690	0.576	0.708	0.710
	(0.213)	(0.212)	(0.200)	(0.330)	(0.299)	(0.201)	(0.331)	(0.327)
4: Minor Injuries - Tenure 0-1 years	0.826	0.827	0.665	0.777	0.388	0.721	0.339*	0.331*
	(0.660)	(0.658)	(0.537)	(0.498)	(0.248)	(0.487)	(0.221)	(0.215)
5: Minor Injuries - Tenure 2-3 years	0.649	0.651	0.588	0.446	0.749	0.707	0.329*	0.347*
	(0.382)	(0.380)	(0.344)	(0.365)	(0.420)	(0.359)	(0.214)	(0.212)
6: Minor Injuries - Tenure 4+ years	1.386	1.381	1.305	1.236	1.456	1.314	1.327	1.316
	(0.603)	(0.594)	(0.566)	(0.602)	(0.821)	(0.539)	(0.691)	(0.651)
Off-set	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Controls	No	No	No	Yes (A)	Yes (B)	Yes (C)	Yes (D)	Yes (D)

Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Each cell represents a separate regression, where the coefficient estimate denotes the incidence rate ratio (column 2-8) or the odds ratio (column 1) of the dummy variable that is equal to 1 if the respondent is "work-unauthorized" and 0 if the respondent is either a "work-authorized immigrant" or "native-born farmworker". The set of controls (D) are listed in Appendix Table A1. Severe injuries are those that were treated at an emergency room, hospital or health center, minor injuries are those that were treated at a physician's office, or migrant clinic. Tenure denotes duration of employment (which can be non-consecutive) with current employer at the time of survey interview date. Period includes 1999, 2002-2004, and 2008-2010.

Table 11.-Alternative Specification: Examine Association Between MSDs, Work-Authorized Status, and Duration of Days Lost Due to MSD Pain/Discomfort

Row: Outcome	(1) Logit	(2) Poisson	(3) Poisson	(4) Poisson	(5) Poisson	(6) Poisson	(7) Poisson	(8) NBR
1: Any MSD, Unauthorized	0.744***	0.776***	0.811***	0.650***	0.730***	0.786***	0.650***	0.639***
	(0.0658)	(0.0590)	(0.0626)	(0.0537)	(0.0543)	(0.0590)	(0.0550)	(0.0566)
2: Any Severe MSD, Unauthorized	0.659***	0.671***	0.702***	0.553***	0.596***	0.654***	0.513***	0.508***
	(0.0789)	(0.0769)	(0.0806)	(0.0878)	(0.0674)	(0.0767)	(0.0876)	(0.0884)
3: Any Severe MSD, Low Days Lost	0.891	0.901	1.013	0.740	0.895	0.915	0.614	0.600
	(0.273)	(0.249)	(0.291)	(0.290)	(0.230)	(0.254)	(0.190)	(0.201)
4: Any Severe MSD, High Days Lost	0.823	0.904	1.066	0.862	0.911	1.018	0.818	0.842
	(0.145)	(0.0817)	(0.114)	(0.132)	(0.110)	(0.114)	(0.151)	(0.170)
Off-set	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Controls	No	No	No	Yes (A)	Yes (B)	Yes (C)	Yes (D)	Yes (D)

Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Each cell represents a separate regression, where the coefficient estimate denotes the incidence rate ratio (column 2-8) or the odds ratio (column 1) of the dummy variable that is equal to 1 if the respondent is "unauthorized" and 0 if the respondent is either a "LPR+" or "USC" farm worker. The set of controls (D) are listed in Appendix Table A1. Severe MSDs are those MSDs for which the respondent indicated had pain that was unbearable. Tenure denotes duration of employment (which can be non-consecutive) with current employer at the time of survey interview date. Period includes 1999-2004, and 2008-2010.

