Acute occupational injury among adolescent farmworkers from South Texas

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ABSTRACT

Purpose This combined cross-sectional/cohort study addressed research gaps by estimating the rate of non-fatal occupational injury and identifying potential determinants among a population of adolescent farmworkers who are largely Hispanic and migrant.

Methods The cohort included 410 farmworkers (aged 13–19 years) attending high school in South Texas along the border with Mexico. Data collection involved a self-administered, Web-based survey that solicited information on demographics, farm work variables including person-time at risk, occupational injury, health status and health risk behaviours. Cox regression was used to identify potential risk factors for non-fatal injury events experienced during a 9-month recall period.

Results Depending on the definition of injury, the rate of non-fatal injury ranged from 27.0–73.6/100 full time equivalents. Variables with an increased and statistically significant HR in an adjusted Cox model included: age groups <15 years-old (5.82) and 16 years-old (4.47), usually sleeping <8 h during the week (2.10), feeling tense, stressed or anxious sometimes/often (2.25), not watching TV (2.65), working around ditches (2.01) and detasseling (2.70).

Conclusions The high observed rates of non-fatal injury combined with the potential negative consequences and cost of these injuries signifies a compelling need for injury prevention efforts targeting adolescent, Hispanic, farmworkers.

BACKGROUND

Although agriculture is among the most hazardous industries in the USA, a number of minors labour in this industry as migrant and seasonal farmworkers. Based on the National Agricultural Workers Survey, minors comprise 6% of the entire hired farmworker population, which is largely Hispanic (83%), foreign-born (75%) and often temporary (ie, migrant or seasonal).[1] The precise number of minors working as farmworkers is not known due to difficulties enumerating a mobile, temporary, underage and potentially undocumented workforce.[1] Crude estimates are in the hundreds of thousands.[2]

These young workers contend with a number of occupational hazards (eg, exposure to chemicals, sharp implements, long work hours)[3] that could increase their risk of injury especially when combined with their development stage.[4] However, these youth are protected by less stringent regulations (eg, minimum age requirements, hazardous task and hour restrictions) than their peers in non-agricultural industries. Recently, efforts were underway to address this inequality by revising the Agricultural Child Labour Hazardous Occupations Orders, but proposed changes were not adopted.[5]

The high rates of fatal injury among young workers in agriculture illustrate its hazardous nature. The rate among those aged 15–24 years in the US from 1998–2007 was 21.3 deaths per 100 000 full time equivalents (FTE), second only to construction, and nearly seven times the rate for all industries combined (3.6 deaths per 100 000 FTE). Further, the rate of fatal injury for young Hispanic workers was nearly twofold the rate for young non-Hispanics.[6] Despite these high rates for fatal injury, little is known about non-fatal injury or its prevention among farmworkers in general and minors specifically.

A number of factors complicate our ability to study non-fatal injury among farmworkers including: fear of retribution for reporting problems at work, difficulty enumerating a mobile workforce, temporary employment at multiple worksites each season, which can hinder calculation of person-time at risk (ie, number of hours spent working), and employment on small farms that are exempt from Occupational Safety and Health Administration regulations.[7–9] A general lack of access to healthcare, a lack of clinicians trained in agricultural health, and language barriers may further minimise reporting. The meaning of 'work-related injury' in English does not translate adequately into Spanish.[3]

Common criteria for injury definitions used in occupational research (eg, loss of ≥4 h of work time or medical treatment) may be too restrictive.[3] The majority of farmworkers are impoverished, with a median annual family income of <$17 500, and lack employer-provided health insurance.[1] They may not be able to pay for medical treatment or take time off from work. Accordingly, surveillance systems based solely on data from patient records, employer-reports (eg, Bureau of Labour Statistics Survey of Occupational Injuries and Illnesses), or worker compensation records, may yield substantial underestimates of injury risk.[9–11]

To overcome these barriers and address research needs, we conducted a 3-year, population-based, combined cross-sectional and cohort study of adolescent farmworkers from the Texas-Mexico border, home to a number of migrant and seasonal farmworkers and their families. This study was school-based and supported by community stakeholders and educators. Participants reported their own injury experiences so that we could estimate the rate of non-fatal injury, by taking person-time at risk into account, and identify potential risk factors.

