

Injuries to Hired Crop Workers in the United States—A Descriptive Analysis of a National Probability Survey

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Background Little empirical data are available examining the injury experience of hired crop workers in the United States (US). This study analyzed work-related injury data collected on these workers from a national survey.

Methods Data were collected through the National Agricultural Workers Survey (NAWS) for the federal fiscal years 1999, 2002, 2003, and 2004. These data provided descriptive injury characteristics and rate estimates from a sample of 13,604 crop farm workers.

Results The injury rate was 4.3 injuries per 100 week-based full-time equivalents (FTE_{WB}). The majority of the injuries occurred to male (84%) and Mexican born (72%) workers. Shuttle migrants had the highest injury rate at 7.2 injuries/100 FTE_{WB} . Workers reporting one or more health conditions and workers reporting one or more musculoskeletal complaints had higher injury. The most common injury events were overexertion from lifting (20%), being struck by hand held objects (13%), and falls to a lower level (10%). Injuries due to falls to a lower level accounted for the highest average number of restricted workdays (45 days).

Conclusions The use of hand tools, falls, and lifting overexertion injuries were identified as significant causes of injury among hired crop workers. Increased injury risk was also seen for crop workers with existing health or musculoskeletal complaints. These results are useful for targeting injury prevention efforts and future research needs for this unique worker population. *Am. J. Ind. Med.* 54:734–747, 2011.

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KEY WORDS: crop workers; occupational injuries; injury rates

INTRODUCTION

In the United States (US), the agricultural work force consists of two types of workers: hired workers and farm

family workers, including farm operators. As agriculture has declined in the US over the past century, hired farm workers have become a larger proportion of the agricultural work force making up a third of all US agricultural workers [Kandel, 2008]. Hired farm workers are important in the production of labor-intensive crops such as fruit, tree nuts, vegetable, and horticultural crops, with crop farms accounting for 78% of the hired labor in 2007 [NASS, 2009].

The hired farm worker labor market is unique because it includes a relatively low-paid, heavily foreign-born, and frequently migrating population [Villarejo, 2003]. A recent Economic Research Service study on hired farm workers suggests that a higher proportion are foreign-born, have limited English language skills, and have less US working

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The findings and conclusions in this report are those of the author(s) and do not necessarily represent the views of the National Institute for Occupational Safety and Health.

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experience than workers in other sectors of the economy [Kandel, 2008]. Hired farm workers are also younger, have significantly less schooling, and have less stable work schedules than other wage and salary workers in the US labor force. Hired farm workers in the crop production sector (referred to as hired crop workers) specifically are predominately Hispanic (83%), foreign born (78%), not proficient in the English language, and relatively young (average age in 2001–2002 was 33 years) [Carroll et al., 2005]. Over half the hired crop workers were not authorized to work in the US in 2001–2002. All these characteristics suggest that hired farm workers, and especially hired crop workers are a vulnerable working population that may be at high risk for work-related injuries.

There are a few studies of occupational injuries among hired farm workers, but these studies covered only a few states with the level of information varying widely between studies [Villarejo, 1998; McCurdy et al., 2003; Cooper et al., 2006; Earle-Richardson et al., 2008; Brower et al., 2009]. No national level study has been published [Villarejo, 2003]. To address this need for nationally representative injury data, the National Institute for Occupational Safety and Health (NIOSH) collaborated with the US Department of Labor (USDOL) to incorporate an injury module into the National Agricultural Workers Survey (NAWS). The purpose of this study was to provide a descriptive analysis of the data from this NAWS injury module.

METHODS

The NAWS

Data for this study were collected through the NAWS for the federal fiscal years (FFY) 1999 and 2002–2004. NAWS is an ongoing national personal interview survey conducted by the USDOL covering crop farm workers 14 years or older [Carroll et al., 2005]. Crop workers are defined as those who perform “field work” on nursery, cash grain, field crop, fruit and nut, vegetable, and Christmas tree farms in the US, regardless of their legal status to work in the US. NAWS also includes persons who work in the production of silage and other animal fodder. As such, the population sampled by the NAWS consists of nearly all hired farm workers in crop production agriculture, including field packers, supervisors, and even those hired crop workers who simultaneously hold non-farm jobs. The sample does not include poultry, livestock and fishery workers, secretaries, mechanics, or workers in the H-2A Temporary Agricultural Workers Program. In addition, the survey excludes the states of Alaska and Hawaii.

The original purpose of the NAWS was to determine crop workers’ attachment to the farm labor market, and collect data on a variety of demographic and economic

issues. This includes information on a workers’ household and family composition, employment history, wages, benefits, working conditions, housing, income and assets, non-agricultural jobs, use of social services, immigration status, language ability, and parental involvement in agriculture.

Because of the unique survey approach used by the NAWS, the NIOSH collaborated with USDOL to incorporate an injury module into the existing NAWS. Federally appropriated discretionary funds were used by NIOSH to collect the NAWS injury module through an Interagency Agreement with the USDOL. The injury module and other occupational health modules incorporated in the NAWS were determined to be routine and ongoing public health surveillance activities by the NIOSH Human Subject Review Board (HSRB) chair and deemed exempt from HSRB review. Injury module data were originally collected for the 1999 FFY (October 1998–September 1999) and then again for FFYs 2002–2004. The injury module was given to all crop workers sampled during these 4 years.

NAWS classifies hired crop workers into three categories, “settled” (non-migrant), “shuttle migrant,” and “follow-the-crop migrant” [Carroll et al., 2005]. Settled crop workers were defined as those who worked out of their home base and did not travel more than 75 miles to find farm work. If the crop worker did not do farm work at their home base, but traveled 75 miles or more to do farm work in a single US location and worked within a 75-mile radius of that new location, NAWS defined them as a “shuttle migrant.” Workers who traveled to multiple farm locations for work were defined as “follow-the-crop migrants.” Follow-the-crop migrants may or may not do US farm work at their home base.

A work-related injury was defined as any injury to the worker in the 12 months prior to the interview that (1) occurred on a farm they were working on in the U.S, or while traveling to or from a farm for work in the US and (2) resulted in one or more of the following: rendered the worker unable to work for at least 4 hr; rendered the worker unable to work as hard as he or she normally did for at least 4 hr; required the worker to seek medical treatment; or required the worker to take strong medicine to keep working (strong medicine is defined as something other than over-the-counter medications). Rashes and skin conditions were not included as injury events in this definition because of a separate dermatitis module in the NAWS.

