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Place of Residence, Working Conditions and the Burden of Back Pain among Hired Farmworkers in the United States

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ABSTRACT

Objectives: Back pain is the leading occupational health problem among agricultural workers. Current study aimed to assess the burden of farm work-related back pain and to investigate its associations with living residence location and work conditions among farmworkers.

Methods: We used the National Agricultural Workers Survey (NAWS) data from 1999 to 2004, 2008–2010, and 2014. Work-related back pain was defined as a back pain that was developed when performing farm work in the 12 months prior to the interview, and it caused pain or discomfort for at least five consecutive days. To assess the associations of place of residence and working conditions (i.e. work equipment and access to toilet and water for washing hands at work) with back pain, we analyzed the data using mixed-effects logistic regression models while adjusting for age, gender, race, birthplace (US vs. foreign country), education, marital status, work authorization (yes vs. no), below poverty income, whether the worker was hired by a farm labor contractor or not, and weekly working hours.

Results: The standardized annual back pain prevalence during the study period ranged from 2.6% to 11.3%. In the adjusted model, farmworkers who lived in a residence located on the farm, who did not have access to toilet at work, and who paid for work equipment had higher odds of back pain than their counterparts.

Conclusion: Back pain is particularly common among farmworkers with poor working and living conditions. Interventions should target the identified high-risk groups to mitigate their burden of back pain.

KEYWORDS
Musculoskeletal problems; back pain; occupational back pain; working conditions

Introduction

Farmworkers are among the most vulnerable and economically disadvantaged population groups in the United States.[1] The poor working and living environment of farmworkers can contribute to the significant burden of health problems observed among this population.[2] Farmworkers are at a high risk for occupational musculoskeletal injuries,[3–5] including back injuries and back pain.[6,7] According to the National Agricultural Workers Survey (NAWS), in 1998–1999, musculoskeletal pain and discomfort was the most commonly reported problem (15%) among farmworkers, with back being the most common body part (6%) affected.[8] A cross-sectional population-based study in China reported a back pain prevalence of 64% among farmers.[9] Similarly, a cross-sectional community survey in Nigeria found a 12-month prevalence of back pain to be as high as 70%.[10] Although there are variations in the prevalence of back pain across studies, most of the studies agree that back pain is a major health problem among farmworkers.[6] Despite the significance of the problem, when compared to other industries, epidemiological studies in agriculture that exclusively focus on back pain are less common.[6]

Back pain is a major public health problem associated with substantial morbidity and disability,[11–13] accompanied with considerable health-care cost, imposing a huge burden on individuals and society.[14,15] Globally, back pain is the leading cause of years lived with disability and is among the top 10 conditions contributing to the highest number of

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disability-adjusted life-years (overall disease burden).[12,13] In the United States, back pain accounts for a quarter of all work-related compensation claims, and it is the underlying cause for 40% of the total work absence.[16] The annual economic cost of lower back pain in the United States is estimated to be between 20 and 98 billion USD, while the annual indirect costs exceed 200 billion.[14,15] The 2010 global burden of disease estimates report has highlighted occupational back pain as an important cause of disability and has called on investigating its risk factors and identifying interventions to tackle the problem.[17]

Studies have found that psychological stressors such as low autonomy and control, ergonomic risk factors, including unusually static or dynamic positions, kneeling, vibration, and stooped posture, and payment strategy are among factors associated with back pain[5,6,18,19] and are commonplace in agricultural-related work.[5,6] In addition to these factors, farmworkers often operate in harsh physical environments and have to migrate from one job to another to fulfill their responsibilities.[20] Occupational Safety and Health Administration (OSHA) has regulations and standards to improve working conditions. For instance, OSHA requires agricultural employers with more than ten employees to provide access to toilet and handwashing facilities. Employers are also required to provide the necessary work equipment to employees. Although there have been improvements in work conditions over time,[21] not all employers follow these regulations.[1,22,23]

Poor work conditions often accompany other occupational risks and hazards[22,23] and have been suggested to be associated with occupational back pain.[24] Nevertheless, despite the significance of back pain among farmworkers, our understanding of its burden as well as its residential and work-related correlates in this population is limited. We used data from the NAWS, a nationally representative survey of hired farmworkers in the United States to provide a descriptive analysis of back pain burden among farmworkers in the United States over the past years and to investigate its association with living residence location and work conditions.