METHODS

Study population

The study population is located along the Texas-Mexico border in Starr County (pop. 60 968 in 2010), which is largely Hispanic (>95%).[12] The county has three independent public school districts (ISD), each with one high school. At the beginning of this study, Rio Grande City Consolidated ISD enrolled 59.6% of the county's students. The next largest district was Roma ISD (38.9%) and the smallest was San Isidro ISD (1.6%).[13 14] Starr County students are primarily Hispanic (99.6%) and of low-socioeconomic status (86.0%).[14]

Sampling and recruitment

We recruited all high school students from the three ISDs who were in grades 9–12 and enrolled in an English class on a main campus during the 2003–2004 school year (N=3584). This sampling frame ensured coverage of more than 90% of the enrolled student body. Three waves of letters inviting parents to allow their children to participate along with a parent consent form were sent home. All students who submitted written parental consent, or who were 18+ years-old, and who provided their own consent electronically could participate. Students received school spirit towels for returning a signed parental consent form, whether or not their parent consented to their participation. They received a school t-shirt for agreeing to participate.

Data collection

Data collection took place September 2003–January 2004. The data collection instrument was a self-administered, confidential, online survey in English or Spanish. A bilingual staff member was available to answer questions. Administered during English classes, the survey duration was approximately 45 min or one class period.

Participants answered items on demographics, work history (eg, approximate dates of employment, hours per day, days per week, type of employer, crop type and tasks), work hazards (eg, use of knives), indicators of work organisation. The occupational injury section measured the nature, body part, location (eg, field, packing shed), approximate date, crop, task, lost time from work or usual activities, and treatment or medical care.[3] Additional sections pertained to health status (eg, self-reported height and weight) and health risk behaviours (eg, alcohol and tobacco use, television watching) that were based on the Centres for Disease Control Youth Risk Behaviour Surveillance System.[15] The majority of items referred to a 9-month recall period (January 1–September 31) to capture the typical migration period of farmworkers with a home base in Starr County, Texas and to be able to anchor questionnaire items using New Year's Day. Participants used calendars with icons that identified major holidays to assist with recall of work details.[16] The survey was constructed in English, translated into Spanish, back translated and differences adjudicated. The survey was pilot-tested with bilingual (ie, Spanish and English) high school students, interviewers and other adults in the community.

Definitions of farm work, migrant, and work-related injury

We defined farm work as *any work that involved an aspect of food production in the USA (eg, field work, farm-based or commercial packing sheds, butchering) for pay or not for pay.*[3] We defined *migrant farm work* as *work that required spending the night away from their home in Starr County. Non-migrant farm work* referred to *work in or near Starr County that did not require an overnight stay.* It should be noted that these definitions are not those used in the National Agricultural Workers Survey (NAWS). The definition of migrant workers in NAWS is *persons who travel at least 75 miles during a 12-month period to obtain a farm job.*[1] We asked the farmworkers to report detailed information on their *most severe, acute injury event that occurred while working on a farm during the recall period.* Farmworkers selected from the following injury categories: major cut or scrape, bruise or crush, sprain or strain, acute muscle spasm, puncture or jab, torn ligament or muscle, heat exhaustion, skin rash or eye problems due to pesticides, sunburn, major insect bite or sting, snake bite and other (specify). Additional items measured loss of time from work or usual activities, medical treatment, location of the injury (eg, field, farm building or shed), approximate date, body part, crop and task. Exclusions included: chronic musculoskeletal symptoms and superficial cuts, scrapes or other injuries, which did not require at least a bandage. A second tighter definition of injury (ie, most severe events that resulted in 4+ hours of lost time from work, school or usual activities or medical treatment) was also used to facilitate comparison with other studies of youth and adults.[3 17 18]