A narrative injury description was collected for each case that described: how the injury happened (e.g., fell from a ladder, struck by something, lifting objects); what the farm worker was doing (i.e., tasks involved); where the injury happened (e.g., field, work shed, road); and what caused the injury (e.g., objects or other workers who may have been involved in the injury). Each injury narrative was individually reviewed and coded for injury event

and source of injury according to the Bureau of Labor Statistics (BLS) Occupational Injury and Illness Classification (OIICS) Manual, [BLS, 2007]. The OIICS is a hierarchical coding scheme (similar to the more commonly understood ICD-9 E-codes) that provides the opportunity to both code and analyze the data at various levels of detail (e.g., 1-digit broad category and 2- to 4-digit more detailed categories). Separate variable fields were used to define the nature of injury, body part injured, task and crop working on at the time of injury, where the worker sought medical treatment for the injury, how the medical care for the injury was paid for, and length of work time lost due to the injury.

Additional general and occupational health modules were included in the NAWS and have been reported on previously [Steege et al., 2009]. Using these supplemental health modules, it was possible to examine the frequency of injuries occurring to crop workers with self-reported health conditions at the time of interview. Two different health categories were examined: one or more existing general health conditions (e.g., diabetes, high blood pressure, tuberculosis, heart disease, urinary tract infections); and one or more reported chronic musculoskeletal complaints.

Other demographic information was obtained directly from the core NAWS and represented working characteristics for the crop worker at the time of interview, but not necessarily at the time of injury. This was due to the 12-month recall period used for identifying a reportable injury event. The result is that the season, crop, task, employer, and location of many reported injury events used in this analysis differs from the season, crop, task, employer, and location recorded for the worker at the time of interview. This core information collected at the time of interview rather than for the injury incident includes items such as region of the country, educational status, length of time doing farm work in the US, and type of migrant.

NAWS collects the race, ethnicity, and country of origin of the crop worker. Because of the variation in how different crop worker groups interpret the meaning of race and ethnicity, NAWS combines these two variables into the following groups: White, Black, Hispanic, and Other. Hispanics were further classified based on the workers' country of origin: US, Mexican, and Non-Mexican.

Sample Design and Analysis

The NAWS uses a multistage sampling methodology that is designed to account for regional and seasonal differences in farming and farm work activities [Carroll et al., 2005]. The sample is initially stratified into 12 geographic regions, derived from the 17 US Department of Agriculture (USDA) designated regions (Table I). Within the 12 regions, a random sample of 80 farm labor areas

TABLE I. The 6 National Agricultural Workers Survey (NAWS) Geographic Regions Used for Reporting Purposes and the 12 Geographic Regions Used for the NAWS Sampling Design*

Six NAWS reporting regions	Twelve NAWS sampling regions	States in the regions
East	Northeast1	CT,ME,MA,NH,NY,RI,VT
	Northeast2	DE,MD,NJ,PA
	Appalachian	NC,VA,KY,TN,WV
Southeast	Florida	FL
	Delta and Southeast	AR,LA,MS,AL,GA,SC
Midwest	Lake	MI,WI,MN
	Corn Belt and Northern Plains	IL,IN,OH,IA,MO,KS,NE,ND,SD
Southwest	Southern Plains	OK,TX
	Mountain 3	AZ,NM
West	Mountain1 and 2	ID,MT,WY,CO,NV,UT
	Pacific	OR,WA
California	California	CA

*Excludes Alaska and Hawaii.

(FLAs), consist of counties with similar farm labor usage, are selected. Within FLAs, counties are drawn with probability proportional to the size of the farm labor expenses within each county. Simple random sampling is used in the selection of growers within counties. The final stage of sampling is the selection of crop workers at the sampled farming establishments. Interviewers approach sampled workers directly to set up interview appointments in the worker's home or other agreed upon location (including off the employer's premise) to conduct the survey. Interviews are conducted in three cycles each year to account for seasonal fluctuation in agricultural production and employment. The cycles start in October, February, and July, with each lasting 10–12 weeks. For reporting purposes, the 12 geographic regions used for the NAWS sample were further condensed into 6 geographic regions (Table I).

SAS SurveyFreq and SurveyMeans procedures were used to take into account the complex sampling design of NAWS [SAS, 2007]. To account for the complex design, sampling regions and interview cycles were defined as strata, while FLAs were defined as cluster samples within the stratified sample. Standard error estimates incorporated a finite population term that accounted for the large proportion of FLAs sampled in each region and cycle of the NAWS.

The NAWS has two statistical weights. The first, a single-year weight that adjusts each individual year's result based on the unequal probability sample weights used in the NAWS, and a multi-year weight that accounts for increases in sampling variance caused by pooling data

across multiple survey years [USDOL, 2005]. All percentage distributions and injury rates were derived using the multi-year sample weight provided in the NAWS as recommended by USDOL. The net result of using the multi-year weights is that multi-year estimates are about 27–30% lower than the 4-year cumulative single-year weighted results (e.g., the number of farm workers is reduced from 13,604 to 9,970 when the final multi-year sample weight is applied). The smaller multi-year estimates are the unbiased expected values for each variable based on the reduced multi-year weighted sample size and provide unbiased estimates of the national percentage distributions with the appropriate multi-year pooled variance estimates. No attempt was made to derive an overall national estimate of total injuries because of a lack of a reliable estimate of the number of hired crop workers in the US.

Injury rates were expressed as the number of injuries/100 week-based full-time equivalents (FTE_{WB}). FTE_{WB} estimates were derived by using information on the number of weeks of farm work each crop worker performed in the past 12 months prior to the interview. One FTE_{WB} was set equal to 50 weeks of farm work. The average number of restricted workdays caused by the injury was also computed for certain sub-groups. For these calculations, injuries with less than 4 hr of restricted work time were considered as 0 days.

RESULTS

Survey Response

There were 3,612 respondents in 1999 NAWS data, 3,361 respondents in 2002, 3,585 respondents in 2003, and 3,046 respondents in 2004 for a total of 13,604 farm worker interviews. Nine farm workers did not answer the injury questions and were excluded from data analyses for a final set of 13,595 workers in the analysis. The overall response rate for crop growers (the employers) was 69% during the 4 years of the study. The response rate for crop workers selected for an interview was 94% for the years 2002–2004; an official worker response rate was not recorded for 1999. Among these respondents, 374 reported at least 1 work-related farm injury. Three workers reported more than one injury, but because of the small number of multiple injuries, only the “most recent injury” was included in the analysis for these three farm workers. After applying the multi-year NAWS weights, the weighted number of crop workers for the 4 years was 9,970 and the weighted number of injured workers was 262 (Table II).

Worker Demographics

The overall observed injury rate for hired crop workers was 4.3 injuries/100 FTE_{WB} (Table II). Male workers

accounted for 83.7% of all injuries and had a higher injury rate than female workers (Table II). By age, the highest proportion of injuries were reported by workers 20–29 years of age (29.8%) followed closely by workers 30–39 years of age (29.0%; Fig. 1). Crop workers less than 20 years of age were found to have the highest injury rate (5.2 injuries/100 FTE_{WB}), although the observed rates for all age groups were similar and not statistically different from each other.