Table 12.-Alternative Specification: Examine Relationship Between MSDs, Work Authorization Status and Duration of Employment with Current Employer

Row: Outcome	(1) Logit	(2) Poisson	(3) Poisson	(4) Poisson	(5) Poisson	(6) Poisson	(7) Poisson	(8) NBR
1: Any Severe MSDs - Tenure 0-1 years	0.819	0.826	0.649	0.791	0.540**	0.595*	0.596	0.569
	(0.260)	(0.250)	(0.196)	(0.373)	(0.147)	(0.181)	(0.277)	(0.257)
2: Any Severe MSDs - Tenure 2-3 years	0.728	0.738	0.655**	0.450***	0.644**	0.595*	0.500***	0.492***
	(0.144)	(0.140)	(0.125)	(0.105)	(0.141)	(0.181)	(0.127)	(0.128)
3: Any Severe MSDs - Tenure 4+ years	0.472***	0.486***	0.444***	0.392***	0.416***	0.437***	0.411***	0.411***
	(0.0833)	(0.0826)	(0.0746)	(0.0789)	(0.0738)	(0.0782)	(0.0868)	(0.0862)
4: Any MSDs - Tenure 0-1 years	1.085	1.073	0.842	0.701	0.763*	0.841	0.693	0.697
	(0.206)	(0.176)	(0.137)	(0.162)	(0.108)	(0.133)	(0.156)	(0.163)
5: Any MSDs - Tenure 2-3 years	0.957	0.962	0.854	0.817	0.829	0.841	0.845	0.830
	(0.134)	(0.118)	(0.104)	(0.118)	(0.105)	(0.133)	(0.134)	(0.138)
6: Any MSDs - Tenure 4+ years	0.478***	0.529***	0.483***	0.499***	0.488***	0.475***	0.522***	0.516***
	(0.0624)	(0.0608)	(0.0555)	(0.0685)	(0.0618)	(0.0551)	(0.0743)	(0.0750)
Off-set	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Controls	No	No	No	Yes (A)	Yes (B)	Yes (C)	Yes (D)	Yes (D)

Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Each cell represents a separate regression, where the coefficient estimate denotes the incidence rate ratio (column 2-8) or the odds ratio (column 1) of the dummy variable that is equal to 1 if the respondent is "unauthorized" and 0 if the respondent is either a "LPR+" or "USC" farm worker. The set of controls (D) are listed in Appendix Table A1. Severe MSDs are those MSDs for which the respondent indicated had pain that was unbearable. Tenure denotes duration of employment (which can be non-consecutive) with current employer at the time of survey interview date. Period includes 1999-2004, and 2008-2010.

5. DISCUSSION

Our study makes a number of contributions, both substantive and methodological, in understanding the occupational health of farmworkers. Substantively, we address the question of differences by immigration status in reported rates of occupational injuries and pain due to occupational musculoskeletal disorders.

Mines and co-authors (2004) found that work-unauthorized farmworkers in the NAWS report significantly *fewer* occupational injuries than their work-authorized counterparts. We were able to replicate the findings of Mines et al. (2004), who based their finding on a chi-squared test of the difference in respondents' yes or no answer to the survey item regarding occupational injuries in the past 12 months. However, we were also able to show that when we account for differences between the groups in weeks worked in US farm work during the past 12 months by modeling injury *rates*, the differences between unauthorized farmworkers and their work-authorized, non-US citizen counterparts are not statistically significant.

In other words, we show that the finding of significant differences in occupational injuries in the NAWS data by Mines et al. (2004) is due to methods which did not adjust for differences in exposure to compare occupational injury *rates*, and that there is, in fact, no significant difference in occupational injury rates by work authorization status in the NAWS data (for the combined years 1999, 2001-2004, and 2008-2012).

With regards to pain related to musculoskeletal disorders (MSD), unauthorized immigrants reported significantly lower incidence rates than legally authorized workers in all models. It is unclear to what extent this finding represents true differences in levels of MSD pain versus different thresholds for considering pain unusual or significant enough to report.

Based on our injury findings, we urge researchers to utilize statistical methods which correctly compare occupational injury and illness *rates* when comparing sub-groups within the NAWS and similar surveys. For our analysis we used the Stata statistical package to carry out poisson regression and negative binomial regression, specifying an offset to calculate rates (StataCorp 2011). Specifying the offset adds the term $\ln(t_i)$ in equations 2-4, which as noted can be re-arranged to produce a model with rates on the left-hand side (Long & Freese 2006).We found Stata's "poisson" command for poisson regression to run much faster than negative binomial regression via Stata's "nbreg" command or using Stata's "glm" general linear models command (StataCorp 2011). Negative binomial regression did not always converge, although the "glm" approach seemed to suffer less from this problem. Although it is computationally more intensive, negative binomial regression is preferable because it produces unbiased estimates on data that is overdispersed (Long and Freese 2006). Practically speaking, we found little if any substantive difference in estimates of IRRs between the two types of models, and thus relied on Poisson regression for exploring various models, and confirming the results of the final model using negative binomial regression. All of these regression commands are

compatible with weights and with Stata's "svy" command to account for the NAWS complex survey design.