Statistical analysis

We used SAS system for Microsoft Window V.9 series and Intercooled STATA V.11.0 for all analyses. Computation of descriptive statistics included the rate of injury per 100 FTE based on person-time at risk and our injury definition. FTEs were computed based on 2000 work hours per year. We evaluated time to most severe injury using Cox regression. First, we considered potential primary determinants or strong confounders based on prior work and published literature using bivariate hazard rate ratios and 95% CIs. Variables significant at the $p \leq 0.05$ levels with the greatest point estimates and most precise CIs were considered to be the strongest variables and the basis of an intermediate model. Additional potential determinants, confounders or effect modifiers were examined next by including them individually in the intermediate model if they were significant at the $p \leq 0.25$ level. Criteria for remaining in the model were variables statistically significant at the $p \leq 0.05$ level or those variables that instituted a 15% change in the hazard rate ratio for one or more of the strongest variables.[19] Next, variables formerly eliminated at the $p \leq 0.25$ level in the unadjusted models were entered independently into the model to ensure that all essential variables were included. The final step was to assess all first-order interactions. Thus, the final model included significant determinants ($p \leq 0.05$ level), confounders (those causing a 15% or more shift in the hazard rate ratio of the strongest variables), and effect modifiers (first order interaction terms significant at $p \leq 0.05$ level). We assessed the fit of the final model using Cox-Snell residuals analysis, influence/leverage analysis,[20] and a global test based on Schoenfeld residuals to assess violation of the proportional hazards assumption.[21]

RESULTS

Demographics and health behaviors

The response rate was 83.9% (n=1247) in Roma ISD, 61.2% (n=1243) in Rio Grande City Consolidated ISD and 67.6% (n=46) in San Isidro ISD, the smallest district, for an overall response rate of 70.8%. There was not a statistically significant difference ($p \leq 0.05$) between participants and non-participants with respect to grade level, the only variable available for comparison. During the 9-month recall period, 410 did farm work. The distribution of demographic variables and selected health behaviours is shown in table 1.

Table 1 Unadjusted associations between demographics and health behaviours and work injury

Variable/category	n*	%	HR	95% CI	p
Demographics					
Sex					
Female	151	40.7	1.00	–	
Male	220	59.3	1.10	0.65 to 1.86	0.734
School grade					
9th	91	24.5	1.00	–	
10th	101	27.2	0.58	0.29 to 1.18	0.131
11th	83	22.4	0.99	0.51 to 1.92	0.967
12th	96	25.9	0.57	0.27 to 1.22	0.146
Age (years)					
≤14	55	14.8	3.88	1.54 to 9.75	0.004
15	94	25.3	1.38	0.53 to 3.56	0.508
16	86	23.2	2.64	1.12 to 6.27	0.027
17	95	25.6	1.00	–	–
≥18	41	11.1	2.43	0.90 to 6.54	0.079
School					
Rio Grande City Consolidated ISD	220	57.7	1.00	–	–
Roma ISD	152	39.9	1.22	0.73 to 2.03	0.455
San Isidro ISD	9	2.4	0.93	0.13 to 6.84	0.946
Country of birth					
USA	274	73.9	1.00	–	–
Mexico/other	97	26.2	0.80	0.44 to 1.46	0.471
Language most comfortable speaking					
English (mostly/only)	67	18.1	1.00	–	–
Spanish/other (mostly/only)	161	43.4	1.61	0.73 to 3.58	0.241
Both English and Spanish equally	143	38.5	1.78	0.79 to 4.01	0.163
Years involved in farm work					
≤1	136	35.7	1.00	–	–
2–3	113	29.7	0.86	0.43 to 1.73	0.680
≥4	132	34.7	1.19	0.66 to 2.14	0.562
Health characteristics and behaviours					
Quantity of sleep during the week					
≥8 h/night	167	51.7	1.00	–	
<8 h/night	156	48.3	2.18	1.22 to 3.89	0.008
Quality of sleep during the week					
Very good/fairly good	282	87.6	1.00		
Very bad/fairly bad	40	12.4	1.57	0.79 to 3.14	0.199
Watch TV each week					
≥1 h per week	296	91.1	1.00	–	–
0 h per week	29	8.9	2.07	1.00 to 4.28	0.049
Current alcohol use					
No	174	53.5	1.00	–	–
Yes	151	46.5	1.71	0.98 to 2.99	0.060
Current cigarette use					
No	238	73.2	1.00	–	–
Yes	87	26.8	1.72	0.97 to 3.04	0.062
Experiencing cold or flu illness					
Not often/never	196	60.9	1.00	–	–
Sometimes/often	126	39.1	1.48	0.86 to 2.55	0.160
Experience headaches or stomachaches					
Not often/never	152	47.2	1.00	–	–
Sometimes/often	170	52.8	1.72	0.97 to 3.02	0.061
Feeling tense, stressed, anxious					
Not often/never	183	56.8	1.00	–	–
Sometimes/often	139	43.2	2.33	1.33 to 4.09	0.003