Mexican born workers accounted for the largest proportion of the reported injuries (72.8%) although US born Hispanics had the highest FTE_{WB} injury rates (6.9 injuries/100 FTE_{WB} ; Table II). US Black and US White workers were found to have higher estimated injury rates compared to Mexican workers. Non-Mexican born Hispanics accounted for only 1.7% of injuries and were found to have comparatively low injury rates (2.7/100 FTE_{WB}). With respect to education, workers with less than 12 years of education accounted for 79.2% of the injuries identified in the NAWS; however, FTE_{WB} -based injury rates were similar between the six different educational categories.

Current Work Characteristics

Among the six geographic regions, California accounted for the highest percentage of the injuries (21.0%) but the lowest injury rate (2.4 injuries/100 FTE_{WB}). The Midwest comprised the second largest number of injuries (20.3%). Workers interviewed in the Southwest region accounted for the lowest percentage of the reported injuries (11.9%), but reported the highest injury rate (7.6 injuries/100 FTE_{WB}).

By type of migrant, settled crop workers accounted for 59.8% of the injuries reported in the NAWS. For migrant workers, shuttle migrants accounted for 31.2% of the reported injuries, while follow-the-crop migrants accounted for 8.7% of the injuries. Shuttle crop workers had injury rates about twice those found for follow-the-crop and settled crop workers. By years of US farm work reported at the time of interview, workers with 2 or more years of US farm work experience were found to account for 83.5% of the reported injuries. Crop workers with less than 1 year of US farm work experience were found to have the highest injury rate (6.1 injuries/100 FTE_{WB}).

Existing Health Conditions

Based on farm worker responses to the NAWS health condition module, crop workers reporting no health conditions at the time of interview were found to account for the highest proportion of the reported injuries (74.9%; Table II). When looking at injury rates, however, workers reporting one or more health conditions had significantly higher rates than workers reporting no existing health

TABLE II. Weighted Distribution of Workers, Injuries, and Injury Rates for Hired Crop Workers in the US by Region, Gender, Race or Ethnicity, Education, Migrant Type, Work Experience, Presence of a Health Condition, and Presence of a Musculoskeletal Complaint (NAWS, 1999, 2002–2004)

Worker variable^a	Worker estimate (SE)	Worker % (SE)	Injury estimates (SE)	Injury % (SE)	Injury rates/FTE_{WB} (SE)
Total ^b	9,970 (374)	100 (—)	262 (26)	100 (—)	4.3 (0.4)
Region where interviewed					
East	1,534 (140)	15.4 (1.3)	43 (10)	16.4 (3.5)	4.8 (1.0)
Southeast	1,262 (117)	12.7 (1.1)	40 (10)	15.4 (3.7)	4.8 (1.1)
Midwest	1,637 (167)	16.4 (1.5)	53 (14)	20.3 (4.6)	5.9 (1.4)
Southwest	803 (90)	8.1 (0.9)	31 (8)	11.9 (2.9)	7.6 (1.7)
West	1,214 (164)	12.2 (1.5)	39 (9)	14.9 (3.4)	5.5 (1.2)
California	3,520 (211)	35.3 (1.8)	55 (11)	21.0 (3.8)	2.4 (0.5)
Gender					
Male	7,670 (288)	76.9 (1.2)	219 (22)	83.7 (3.5)	4.5 (0.4)
Female	2,300 (160)	23.1 (1.2)	43 (11)	16.3 (3.5)	3.5 (0.9)
Race/ethnicity/country of origin					
US White	1,082 (93)	10.9 (0.9)	34 (7)	12.8 (2.6)	4.7 (0.9)
US Hispanic	700 (78)	7.0 (0.7)	22 (7)	8.6 (2.7)	6.9 (2.1)
US Other	405 (54)	4.1 (0.6)	13 (5)	4.9 (1.8)	4.6 (1.6)
Mexican	7,492 (333)	75.1 (1.3)	191 (23)	72.8 (4.0)	4.2 (0.5)
Other Non-US	291 (47)	2.9 (0.5)	2 (1)	0.8 (0.4)	1.1 (0.6)
Highest grade completed					
1st–6th Grade	4,756 (207)	22.6 (1.0)	116 (16)	44.3 (4.2)	3.9 (0.5)
7th–8th Grade	722 (50)	32.3 (0.4)	23 (8)	8.6 (3.0)	5.1 (1.8)
9th–11th Grade	2,166 (123)	21.6 (0.8)	58 (12)	22.1 (3.7)	4.8 (0.9)
12th Grade	1,403 (82)	14.1 (0.7)	40 (9)	15.1 (3.1)	4.6 (1.0)
13+ years	482 (44)	4.8 (0.4)	15 (5)	5.6 (1.7)	4.9 (1.4)
No schooling/unk.	441 (38)	4.6 (0.3)	11 (4)	4.3 (1.3)	4.1 (1.3)
Type of migrant					
Settled	6,012 (246)	60.3 (1.6)	157 (18)	59.8 (5.0)	3.6 (0.4)
Follow the crop	880 (89)	8.8 (0.8)	23 (6)	8.7 (2.2)	3.7 (0.9)
Shuttle	3,048 (196)	30.6 (1.3)	82 (17)	31.2 (4.9)	7.2 (1.4)
Unknown	29 (—)	0.3 (—)	1 (—)	0.2 (—)	— (—)
US farm work experience					
< 1 year of farm work	1,715 (126)	17.2 (1.0)	24 (9)	9.2 (3.2)	6.1 (2.3)
1 to < 2 years of farm work	875 (71)	8.8 (0.6)	19 (6)	7.3 (2.2)	3.9 (1.2)
2+ years of farm work	7,360 (274)	73.8 (1.0)	217 (23)	83.5 (3.8)	4.2 (0.4)
Unknown	20 (—)	3.1 (—)	2 (—)	0.8 (—)	— (—)
Health conditions					
None	8,395 (319)	84.2 (0.7)	196 (20)	74.9 (4.0)	3.9 (0.4)
1+ Health conditions	1,575 (97)	15.8 (0.7)	66 (14)	25.1 (4.0)	6.4 (1.3)
Musculoskeletal complaints					
None	7,926 (306)	79.5 (0.9)	124 (17)	47.3 (4.2)	2.6 (0.4)
1+ Musculoskeletal complaints	2,045 (118)	20.5 (0.9)	138 (17)	52.7 (4.2)	10.9 (1.3)

^aCharacteristics as reported by the crop worker at the time of interview, not the time of injury.^bEstimates may not add to the total because of rounding.