We also note that most other commonly used statistical packages provide tools to estimate these models. In particular, SAS's "genmod" generalized linear models routine allows options for both Poisson and negative binomial regression (SAS Institute 2008). SAS also offers a routine called "countreg" specifically for regression models of count data, which provides additional options for poisson and negative binomial regression models (SAS Institute 2008). More information on these models is available in Hilbe (2011) and Long (1997).

Using these multivariate regression models allows us to control for risk factors other than work authorization which may differ among the samples and which may have independent effects on occupational injury and illness rates. Tables 1 and 2 show the considerable differences in risk factors including age, educational attainment, English ability, crop, and task. Controlling for these factors in a multivariate regression framework allows a comparison across work authorization statuses net of differences due to other measured factors. In the case of injuries (Table 3), we can see that controlling for the full set of variables (columns 7 and 8) moves the IRR for unauthorized closer to unity, while for MSDs (Table 4) adding the full set of control variables actually moves the IRR further away from one (columns 7 and 8). In both cases adding the additional controls addresses omitted variable bias.

Our analysis of potential differences in memory decay (recall bias), did not find evidence of differences in recall over time between unauthorized farmworkers and their authorized non-US citizen counterparts. We also did not observe a pattern of differences consistent with memory decay in our comparisons of USCs and LPR+ when considering *all* injuries. However we did see a pattern consistent with memory decay (significantly higher annualized relative rates for injuries over more recent reporting periods than longer reporting periods) between USCs and LPR+ only for injuries deemed severe (those treated at an emergency room, hospital, or health center). This suggests that comparisons of more severe occupational injuries between USCs and both LPR+ and unauthorized farmworkers could be biased by differences in memory decay when using injuries during the full 12 month recall period.

In designing both new surveys and approaches to analyze existing survey data, there is a trade-off between longer and shorter recall periods for occupational injuries. Shorter recall periods are likely to result in more *complete* reporting of injuries, but also fewer injuries about which to collect data. We believe the NAWS design strikes a good balance, because it records the dates of injuries reported, as well as the work history over the prior 12 months, allowing researchers to calculate and compare annualized injury rates over shorter or longer periods.

We also examined the data for evidence of differences in reporting behavior. Our hypothesis was that differences in reporting were more likely to take place with regards to less severe injuries, which might be more easily forgotten and/or concealed. Vulnerable workers might tend to hide more minor injuries if they felt that reporting them could reflect poorly on them (e.g., that they are clumsy or careless). Desires to conceal minor injuries from employers could impact reporting in the NAWS if respondents do not fully understand or trust the survey's confidentiality.

Our analysis of the full occupational injury supplement sample did not indicate that unauthorized workers were significantly more likely than legally authorized workers to report injuries severe enough to require treatment at an emergency room, hospital or health center. We did find that US citizen farmworkers were significantly more likely to report such severe workplace injuries on the NAWS. We did not find any significant differences between rates of reporting less severe injuries that were treated at a doctor's office or clinic.

Further analysis revealed that among workers with less than one year tenure at their current employer, unauthorized workers were significantly more likely to report severe injuries than legally authorized workers. The overall finding of significantly higher rates of severe injuries among US citizens seems to be driven by differences among farmworkers with 2 or more years of tenure at their employer.

On the whole, we did not find compelling evidence of differences in occupational injuries rates between work-authorized and unauthorized non-US Citizen farmworkers, nor clear and consistent evidence of differences in reporting behavior. Larger sample sizes would allow us to continue to narrow in on any smaller differences. Regarding MSDs, we did find that unauthorized farmworkers report significantly lower rates, but it remains unknown to what extent this reflects differences in underlying true rates, rather than differences in reporting behavior. Ultimately we can never say with absolute certainty that estimates based on self-reported data give unbiased estimates of differences in true rates. In industries where MSDs are believed to be common, it may be useful to collect data from clinical tests which detect indicators of inflammation (Wilander et al. 2014).