*May not sum to 410 due to missing values.
ISD, independent public school district

Due to unexpected problems with computer servers during data collection, records for 61 (14.9%) of the 410 farmworkers lacked some of the non-work exposure variables. Demographics and injury status for farmworkers with and without data were compared using Pearson χ^2 statistics to assess potential bias. The only variable that differed significantly was gender.

Table 2 Description of most common work variables and unadjusted association with injury

Variable/category	n†	%	HR	95% CI	p
Location					
Texas only	185	48.6	referent	–	–
Both	21	5.5	0.78	0.24 to 2.58	0.687
Out of Texas only	175	45.9	1.21	0.72 to 2.02	0.478
Employer type					
Contractor only	90	23.6	Referent	–	–
Commercial owner or grower only	49	12.9	1.36	0.51 to 3.59	0.535
Small owner or grower only	139	36.5	2.08	1.00 to 4.34	0.052
Combination of employer types/other	103	27.0	2.02	0.94 to 4.35	0.072
Crops or animals worked*					
Asparagus	26	6.8	1.10	0.44 to 2.76	0.835
Beans	33	8.7	1.27	0.60 to 2.69	0.527
Beets	21	5.5	1.92	0.87 to 4.24	0.105
Potatoes	24	6.3	1.43	0.64 to 3.17	0.384
Cherry	18	4.7	1.87	0.80 to 4.37	0.150
Corn	70	18.4	1.46	0.81 to 2.62	0.204
Cotton	138	36.2	0.53	0.30 to 0.96	0.035
Grapes	21	5.5	1.80	0.77 to 4.19	0.174
Onion	24	6.3	0.21	0.03 to 1.52	0.122
Peanuts	48	12.6	0.75	0.34 to 1.66	0.483
Watermelon/other melon	65	17.1	1.11	0.600 to 2.05	0.737
Livestock	40	10.5	1.23	0.57 to 2.65	0.596
Job tasks performed*					
Cleaned	55	14.4	1.44	0.78 to 2.66	0.244
Cleared	114	29.9	1.59	0.96 to 2.65	0.074
Cut	122	32.0	0.88	0.51 to 1.52	0.652
Detasseled	31	8.1	1.68	0.76 to 3.70	0.199
Harvested from ground	34	8.9	1.09	0.49 to 2.39	0.838
Harvested from trees	9	2.4	0.56	0.08 to 4.09	0.569
Hoed	85	22.3	0.88	0.48 to 1.59	0.663
Operated machinery	14	3.7	1.06	0.26 to 4.36	0.931
Weeded	27	7.1	1.17	0.47 to 2.92	0.737
Job hazards*					
All-terrain vehicle	92	27.1	1.29	0.74 to 2.23	0.364
Gasoline/solvents	41	12.0	1.32	0.68 to 2.57	0.413
Insect repellent	94	27.5	1.71	1.01 to 2.91	0.047
Irrigation ditches	58	17.1	1.81	1.02 to 3.20	0.043
Knives	85	25.3	1.23	0.69 to 2.17	0.482
Pesticides	69	20.4	1.83	1.05 to 3.19	0.033
Pesticide/fertilizer sprayer	79	23.4	1.12	0.63 to 2.00	0.689
Plants as tall as face	118	34.5	1.31	0.77 to 2.23	0.323
Repeated bending	133	39.0	1.21	0.72 to 2.05	0.471
Repeated hand movement	181	53.2	0.99	0.59 to 1.68	0.979
Repeated lifting (heavy loads)	102	29.9	1.03	0.59 to 1.78	0.923
Sharp tools	100	29.6	1.34	0.78 to 2.31	0.293
Tractors	103	30.4	1.27	0.74 to 2.18	0.388
Work organisation					
Work harder/faster than like	110	32.3	1.80	1.07 to 3.02	0.027
Work without rest breaks	45	13.2	1.29	0.67 to 2.46	0.444