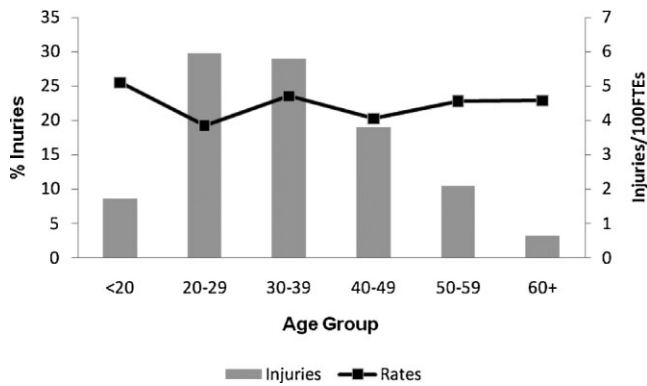


FIGURE 1. Percentages and rates of farm work injuries per 100 FTE for hired crop workers in the US by age group (NAWS, 1999, 2002–2004).

conditions. For musculoskeletal complaints, workers reporting one or more complaints at the time of interview were found to have accounted for slightly more reported injuries than their counterparts with no reported musculoskeletal complaints (52.7% and 47.3%, respectively). As was seen for health conditions, workers reporting one or more musculoskeletal complaints had significantly higher injury rates compared to those reporting no musculoskeletal complaints at the time of interview (rate ratio = 4.2). Crop workers reporting both existing health conditions and musculoskeletal complaints accounted for 11.3% of the injuries in this study, with an injury rate of 8.5 injuries/100 FTE_{WB}. Crop workers reporting no health conditions and no musculoskeletal complaints accounted for 33.5% of the injuries in this study, for an injury rate of 2.1 injuries/100 FTE_{WB}.

Injury Characteristics

Table III provides a breakdown of the proportion of injuries reported by: the type of crop worked with; the task at the time of injury; where the injured person received medical treatment; how the medical treatment was paid for; and the length of restricted activity due to the injury. Workers reported the type of crop worked with at the time of injury. For injuries to those working with fruits and nuts, 50.1% occurred while harvesting the crop, while those working with vegetables had 50.5% of their injuries doing post-harvest work activities (cross-tabulations not shown in table). Figure 2 shows the distribution of the reported injuries by month of the year. The majority of the injury events occurred in the months of June, August, and October (43.5%) corresponding to the harvest season. The lowest months for injuries to occur were January and February.

Nearly 85% (222 of 262 injuries) of the injured workers reported that they sought some form of medical

TABLE III. Weighted Distribution of Farm Work Injuries for Hired Crop Workers in the US by the Type of Crop, Task, Where the Injury Was Treated, How Treatment Was Paid for, and Length of Restricted Work Activity (NAWS, 1999, 2002–2004).

Injury variable ^a	Injury estimate (SE) ^b	Percent (SE)
Total	262 (26)	100.0
Type of crop when injury occurred		
Field crops	41 (8)	15.6 (3.1)
Fruits and nuts	73 (13)	27.8 (4.2)
Horticulture	68 (15)	26.1 (4.7)
Vegetables	53 (12)	20.2 (3.9)
Miscellaneous/multiple crops	9 (4)	3.5 (1.8)
Unknown	17 (4)	6.7 (1.6)
Task when injury occurred		
Pre-harvest	47 (9)	17.8 (3.2)
Harvest	59 (9)	22.7 (3.2)
Post-harvest	60 (13)	23.1 (4.2)
Semi-skilled	33 (6)	12.6 (2.2)
Other	44 (11)	16.8 (4.2)
Unknown	18 (4)	7.0 (1.6)
Where injury treated		
Community health center/hospital/ED	104 (13)	39.7 (3.9)
Private medical doctor's office/private clinic	72 (13)	27.5 (4.1)
Healer/curandero	7 (4)	2.8 (1.4)
Migrant clinic	11 (3)	4.2 (1.3)
Chiropractor or naturopath office	6 (3)	2.2 (1.0)
First aid at scene	9 (3)	3.5 (1.0)
No medical treatment	40 (12)	15.1 (4.0)
Other and unknown	13 (4)	4.9 (1.5)
Medical payment		
Paid out of own pocket	18 (5)	7.0 (1.8)
Employer provided health plan	71 (13)	27.1 (4.2)
Workers' compensation	60 (12)	22.9 (4.1)
Employer's own pocket	31 (10)	11.7 (3.7)
Other/combination	20 (5)	7.8 (1.9)
No charge/did not pay bill	14 (4)	5.5 (1.6)
Unknown and not applicable	47 (12)	18.0 (4.0)
Time of restricted work activity		
<4 hr	17 (6)	6.4 (2.2)
4 hr but <1 day	11 (3)	4.3 (1.2)
1–7 days	149 (21)	56.9 (4.4)
8–14 days	13 (3)	4.9 (1.1)
15–30 days	35 (8)	13.2 (2.9)
31+ days	32 (7)	12.1 (2.5)
Unknown	6 (2)	2.3 (0.8)

^aCharacteristics as reported by the crop worker at the time of injury.

^bEstimates may not add to the total because of rounding.

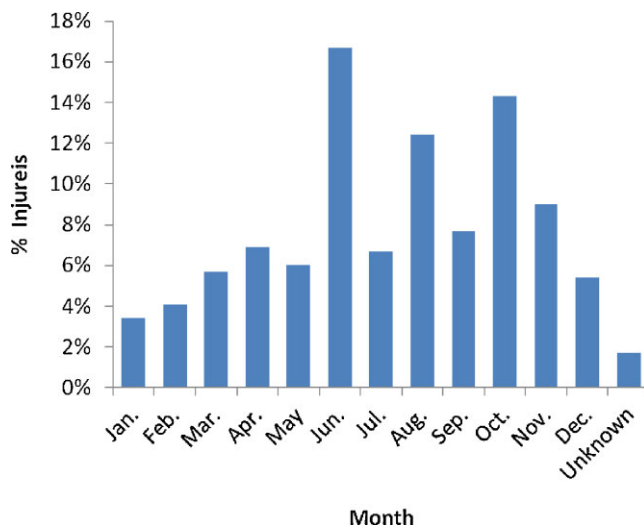


FIGURE 2. Percent of farm work injuries among hired crop workers in the US by month (NAWS, 1999, 2002–2004). [Color figure can be viewed in the online issue, which is available at wileyonlinelibrary.com.]

treatment for their injuries (Table III). Community health center, hospital, and emergency room were reported as the most common place to receive injury treatment (39.7%), followed by a private doctor's office or private clinic (27.5%). The cost of treatment was typically paid by an employer-provided health plan (27.1%) or workers' compensation insurance (22.9%). Only 7.0% of the workers reported having to cover the cost of medical treatment out-of-pocket.