Methods

Study population

NAWS, a random sample survey of United States crop workers, is an ongoing survey that began in 1989 and has so far collected data on more than 60,000 respondents. The interviews are conducted over three interviewing cycles to assure inclusion of seasonal workers. This survey uses an employment-based sampling approach, which achieves a higher likelihood of including migrant workers. The survey includes those working on nursery, cash grain fruit and nut, Christmas tree, and field crop farms in the United States (excluding the states of Alaska and Hawaii), regardless of their legal status to work or live in the United States. The primary objective of the NAWS has been to investigate crop workers and their attachment to the farm labor market. The NAWS routinely has been collecting data on a wide range of socio-demographic characteristics including farmworkers age, gender, education, job history, housing, and immigration status. The survey also includes a musculoskeletal module and a number of other modules that have been supported by funds from the National Institute for Occupational Safety and Health (NIOSH) and have been administered during several NAWS interview cycles.[25] The current study used data collected during federal fiscal years (FFY) 1999–2004, 2008–2010, and 2014, as these were the years and cycles when the musculoskeletal module was administered, and data on the outcome of interest (self-reported back pain) were collected.

The NAWS stratified sampling frame has 12 distinct agricultural regions (strata) that are based on the United States Department of Agriculture's 17 agricultural regions. For sampling purposes, the regions are further divided into several multi-county sampling units called Farm Labor Areas (FLAs). The sampling strategy further divides the FLAs into counties. Subsequently, within counties, employers (farming establishments) are randomly sampled. The final sampling units–employees–are randomly selected from the sampled farming establishments for interview.

Measures: outcome, exposures and covariates

In this study, we used the self-reported data collected through the musculoskeletal module of the NAWS questionnaire. We defined work-related back pain as back pain that developed when performing farm work in the 12 months prior to the

interview, and which caused pain or discomfort for at least five consecutive days.

NAWS included data on whether the worker was hired by a farm labor contractor or not. Farmworkers self-reported weekly working hours during the week before the interview were categorized as follows: up to 24 h, 25 to 34 h, 35 to 40 h, 41 to 50 h, 51 to 60 h, and more than 60 h. Farmworkers were asked to report whether they lived in an on-farm residence, off-farm residence, or other arrangement. A total of 50 participants (<0.2%) reported other living arrangements and were considered living in an off-farm residence. Farmworkers' responses to questions about access to toilet and water for washing hands at work were among proxy variables for work conditions. We also used arrangement of required equipment at work as another proxy variable for work conditions. The data on this variable were collected by asking farmworkers to report who paid for the equipment required for their work.

Socio-demographic characteristics of participants including age, gender, race, birthplace, and education were obtained from the core NAWS. Age was a self-reported variable representing age of the respondent at the time of the interview. We categorized country of birth into two broad categories – US-born and foreign-born. The US-born group also included participants who were born in Puerto Rico. The variable on education was based on the years of education, and we operationalized it by categorizing the responses into the following categories: no schooling, primary school (1st–7th grade), high school (8th–11th grade), high school graduate (12th grade), and college or more (13+ grade). NAWS public dataset included additional variables on socio-demographic characteristics of participants. The NAWS constructed family poverty variable was based on the estimated family income and the Federal Poverty Levels (FPL) while adjusting for family size.

Statistical analysis

We calculated frequencies and percentages to evaluate the distribution of various socio-demographic characteristics among the total sample as well as US-born and foreign-born farmworkers separately. We summarized the prevalence of back pain across groups characterized by socio-demographic variables. Additionally, the yearly prevalence of back pain was standardized to the weighted age, gender, and birthplace distribution of the farmworkers interviewed in 2014. Consequently, the age and gender standardized prevalence were calculated for US-born and foreign-born farmworkers.