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APPENDIX

Table A1. Set of Demographic Variables

Variables	A	B	C	D
Age	X			X
Female	X			X
Speak Spanish	X			X
Speak Indigenous language	X			X
Speak other language	X			X
Do not speak English	X			X
Married	X			X
Task 1 (Pre-Harvest)	X			X
Task 3 (Post-Harvest)	X			X
Task 4 (Semi-Skilled)	X			X
Task 5 (Supervisor/Other)	X			X
Crop Risk	X			X
Migrant type 2 (Newcomer)	X			X
Migrant Type 3 (Settled)	X			X
Migrant type 4 (Shuttled)	X			X
Attended college	X			X
Age first did any farm work in the US		X		X
Have children		X		X
Live with nuclear family in the US		X		X
Have any education in the US		X		X
Own vehicle in the US		X		X
Can get non-farm work in 2 months			X	X
Expect to do farm work within next 5 years			X	X
Referred to farm work by friend or relative			X	X
Performed any kind of non-farm work			X	X
Lives in employer-owned housing			X	X

Note: Each column represents the set of demographic variables that are considered in the analyses.

Table A2. Legal Immigration Status and Reporting of Occupational Injuries: Sample Includes Information about Country of Permanent Residence

	Any Injuries (1)	Minor Injuries (2)	Severe Injuries (3)
USC	1.115	1.464	1.663
	(0.448)	(0.676)	(0.898)
Unauthorized	1.099	2.717**	1.304
	(0.324)	(1.303)	(0.812)
US is not permanent residence	3.939***	1.739	6.288***
	(1.441)	(0.927)	(3.409)
Exposure-adjusted	Yes	Yes	Yes
Controls	Yes (D)	Yes (D)	Yes (D)

Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The omitted category includes individuals who are legally authorized to work in the U.S (LPR+). The set of controls (D) are listed in Appendix Table A1. Results shown under the Negative Binomial model with set of demographic variables.

PUBLICATIONS

To date no manuscripts reporting results from the project are accepted for publication. The research team continues work on two manuscripts reporting results for submission to peer-reviewed journals. One manuscript deals with the importance of correctly estimating exposure adjusted occupational injury rates, while the other reports on results regarding memory decay and differences in severity of injuries.

INCLUSION ENROLLMENT TABLE

This study analyzed secondary data and it did not involve enrollment of subjects by the investigators. Inclusion Tables B1 and B2 provide the distribution by race/ethnicity for the samples analyzed.

Inclusion Table B1: MSD Illnesses sample of the NAWS dataset

Racial Categories	Ethnic Categories									Total
	Not Hispanic or Latino			Hispanic or Latino			Unknown or Not Reported Ethnicity			
	Female	Male	Unknown or Not Reported	Female	Male	Unknown or Not Reported	Female	Male	Unknown or Not Reported	
American Indian/Alaska Native	4	13		198	1,441		1	1		1,658
Asian	4	8		-	8		4	1		25
Native Hawaiian or Other Pacific Islander	7	13		1	-		-	1		22
Black or African American	97	746		15	87		4	82		1,031
White	745	1,969		1,468	5,718		46	79		10,025
More Than One Race or Other	16	74		1,920	9,566		3	10		11,589
Unknown or Not Reported	1	2		67	299		5	12		386
Total	**874**	**2,825**	**-**	**3,669**	**17,119**	**-**	**63**	**186**	**-**	**24,736**

Inclusion Enrollment Table B2: Occupational Injury Sample of the NAWS

| Racial Categories | Ethnic Categories | | | | | | | | | Total |
| | Not Hispanic or Latino | | | Hispanic or Latino | | | Unknown or Not Reported Ethnicity | | | |
	Female	Male	Unknown or Not Reported	Female	Male	Unknown or Not Reported	Female	Male	Unknown or Not Reported	
American Indian/Alaska Native	4	11		169	1,039		1	1		1,225
Asian	4	8		-	8		3	1		24
Native Hawaiian or Other Pacific Islander	6	11		1	-					18
Black or African American	58	563		12	75		-	57		765
White	581	1,660		1,037	4,011		22	45		7,356
More Than One Race or Other	12	58		1,454	7,309		2	9		8,844
Unknown or Not Reported	1	2		33	148		1	9		194
Total	**666**	**2,313**	**-**	**2,706**	**12,590**	**-**	**29**	**122**	**-**	**18,426**

INCLUSION OF GENDER AND MINORITY STUDY SUBJECTS

The majority of NAWS respondents were Hispanic males because this is representative of the target population in the Agricultural sector. About 25% of the total study population was female.

INCLUSION OF CHILDREN

No subjects less than 18 years of age were included as the secondary analysis of the data. Data from NAWS did not capture information on the study topic for children, and therefore children were excluded.