Ninety-one percent of the injuries resulted in at least 4 hr of restricted work activity with most workers reporting between 1 and 7 days of restricted activity (56.9%). Over 25% of the workers reported restricted activity of over 15 days (Table III). The most common broad category (i.e., 1-digit level) of injury event was contact with objects (32.8%), followed by bodily reactions (31.6%), falls (16.2%), and exposure to substances and environments (10.3%; Table IV). Specific injury events were over-exertion injuries due to lifting objects (19.8%), being struck by slipping handheld objects (12.8%), and falls to a lower level (9.9%). The leading broad category (i.e., 1-digit) of source of injury reported by injured crop workers was persons, animals, plants, and minerals (19.6%), followed by tools, instruments, and equipment (19.3%), structures and surfaces (15.5%), and containers (13.5%). More specific (i.e., 2-digit level) common sources of injury reported for these injuries were floors, walkways and ground (13.9%), non-powered hand tools (13.7%), plants and trees (11.8%), and non-pressurized containers (11.4%).

The most common type of injury reported was sprains and strains (38.8%), followed by cuts and lacerations (21.2%), and fractures or dislocations (12.5%; Table V).

Detailed cross-tabulations not shown in tables revealed that cuts and lacerations were the leading type of injury (53.5%) to workers less than 20 years of age, while sprains and strains were the leading type of injury to workers of 20 years of age or older (39.7%). Sprains and strains most frequently resulted from bodily reaction (75.9%), while cuts and lacerations were caused by contact with objects (90.1%). Fractures and dislocations commonly resulted from a fall (36.3%) or contact with an object (31.3%).

The hands, wrists, and fingers (32.8%), and the back (24.5%) were the leading body parts injured (Table V). Additional cross-tabulations not shown in tables revealed that the hands, wrists, and fingers were the most common body part injured by all age groups. More than half of the injuries to hands, wrists, and fingers were cuts and lacerations (55.3%). Sprains and strains were the most common type of injury to the back (87.5%), arms and elbows (48.2%), legs (51.3%), shoulders (63.5%), and feet, ankles, and toes (60.0%).

The average number of restricted workdays for all farm worker injuries was 18.2 days (Table IV). By 2-digit type of injury event codes, falls to a lower level (44.7 days), and highway incidents (33.2 days) resulted in the highest average number of restricted activity days. The 2-digit source of injury category [BLS, 2010] with the highest average number of restricted workdays was a floor, walkway, or the ground (35.3 days) and was commonly associated with falls. The second highest 2-digit source of injury with respect to the average number of restricted workdays was highway vehicles (28.0 days), which were primarily associated with highway events. By type of injury, fractures and dislocations resulted in the most restricted activity workdays with an average of 41.4 days (Table V). By body part injured, injuries to the back accounted for the highest average number of restricted activity workdays (38.1), followed by injuries occurring to multiple body parts (34.5 days).

DISCUSSION

NAWS General Findings

Findings from this study that have been reported previously in the general literature include: males account for the most work injuries among hired farm workers [Hoskin et al., 1988; Myers, 1997, 1998, 2001; Steinhorst et al., 2006]; inexperienced workers may be at higher risk of injury compared to experienced workers [Root and Hoefler, 1979; Siskind, 1982; Leigh, 1986; Sahl et al., 1997; Breslin and Smith, 2006]; existing health conditions impact injury risk [Zwerling et al., 1995; Lewis et al., 1998; Sprince et al., 2003; Voaklander et al., 2006], and

TABLE IV. Weighted Distribution of Farm Work Injuries and Average Days of Restricted Work Activity for Hired Crop Workers in the US by Type of Injury Event and Source of Injury (NAWS, 1999, 2002–2004)

Injury variable	Injury estimates (SE)	Percent (SE)	Average restricted workdays (SE)
Total ^a	262 (26)	100	18.2 (2.8)
Type of injury event ^b			
Contact with objects (0)	86 (15)	32.8 (4.4)	11.9 (2.9)
Struck against object (01)	9 (2)	3.5 (1.0)	8.4 (1.8)
Struck by object (02)	52 (11)	19.9 (3.5)	9.6 (1.6)
Struck by slipping handheld object (0232)	33 (8)	12.8 (2.5)	10.6 (1.3)
Caught in objects (03)	15 (6)	5.6 (2.2)	28.4 (12.7)
Rubbed or abraded by friction or pressure (05)	8 (3)	2.9 (1.1)	3.4 (0.5)
Falls (1)	42 (7)	16.2 (2.6)	37.7 (6.2)
Fall to lower level (11)	26 (5)	9.9 (2.0)	44.7 (5.9)
Fall on same level (13)	13 (4)	5.0 (1.4)	25.3 (15.7)
Bodily reaction/exertion (2)	83 (16)	31.6 (4.6)	17.6 (4.4)
Bodily reaction (21)	18 (4)	7.0 (1.5)	12.4 (4.6)
Overexertion (22)	62 (15)	23.6 (4.6)	18.7 (5.9)
Overexertion in lifting (221)	52 (15)	19.8 (4.7)	20.5 (7.4)
Exposure to substances/environments (3)	27 (6)	10.3 (2.2)	3.2 (0.8)
Exposure caustic/allergenic substance (34)	21 (5)	8.1 (2.0)	2.3 (0.5)
Contact with skin/tissues (342)	12 (4)	4.8 (1.6)	2.0 (0.5)
Transportation events (4)	21 (6)	8.0 (2.1)	24.5 (5.0)
Highway incidents (41)	10 (4)	4.0 (1.6)	33.2 (9.1)
Other and unknown events	3 (1)	1.1 (0.6)	6.1 (0.7)
Source of injury ^b			
Chemicals (0)	13 (4)	5.1 (1.6)	1.5 (0.2)
Agricultural chemicals and pesticides (06)	12 (4)	4.5 (1.5)	1.4 (0.2)
Containers (1)	35 (11)	13.5 (3.8)	9.1 (3.4)
Non-pressurized containers (11)	30 (11)	11.4 (3.7)	6.0 (2.1)
Furniture and fixtures (2)	3 (2)	1.3 (0.7)	18.6 (12.9)
Machinery (3)	22 (7)	8.5 (2.4)	24.4 (8.6)
Agricultural and garden machinery (31)	19 (7)	7.3 (2.4)	24.2 (9.6)
Parts and materials (4)	4 (1)	1.5 (0.5)	60.5 (13.6)
Persons/animals/plants/minerals (5)	51 (11)	19.6 (3.8)	21.2 (7.2)
Animals and animal products (51)	7 (3)	2.6 (1.2)	4.4 (0.9)
Plants/trees (58)	31 (10)	11.8 (3.5)	16.6 (6.8)
Structures and surfaces (6)	41 (7)	15.5 (2.5)	32.8 (6.0)
Floors/walkways/ground (62)	36 (7)	13.9 (2.4)	35.3 (6.6)
Tools/instruments/equipment (7)	51 (11)	19.3 (3.5)	8.4 (1.2)
Non-powered hand tools (71)	36 (8)	13.7 (2.6)	10.2 (1.1)
Vehicles (8)	29 (6)	10.9 (2.2)	21.1 (4.6)
Highway vehicles (82)	14 (5)	5.2 (1.7)	28.0 (8.0)
Industrial vehicles (85)	14 (4)	5.2 (1.4)	16.0 (3.8)
Other and unknown sources	12 (3)	4.7 (1.1)	5.4 (1.9)

^aEstimates may not add to the total because of rounding.