To assess the associations of place of residence and working conditions (i.e., work equipment and access to toilet and water for washing hands at work) with back pain, we calculated back pain prevalence by the categories of these variables. We applied mixed-effects logistic regression models to estimate associations of these factors with farm work-related back pain among farmworkers in the United States. The initial model was adjusted for age, gender, birthplace (US vs. foreign country), education, marital status, and below poverty income. In the second model, in addition to the variables in the initial model, we further adjusted for race, work authorization (yes vs. no), whether the worker was hired by a farm labor contractor or not, and weekly working hours. To assess the association between each exposure of interest and back pain adjusted for the other exposures, we applied the third multivariate regression model with all the covariates included in the second model while concurrently adjusting for living residence location and work condition related variables. To account for the sampling design and regional and temporal variations in back pain prevalence, all the mixed-effects models included a random intercept for the 171 FLAs and fixed effects for the 12 regions and 30 interview cycles (three interview cycles per each FFY).

The NAWS public dataset includes a composite sampling weight variable that accounts for length of work week (adjusting for the number of days a worker works), as well as seasonal and regional weights. The weights were used to provide nationally representative estimates while accounting for the multistage sampling design. All the analyses applied the stabilized weights. We used SAS software, version 9.4 (SAS Institute, Cary, NC) for all analyses.

Results

The total sample included 28,997 respondents: 3612 were interviewed in 1999; 3586 in 2000;

3111 in 2001; 3361 in 2002; 3585 in 2003; 3046 in 2004; 2182 in 2008; 2219 in 2009; 1472 in 2010; and 2823 in 2014. In the weighted sample, farmworkers in California accounted for one-third of the total sample. The East, Southeast, Midwest, and West comprised 14.5%, 12.7%, 17.1%, and 13.2% of the total-weighted sample, respectively, while the Southwest had the lowest number of farmworkers, representing 7.7% of the total-weighted sample.

The majority of farmworkers were 18 to 44 years-of-age (Table 1). Workers under 18 and over 55 years-of-age were a minority. More than three-quarters (76.1%) of the farmworkers were male, and the proportion of males among foreign-born farmworkers was slightly higher than the proportion of males among the US-born farmworkers (77.8% vs. 71.1%). Hispanic farmworkers were a significant majority (80.1%) in the total sample. White non-Hispanic and other non-Hispanic farmworkers represented the next common race/ethnic groups, respectively (14.1% and 3.4%). Almost all foreign-born farmworkers (97.3%) were Hispanic. Slightly more than one-third of the farmworkers (37.0%) were married or living with a partner, and those single accounted for more than half of the total sample (57.4%). Two-thirds of farmworkers (39.6%) in the total sample had a family income falling below the federal poverty levels. A quarter (26.4%) of the US-born farmworkers experienced a below poverty level family income, while the prevalence of poverty among foreign-born farmworkers was significantly higher (44.0%). The majority of farmworkers (84.6%) lived in an off-farm residence. The US-born farmworkers were slightly more likely to live at an off-farm residence when compared to foreign-born farmworkers (86.0% vs. 84.1%). Overall, 94.8% of farmworkers had access to toilet at work, with foreign-born farmworkers reporting slightly higher rates of access to toilet (95.2%) compared to US-born farmworkers (93.7%). Water for washing hands at work was provided to 94.6% of farmworkers, and it did not vary by farmworkers' birthplace. Employers provided a majority of farmworkers with working equipment; nevertheless, a notable proportion of farmworkers paid either fully or partly for the equipment – 7.6% and 4.6%, respectively. Foreign-born farmworkers were more likely to pay for their work equipment compared to US-born farmworkers.