*Participants could report multiple crops, job tasks, hazards.
†May not sum to 410 due to missing values.

Approximately, 80% of farmworkers without data were male compared with 55.9% of farmworkers with data (1 df; χ^2=12.3; p=0.000). The reason for this difference is unclear.

Employment and workplace hazards

The vast majority of farmworkers (79.8%) engaged in migrant farm work during the recall period. The remaining 20.2% only held farm jobs in or near Starr County. On average, farmworkers laboured 5.1 days/week and over 8.3 h/day for an average of 1.9 farm employers (range: 1–6). The average duration of employment was 1.7 months (9-month period). The largest proportion (36.5%) reported working for a small farm owner only while 23.6% reported working for a contractor only, 12.9% reported working for a commercial owner or grower only, and 27.0% reported working for other or a combination of employer types. Farmworkers laboured in 29 different states of which the top 10 were California, Illinois, Indiana, Michigan, Minnesota, Nebraska, North Dakota, Oklahoma, Texas and Washington. The largest proportion (48.6%) worked only within Texas (table 2). The most frequently worked crops and performed tasks are displayed in table 2.

Table 3 Description of farm work injuries

Variable	n* (%)
Sex	
Female	22 (36.7)
Male	38 (63.3)
Nature	
Acute muscle spasm	1 (1.6)
Bruise or crush	9 (14.8)
Eye problem due to pesticides	3 (4.9)
Heat exhaustion	5 (8.2)
Major cut or scrape	13 (21.3)
Major insect bite or sting	2 (3.3)
Puncture or jab	2 (3.3)
Skin rash due to pesticides or poison ivy	4 (6.6)
Snakebite	1 (1.6)
Sprain or strain	9 (14.8)
Sunburn	1 (1.6)
Torn ligament or muscle	1 (1.6)
Other or missing	10 (16.4)
Body parts	
Arms	6 (9.8)
Back	5 (8.2)
Chest or trunk	2 (3.3)
Feet	6 (9.8)
Hands	8 (13.1)
Head or face including eyes	7 (11.5)
Legs	1 (1.6)
Multiple	21 (34.4)
Other or missing	5 (8.2)
Location	
Farm or ranch field	25 (41.0)
Farm building or shed	3 (4.9)
Farm road	2 (3.3)
Animal pen	2 (3.3)
Missing/other	29 (47.5)
Lost time	
None	32 (52.5)
<4 h	7 (11.5)
≥4 h but < 1 day	6 (9.8)
≥1 days	15 (24.6)
Missing	1 (1.6)
Medical treatment	
Employer	3 (4.9)
Family or friend	12 (19.7)
Medical care provider	7 (11.5)
Self	18 (29.5)
None	15 (24.6)
Other or missing	6 (9.8)

*May not sum to 61 injuries due to missing values.