^bCategories based on the Bureau of Labor Statistics Occupational Injury and Illness Coding Structure.

musculoskeletal complaints impact injury risk [Sprince et al., 2003; Suutarinen, 2004; Voaklander et al., 2006].

Specific health conditions reported to be associated with farm-related injuries include: hearing loss [Zwerling

et al., 1995; Lewis et al., 1998; Sprince et al., 2003], poor vision [Zwerling et al., 1995; Sprince et al., 2003], depression [Sprince et al., 2003], general health problems [Lewis et al., 1998], and urinary tract disorders (one of the health

TABLE V. Weighted Distribution of Farm Work Injuries and Average Days of Restricted Work Activity for Hired Crop Workers in the US by Type of Injury and Body Part Injured (NAWS, 1999, 2002–2004)

Injury variable	Injury estimates (SE)	Percent (SE)	Average restricted workdays (SE)
Total ^a	262 (26)	100	18.2 (2.8)
Type of injury			
Sprain, strain	102 (17)	38.8 (4.5)	19.2 (4.0)
Cut, laceration	55 (11)	21.2 (3.4)	9.0 (1.3)
Fracture, dislocation	33 (7)	12.5 (2.5)	41.1 (7.0)
Bruise, contusion	21 (5)	8.1 (1.9)	12.6 (2.0)
Burn, blister, scald	12 (4)	4.4 (1.5)	1.6 (0.2)
Scrape, abrasion	7 (2)	2.8 (0.7)	3.0 (0.9)
Sting/bite	5 (3)	2.1 (1.1)	3.7 (0.9)
All other injuries	20 (5)	7.6 (1.9)	29.5 (10.1)
Unknown	7 (4)	2.6 (1.5)	3.5 (0.4)
Body part injured			
Head, face, neck	14 (4)	5.4 (1.6)	6.4 (0.8)
Eye	18 (4)	6.9 (1.6)	2.2 (0.5)
Back	64 (13)	24.5 (4.0)	38.1 (8.2)
Shoulder	5 (2)	2.0 (0.7)	15.1 (7.4)
Arm, elbow	13 (4)	4.8 (1.4)	4.3 (0.7)
Hand, wrist, fingers	86 (15)	32.8 (4.3)	12.2 (2.9)
Leg	23 (6)	8.9 (2.0)	14.0 (4.3)
Foot, ankle, toes	17 (4)	6.5 (1.4)	11.6 (3.0)
Thorax, abdomen, pelvis	12 (3)	4.5 (1.3)	12.9 (3.4)
Multiple body parts	9 (4)	3.3 (1.5)	34.5 (9.2)
All other/unknown	1 (1)	0.3 (0.2)	1.0 (—)

^aEstimates may not add to the total because of rounding.

conditions in the NAWS) [Voaklander et al., 2006]. Voaklander et al. [2006] also looked at hypertension, cardiovascular disease, and diabetes, of which only diabetes was found to have any suggestion of an association to farm injuries (adjusted odds ratio = 1.63; 95% CI: 0.77–3.43). For musculoskeletal complaints two independent studies linked arthritis to injury risk for farmers and farm workers [Sprince et al., 2003; Voaklander et al., 2006], while Suutarinen [2004] found a significant association between musculoskeletal complaints and injury in a study of farm operators. Zwerling et al. [1995] also found an association between lifting heavy objects (an indirect measure of musculoskeletal risk) and injury for older agricultural workers.

The identification of existing health conditions and musculoskeletal complaints as potential risk factors for work-related injuries impacts a significant number of hired crop workers in the US. Steege et al. [2009], in an analysis of the FFY 1999 NAWS health modules, estimated that 12.1% of the hired crop workers in the US reported at least one of the health conditions used to assess worker health in this study, and that 14.9% of the crop workers

reported at least one musculoskeletal complaint. In this current study, 30.9% of the crop workers reported an existing health condition, an existing musculoskeletal complaint, or both.

Findings from this study not previously seen in the literature include: hired crop workers interviewed in the Southwest region of the US had the highest reported injury rates (Table II); settled hired crop workers accounted for nearly 60% of the injuries reported in the NAWS (Table II); US born Hispanics were at highest risk for work-related injuries, followed by US born Blacks and Whites; and injuries occurring to hired crop workers resulted in an average of 18.2 days of restricted work activity (Table III). The inclusion of large numbers of settled and US born crop workers sets the NAWS apart from other studies looking at hired crop workers in the US, and in part, addresses a recommendation from the National Research Council (NRC) and Institute of Medicine that NIOSH agricultural injuries and illnesses surveillance focus more broadly on all hired farm workers rather than solely on migrant workers [NRC, 2008].

NAWS Compared to Previous Crop Worker Studies

Estimates of injuries and injury rates for hired crop workers in the US are routinely reported by BLS from the Survey of Occupational Injuries and Illnesses (SOII) [BLS, 2010]. A limitation to the SOII is that it only covers farms with 11 or more employees. The SOII restricted workday injury rate (the most comparable to the injury definition used in this study) for all private sector workers in 2000 was 2.8 injuries/100 FTEs, and 3.8 injuries/100 FTEs for hired crop workers [BLS, 2001]. Both SOII rates were lower than the FTE_{WB} rate from this study (Table II). Other studies in the literature that address the occupational injury experience of hired crop worker in the US are limited in number, focusing on crop workers in a specific state or geographic area [Villarejo, 1998; McCurdy et al., 2003; Cooper et al., 2006; Earle-Richardson et al., 2008; Brower et al., 2009].