The overall prevalence of farm work-related back pain among farmworkers was 6.7%. Farmworkers in the Southwest and in the West had the lowest prevalence of back pain, 4.5% and 4.8%, respectively (Table 2). Farmworkers in the East, Midwest, Southeast, and California had back pain prevalence ranging from 6.1% to 8.0%. The back pain prevalence among farmworkers under 18 years-of-age was 8.2%. Farmworkers between the ages of 18 to 24 had the lowest back pain prevalence (5.5%). Female farmworkers had a back pain prevalence of 8.9%, which was considerably higher than the back pain prevalence of 6.0% observed in male farmworkers. The back pain prevalences across the race and ethnicity groups were between 6.5% and 7.0% and were not substantially different from one another. The prevalence of back pain was the highest among widowed or separated farmworkers (7.8%), significantly higher than the prevalence among those married or living together (6.0%). Farmworkers with no schooling had a back pain prevalence of 8.3%. The back pain prevalence among those with college or a higher level of education, at 5.0%, was the lowest. The prevalence of back pain among those with below poverty line family income was 6.2%, significantly lower than the back pain prevalence of 7.2% observed among farmworkers with a family income above the poverty line. Those living at an off-farm residence and those living at an on-farm residence had back pain prevalence of 6.8% and 6.3%, respectively. Farmworkers with and without access to toilet and water for washing hands had a similar back pain prevalence, ranging from 6.7% to 7.0%. Those farmworkers fully paying for their work equipment had a back pain prevalence of 10.2%, substantially higher than farmworkers with different arrangements for their work equipment.

Figure 1 provides a detailed breakdown of back pain prevalence by FFY. After standardizing for age, gender, and birthplace distribution, the highest back pain prevalences were observed in 2000 (10.9%) and 2002 (11.3%). We did not observe any clear trend in the differences between the US-born and foreign-born farmworkers back pain prevalence.

Table 1. Weighted distributions of socio-demographic characteristics, place of residence and working conditions in hired farmworkers in the US by their birthplace (National Agricultural Workers Survey (NAWS), 1999–2004, 2008–2010, and 2014).

	US-born Weighted No. (%)	Foreign-born Weighted No. (%)	All Weighted No. (%)
Age			
14–17	455 (6.5)	612 (2.8)	1067 (3.7)
18–24	1723 (24.5)	5463 (24.9)	7185 (24.8)
25–34	1355 (19.3)	6613 (30.1)	7968 (27.5)
35–44	1326 (18.9)	5056 (23.0)	6383 (22.0)
45–55	1269 (18.1)	2703 (12.3)	3972 (13.7)
55+	889 (12.7)	1526 (6.9)	2415 (8.3)
Gender			
Male	4988 (71.1)	17,090 (77.8)	22,078 (76.1)
Female	2030 (28.9)	4889 (22.2)	6919 (23.9)
Race/ethnicity			
White non-Hispanic	4038 (57.5)	36 (0.2)	4074 (14.1)
Other non-Hispanic	829 (11.8)	158 (0.7)	987 (3.4)
Hispanic	1823 (26.0)	21,389 (97.3)	23,212 (80.1)
Unknown	327 (4.7)	397 (1.8)	724 (2.5)
Marital status			
Married or living together	3331 (47.5)	7405 (33.7)	10,736 (37.0)
Widow or separated	529 (7.5)	1064 (4.8)	1593 (5.5)
Single	3148 (44.9)	13,479 (61.3)	16,627 (57.3)
Education			
No schooling	21 (0.3)	1118 (5.1)	1140 (3.9)
1st to 7th grade	521 (7.4)	13,233 (60.2)	13,753 (47.4)
8th to 11th grade	1921 (27.4)	5410 (24.6)	7331 (25.3)
High school graduate (12th) grade)	2941 (41.9)	1628 (7.4)	4569 (15.8)
College or more (13+ years)	1612 (23.0)	537 (2.4)	2149 (7.4)
Family income below poverty			
No	5071 (72.3)	12,152 (55.3)	17,223 (59.4)
Yes	1817 (25.9)	9660 (44.0)	11,477 (39.6)
Region where interviewed			
East	1678 (23.9)	2540 (11.6)	4217 (14.5)
Southeast	1168 (16.6)	2509 (11.4)	3677 (12.7)
Midwest	2445 (34.8)	2510 (11.4)	4955 (17.1)
Southwest	651 (9.3)	1594 (7.3)	2245 (7.7)
West	649 (9.2)	3175 (14.4)	3824 (13.2)
California	426 (6.1)	9652 (43.9)	10,077 (34.8)
Living residence location			
Off-farm	6034 (86.0)	18,481 (84.1)	24,516 (84.6%)
On-farm	865 (12.3)	3230 (14.7)	4095 (14.2%)
Access to toilet			
Yes	6573 (93.7)	20,923 (95.2)	27,496 (94.8%)
No	440 (6.3)	1032 (4.7)	1472 (5.1%)
Access to water for washing hands			
Yes	6686 (95.3)	20,742 (94.4)	27,428 (94.6%)
No	312 (4.4)	1019 (4.6)	1330 (4.6%)
Paying for work equipment			
Employer pays	6060 (86.4)	17,521 (79.7)	23,581 (81.3%)
Farmworker pays	171 (2.4)	2032 (9.3)	2203 (7.6%)
Farmworker pays some	220 (3.1)	1122 (5.1)	1342 (4.6%)
Others pay	38 (0.5)	93 (0.4)	132 (0.5%)
Don't need equipment	511 (7.3)	1150 (5.2)	1662 (5.7%)