Analysis of time to injury event

In total, 381 of the 410 farmworkers reported viable work records and contributed 165 796.2 person-hours of time at risk or 82.9 FTE. These farmworkers reported a total of 61 most severe injuries during the recall period. The rate of most severe injury was 73.6 per 100 FTE (95% CI 57.3 to 94.6). For those injuries that were medically attended or included ≥4 h lost work/activity time, the rate was 27.0 per 100 FTE (95% CI 18.1 to 40.3). Table 3 displays descriptions of farm work injuries by gender, nature, body part, lost time, and medical treatment.

Tables 1 and 2 display the unadjusted associations between our main exposure variables of interest and injury. Table 4 displays the adjusted Cox model. The following variables had statistically significant ($p \leq 0.05$) HRs: sleeping fewer than 8 h/night on weeknights on average (2.10), feeling tense, stressed or anxious sometimes/often (2.25), watching 0 h of television per week on average (2.65), working around ditches (2.01) and detasseling (2.70). Age was also included in the model as five categories: <15 years (5.82), 15 years (1.71), 16 years (4.47), 17 years (referent; 1.00) and ≥18 years (2.76). All graphical depictions based on the Cox-Snell residual analysis and influence/leverage analysis supported a reasonably well-fit model. Similarly, the global test based on Schoenfeld residuals suggests no violation of the proportional hazards assumption across time based on a χ^2 distribution with 9° of freedom and the p value (0.67). Since data represented students from all three different public schools in Starr County, we also examined the potential impact of clustering of responses by school by introducing a term for school into the final model. We found no evidence that clustering of responses by school biased the findings.

Table 4 Final Cox model examining time to injury event

Variable*	HR	95% CI	p
Age			
<15 years	5.82	1.90 to 17.82	0.002
15 years	1.71	0.53 to 5.55	0.307
16 years	4.47	1.56 to 12.80	0.005
17 years	referent	–	–
≥18 years	2.76	0.80 to 9.59	0.110
Quantity of sleep during the week			
≥8 h/night	referent	–	–
<8 h/night	2.10	1.09 to 4.04	0.026
Feeling tense, stressed, anxious			
Not often/never	referent	–	–
Sometimes/often	2.25	1.24 to 4.09	0.008
Average TV watching/week			
Yes	Referent	–	–
No	2.65	1.17 to 6.03	0.020
Working around ditches			
No	Referent	–	–
Yes	2.01	1.09 to 3.74	0.026
Task—Detasseling			
No	referent	–	–
Yes	2.70	1.15 to 6.34	0.023

*n=295 records and 49 injuries.

DISCUSSION

A major strength of this study is the availability of person-time data at risk and estimated rate of non-fatal occupational injury among a large number of adolescent farmworkers who are Hispanic and largely engaged in migrant farm work. This is notable because the majority of published studies of non-fatal agricultural injury concentrate on farm owners and operators and their families.[8 22–25] A few studies involved surveys of farmworkers, but these focus mostly on adults.[3 10 17 26 27] Studies with adolescent agricultural workers often do not include Hispanic workers or have other limitations (eg, small sample size, lack person-time at risk).[3 27–33]

Our estimated rate (27.0/100 FTE) for the most severe injury using the restrictive definition is similar to available studies of adolescents working in agriculture that employ similar definitions (20.8–28.1/100 FTE).[18 28 30] The study with the most comparable population focuses on teenage agricultural workers from Washington State. In the study, the rate of injury among Hispanic teenagers was 20.8/100 FTE (95% CI 6.6 to 62.2).[28]

This and our estimate surpass the estimate (5.2/100 FTE) derived from NAWS data for hired farmworkers <20 years of age.[34] NAWS data are collected at or near the worksite where respondents, fearing negative consequences, may not report injury events. This could partially explain the discrepancy.