Villarejo [1998] examined workers' compensation data for the state of California for the year 1994. When looking only at crop operations, the rate of injury was 10.0 injuries/100 FTEs. McCurdy et al. [2003] also looked at work-related injuries occurring to crop workers in California by studying a cohort of 1,201 adult workers living in six Northern California Migrant Family Housing Centers in 1997. Settled farm workers were not included in the study. The injury rate from this study was 9.3 injuries/100 FTEs. Cooper et al. [2006] conducted a 2-year study of 154 migrating families from Starr County, Texas. The majority of these families (66% in year 1 and 72% in year 2) reported interstate migration, working in 24 different states. Work-related injuries within this cohort were obtained from surveys completed by the mothers in these migrating families during the migration season. The worker injury rate from this study was found to be 12.5 injuries/100 FTEs.

Earle-Richardson et al. [2008] conducted a study of migrant crop workers in a 4-county area of New York State. Work-related injuries and illnesses estimated were compared from a survey of 550 crop workers and review of chart records in 2 Migrant Health Clinics (MHC) serving the counties. Injury and illness rates from the study ranged from 27.4 to 29.3 work-related cases/10,000 worker-weeks (or 13.7–14.7 per 100 FTE). Brower et al. [2009] expanded the Earle-Richardson et al. [2008] study by examining migrant crop workers in parts of New York State and Maine at various times between 2001 and 2006. Work-related injury and illness events were identified from: a survey of 1,103 workers; hospital emergency departments (ED, New York only); and MHC. The estimated rates from the study were 7.9 injury and illnesses/100 FTEs in Maine and 11.7 injuries and illnesses/100 FTEs in New York.

All five of these studies provided incidence rates higher than the FTE_{WB} injury rate found using the NAWS, but direct comparisons are difficult to make because of the variety of injury definitions, populations covered, and study methodologies used. Two common differences include the exclusion of settled crop workers in four of the studies [McCurdy et al., 2003; Cooper et al., 2006; Earle-Richardson et al., 2008; Brower et al., 2009], the inclusion of non-traumatic injuries as reportable conditions in three studies [Cooper et al., 2006; Earle-Richardson et al., 2008; Brower et al., 2009], and the inclusion of non-farm work injuries in one study (e.g., vegetable cannery, meat processing plant) [Cooper et al., 2006]. McCurdy et al. [2003] used an injury definition most similar to that of the NAWS, and looked at a group similar to the NAWS definition of shuttle migrants. The injury rate estimate from McCurdy et al. [2003] (9.3 injuries/100 FTEs) was similar to that seen for shuttle migrant workers in the NAWS (7.2 injuries/100 FTE_{WB} ; Table II).

With respect to the characteristics of the injury, sprains and strains were consistently reported as the leading nature of injury in the previous studies of hired crop workers accounting for 31–58% of the reported injuries [McCurdy et al., 2003; Earle-Richardson et al., 2008; Brower et al., 2009]. McCurdy et al. [2003] found overexertion events, which are associated with sprain and strain injuries, were the leading cause of injury to hired crop workers (28%). With respect to overexertion exposures, Cooper et al. [2006] found that migrant workers reported a high prevalence of work tasks associated with overexertion events (23–26% reported repetitive lifting; 20–25% reported moving heavy objects). Cuts and lacerations, the second most common nature of injury identified in the NAWS (Table II), accounted for 11.6% of the injuries reported by McCurdy et al. [2003] and 19.6% of the worker-reported injuries from the study conducted by Brower et al. [2009]. From an exposure standpoint, Cooper et al. [2006] found that 58–60% of the migrant farm workers in their study reported work involving knives and other sharp hand tools which were identified in the NAWS to be associated with cuts and lacerations.

This study found that crop workers who sought medical treatment for a work injury most often went to a community operated clinic, hospital, or ED (39.7%), or a private doctor's office or private clinic (27.5%; Table III). These findings differ greatly from treatment locations reported by Earle-Richardson et al. [2008] and Brower et al. [2009] who found crop workers most often sought treatment at a MHC (54%). This large discrepancy between where crop workers sought care in the NAWS and the New York-based studies may be due to differences in the populations covered in the studies and where crop workers seek treatment for different types of health conditions. Both New York studies looked only at migrant

workers, while the NAWs included both migrant and settled crop workers. Migrant workers may be more inclined to use MHCs, especially in areas like New York and Maine that are far removed from the worker's home. Evidence that crop workers seek treatment for different types of health conditions from different healthcare providers was provided by Brower et al. [2009] who reported that 83.7% of the cases treated at MHCs were non-traumatic (e.g., chronic musculoskeletal complaints, dermatitis), while 88.5% of the cases treated at EDs were traumatic injuries.

One possible motivator for crop workers to seek health care for different conditions from different providers may be how medical costs are paid. For the medically treated work-related injuries reported in the NAWS (222 of 262 injuries), medical costs were paid 73% (162 injuries/222 medically treated cases) percent of the time by employer-provided health insurance, workers' compensation, or employers directly (Table III). Only 8% (18 injuries/222 medically treated cases) were paid out-of-pocket by the crop worker. This differs significantly from the method of payment distribution reported from the FFY-1999 NAWS for all work-related conditions (traumatic injury, non-traumatic injury, occupational illnesses) where 23.1% were paid out-of-pocket by the worker [Steege et al., 2009]. The large difference observed for health care out-of-pocket payments for work injuries and all work-related conditions suggests that injuries are more readily recognized for their work-relatedness, and therefore more readily paid for by employer-based mechanisms. The medical costs of occupational illnesses and chronic conditions are less often paid for by employer-based mechanisms because of the greater difficulty in proving the association with work exposures. This in turn would encourage crop workers to seek treatment for these non-traumatic conditions from providers such as MHCs.

Future Directions for NAWS

The demographics of the hired crop worker population create nearly insurmountable hurdles for occupational morbidity surveillance. Hired crop workers have been described as marginalized or under-reported, but that does not adequately describe the full array of difficulties faced by those attempting to develop interventions for this population. While the political landscape for this population has changed greatly over the last half century, the last two decades starting in the mid-1990s, has seen an increasingly politically charged atmosphere. Howard [2010] characterized this atmosphere as one with public debate centering around "toughening border enforcement, building fences along the international border with Mexico, expanding grounds for deporting Mexican nationals, enhancing restrictions on the hiring of unauthorized

migrants, closing opportunities for unauthorized migrants to legalize their status, and limiting their access to social safety-net services."

Several different demographic characteristics of the hire crop worker population have been identified in the literature as hurdles to the collection of scientific information [Schenker, 2010]. The NAWS however, collects a great deal of the socio-economic, demographic, work history, and environmental conditions useful in better understanding the conditions the crop workers face on and off the job. NAWS includes questions about the crop worker's documentation (legal) status, and includes additional questions that can be used to verify such. The NAWS also included healthcare outcomes for occupational injuries, such as source of medical treatment and medical payment information. Family income is also collected via the NAWS. The ability of NAWS to collect this type of health and income information demonstrates the ability of this survey to be expanded to collect even greater details. In fact, numerous agencies would be served a wealth of valuable data by investing in the NAWS to add modules with their specific data needs as the amount of information that can be gleaned from the NAWS methodology is nearly limitless.

This descriptive study was the initial step in better understanding occupational farm work injuries occurring to hired crop workers in the US, but more needs to be done to identify potential risk factors for these injuries. Work is currently ongoing to use the large amounts of socio-economic, demographic, and environmental data from NAWS to examine the relationships between these factors and crop worker's injury experience using multi-variable models. NIOSH has also collected information from the NAWS injury module for the FFYs 2008–2010 to monitor changes in injury rates for this high-risk population and to assess how recent changes in the hired crop workforce may be impacting the occupational injury patterns seen in this study.

Limitations and Strengths

Limitations that are commonly associated with NAWS have been outlined in a previous NIOSH study by Steege et al. [2009]. These limitations include: the small sample size of NAWS, which may limit the power to detect differences in injury rates between sub-groups; the percentage of young and undocumented workers in NAWS, which may impact the self-reporting of injuries on the job; the possibility of under reporting injuries due to the 12-month recall period used in the NAWS; and the fact that farm workers who have been injured and have not worked for at least 1 of the last 15 consecutive days were not eligible to participate in the NAWS. Additionally, culturally related cognitive bias associated with

self-reported injuries due to the hired crop worker not interpreting the question as intended by the survey author(s) [Kahneman and Tversky, 1972], and language conversion issues, such as the lack of a Spanish word or phrase that encompasses the English meaning of a “work-related injury” are of concern [Cooper et al., 2006]. Most of these limitations suggest that the proportion of crop workers injured due to farm work was higher than reported here.

An analytical limitation of the NAWS is the time difference between when a worker was injured and when they were interviewed. Several of the variables examined here were based on the crop worker’s job at the time of interview. Variables such as region, migrant status, length of US farm work experience, and the presence of health conditions may have been different at the time the worker was injured.

Nearly one-third of growers refused to allow for their hired crop workers to be interviewed. It is unknown if these growers differ from those growers who agreed to participate in the survey (69% of growers agreed to participate). Lastly, the statistical sampling methodology and weighting scheme do not provide a mechanism to analyze state level data; therefore, regulatory enforcement and other differences such as types of crops grown cannot be examined between states. Slight modifications in the sampling methodology and statistical weighting procedures could provide for more detailed state data at least for the largest crop producing states (e.g., California, Florida, Texas, Washington state).

Despite these limitations, the NAWS provides a unique view of the occupational injury experience for hired crop workers in the US. NAWS is the only national population-based survey that collects workers’ safety and health information for all hired crop farm workers. NAWS provides a technique for statistical enumeration of the hired crop workforce, as a nationally representative sample is utilized to select growers (the actual place of employment), from which hired crop workers are sampled. The survey is conducted year around in a manner that accounts for seasonality of agriculture. This sampling technique and resulting statistical enumeration was recently validated through an independent study [Williams et al., 2009]. The other national survey of worker injuries, the BLS SOII, only covers farms with 11 or more employees, and is based on employer Occupational Safety and Health Administration records [BLS, 2010].

The NAWS is a face-to-face interview with the crop worker (in a place of convenience for the crop worker, including away from the employer’s premise), allowing the worker to freely talk about the details of injuries experienced on the job. The face-to-face methodology also allows for use of diagrams and other interview aides to help clarify the survey instrument, something that may be

particularly important for these workers. The NAWS also provides unique information about crop workers not available from other sources, including a workers migration status, work experience, nationality, education, and general overall health, some of which appear to be important risk factors for injury within this population.

A final advantage of the NAWS is that the survey provides its own denominator information, providing a mechanism for the FTE_{WB} rate calculations. The ability to calculate FTE_{WB} injury rates was especially valuable because of the seasonal nature of farm labor, and the major differences in the amount and type of farm work done by different sub-groups of hired crop workers. Previous research has shown that injury rates using FTEs provide a better measure of work-related injury risk [Ruser, 1998; Bonauto et al., 2003]. While the FTE formula for this study did not use the number of hours worked, the use of actual weeks of farm work during the previous year provides an adjustment methodology for part-time and seasonal differences among hired crop workers. The typical hours worked per week in the NAWS is between 36 and 38 hr [Martin, 2002], which is near the 40 hr/week assumption made in this study. Other studies have reported farmworkers working on average 40–50 hr/week [McCurdy et al., 2003; Grzywacz et al., 2007] and as high as 60 hr/week [Cooper et al., 2006]. These higher estimates would suggest injury rates presented here are overstated 25–50%. These three studies, however, only examined migrant farmworkers, excluding settled farmworkers that make up the majority (60%) of this population. Modifications to the work history information collected in the NAWS are currently being explored to provide for more precise calculations of work exposure, including number of hours worked.

CONCLUSIONS

Hired crop workers are at high risk for occupational injuries. Sub-populations of hired crop workers identified in this study with the highest injury risks include shuttle migrant workers, US Hispanic workers, and workers with less than 1 year of US farm work experience. The injuries from the use of hand tools, falls, and overexertion from lifting were identified as significant concerns for crop workers in the US, and were consistent with the existing literature. Falls from elevation were especially important because of the high number of restricted workdays associated with these events.

Workers with existing health conditions or musculoskeletal complaints were also found to be at elevated risk for work-related injuries and represent a significant crop worker sub-population both in terms of injury burden (66.5%), highest injury rate of 10.9/100 FTE_{WB} for prior musculoskeletal complaints, and in terms of the overall

crop worker labor force (30.9%). These findings suggest that injury prevention initiatives directed at hired crop workers must be broad based, focusing as much on the overall health of workers as on other, more traditional occupational injury approaches such as worker training. Additional research should be pursued to assess other health-related risk factors (e.g., impaired vision, impaired hearing, and depression) that have been linked to occupational injuries in other populations to see what role they play in the injury risks of hired crop workers in the US.

The high number of restricted workdays associated with the work-related injuries of hired crop workers points to the disparate burden and need to provide effective injury prevention mechanisms for this marginalized and under reported population. Special emphasis needs to be placed on methods to reduce falls (especially those from elevations), highway transportation incidents, injuries due to being caught in objects, and acute overexertion injuries, all of which account for over 20 days of restricted work activity on average (Table III). Resources exist to address some of these issues, but more emphasis needed to be placed on new approaches to assist farm operators, crop workers, safety agencies, and farm worker advocates in reducing agricultural worker risks [Baron et al., 2001; NIOSH, 2010].

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