Using our broader injury definition, the rate increased to 73.6/100 FTE (95% CI 57.9 to 95.6), which underscores the need to collect comprehensive injury data in order to fully understand the injury experience of this vulnerable population. Six potential determinants of acute injury were identified. A non-linear pattern emerged for the rate of injury by age that was unexpected based on other studies of youth working in agriculture.[35] For example, the risk of injury was lowest among 15 year-olds and 17 year-olds, but highest among those <15 years-old and those who were 16 years-old. Also unlike other studies, we did not find an elevated risk for males compared with females.[8]

The association (HR=2.10) with sleeping <8 h per night during the week is consistent with studies of adolescent farm residents in Colorado[36] and adolescent farmworkers in China.[37] The association (HR=2.25) with general symptoms of anxiety (experienced sometimes or often) was similar to the study of adolescent farmworkers in China where the risk of injury was greater among youth who experienced family and school related stressors.[37] Not watching television on a weekly basis was associated with an increased rate of injury (HR=2.65), potentially indicative of lower socio-economic status. The rate of injury was greater among those who reported working around ditches (HR=2.01), a possible surrogate for an unmeasured hazard or combination of hazards. Finally, those who reported detasseling as a job task were more likely to sustain an injury (HR=2.70). Detasseling corn involves working with or around sharp implements and irrigation systems, exposure to extreme heat and other harsh weather conditions, and maintaining hazardous postures that may increase the risk of injury.

The use of self-reported data in this study has both strengths and limitations. We were unable to validate the reporting of injury or work patterns against medical or work records. However, our injury rates, based on a more restrictive definition, are within the range of prior studies. The reported work patterns such as crops worked, tasks performed and state of employment are similar to a prior study and suggest that our method of data collection is reliable.[3] Finally, bias may arise from collecting data pertaining to the previous migration season (2002–2003) prior to the formation of the study cohort in 2003. As a result, identified determinants of injury may be predictors of injury survival and recovery rather than the occurrence of injury events. To examine this potential bias, we compared the rates in this study to those from a subsequent analysis of injury across two additional years of follow-up. Rates were similar across all 3 years signifying that this potential bias, if present, is not dramatically impacting our conclusions.

CONCLUSIONS

This study extends our previous work with migrant farmworker families by demonstrating that meaningful injury and person-time data can be collected directly from adolescents. The difference in magnitude of the injury rates based on the comprehensive versus restricted injury definitions illustrates that commonly used criteria for injury in occupational health research (eg, medical treatment, loss of ≥4 h of work time) may grossly underestimate its occurrence in this adolescent population. In addition, Zaloshnja, Miller and Lee[38] estimated that the annual cost of non-fatal injury among hired youth in agriculture was $15.4 million in terms of medical costs, work and household productivity loss, and quality of life loss (in 2005 dollars). Long term consequences, such as disability, are especially a concern if future participation in the workforce is threatened leading to economic hardships. The high observed rates of non-fatal injury combined with their potential consequences and costs illustrates a compelling need for injury prevention efforts targeting adolescent, Hispanic, farmworkers. A variety of prevention approaches are applicable to working youth and may be tailored to this population. These include programmatic interventions designed to reduce hazardous exposures as well as evidence-based policies that are implemented, and enforced.

What is already known on the subject

- Farmworkers often labour intensely for long hours while being exposed to a variety of occupational hazards that influence injury risk.
- Although the rate of occupational injury in the agricultural industry is among the highest in the nation, little is known about injury in migrant and seasonal farmworkers in general and adolescents specifically.
- National surveillance systems that are currently in place do not capture adequately injury among migrant and seasonal farmworkers.

What this study adds

- Estimated rates of non-fatal occupational injury among adolescent migrant and seasonal farmworkers that are based on a large sample size and person-time at risk.
- An illustration of how standard definitions may not be sufficient for understanding the burden of occupational injury in this population. By applying a definition that is more appropriate for vulnerable, Hispanic, adolescent farmworkers, the rate of occupational injury was nearly three times the rate based solely on the standard definitions often used in research and practice.
- Evidence that sleep and stress also may contribute to occupational injury in this population.

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