After adjusting for covariates (age, gender, race, birthplace, education, marital status, work authorization, below poverty income, whether the worker was hired by a farm labor contractor or not, and weekly working hours), farmworkers living at an on-farm residence had 12% higher odds of back pain. Not being provided with access to toilet and water for washing hands at work were weakly associated with higher odds of back pain among farmworkers. Farmworkers paying for work equipment had 49% higher odds of back pain compared to those farmworkers who had employers paying for the work equipment. Concurrently including living residence location and work condition

Table 2. Weighted distribution of back pain prevalence by socio-demographic characteristics, place of residence and working conditions among hired farmworkers in the US by their birthplace (National Agricultural Workers Survey (NAWS), 1999–2004, 2008–2010, and 2014).

Back pain cases and prevalence in each row category		
	Weighted No. (%)	p-Value
Age		<0.01
14–17	87 (8.2)	
18–24	392 (5.5)	
25–34	531 (6.7)	
35–44	487 (7.6)	
45–55	285 (7.2)	
55+	164 (6.8)	
Gender		<0.01
Male	1328 (6.0)	
Female	617 (8.9)	
Race/ethnicity		0.93
White non-Hispanic	280 (6.9)	
Other non-Hispanic	69 (7.0)	
Hispanic	1549 (6.7)	
Unknown	47 (6.5)	
Marital status		<0.01
Married or living together	640 (6.0)	
Widow or separated	124 (7.8)	
Single	1181 (7.1)	
Education		<0.01
No schooling	94 (8.3)	
1st to 7th grade	946 (6.9)	
8th to 11th grade	468 (6.4)	
High school graduate (12th) grade)	326 (7.1)	
College or more (13+ years)	107 (5.0)	
Family income below poverty		<0.01
No	1231 (7.2)	
Yes	709 (6.2)	
Region where interviewed		<0.01
East	257 (6.1)	
Southeast	283 (7.7)	
Midwest	314 (6.3)	
Southwest	102 (4.5)	
West	184 (4.8)	
California	806 (8.0)	
Living residence location		0.23
Off farm	1669 (6.8)	
On farm	258 (6.3)	
Access to toilet		0.70
Yes	1842 (6.7)	
No	103 (7.0)	
Access to water for washing hands		0.86
Yes	1823 (6.7)	
No	90 (6.8)	
Paying for work equipment		<0.01
Employer pays	1553 (6.6)	
Farmworker pays	224 (10.2)	
Farmworker pays some	75 (5.6)	
Others pay	7 (5.2)	
Don't need equipment	73 (4.4)	

related variables in the regression model while adjusting for the previously included covariates, the association between back pain and work equipment arrangement did not change. Nonetheless, the associations between back pain and provision of water for washing hands at work became less conclusive, closer to the null. Table 3 presents the adjusted estimates and their respective confidence intervals. The sensitivity analyses stratifying the study sample into seasonal and year-round employees yielded findings consistent with the results obtained from the analyses of the full sample.

Discussion

This study assessed the burden of farm work-related back pain among farmworkers during the period from 1999 to 2014 using data from NAWS, a nationally representative survey of farmworkers in the United States. It also described living residence location and work conditions of farmworkers and examined their association with farm work-related back pain.

The year-round multi-stage sampling of farmworkers in NAWS provided a nationally representative sample and a unique opportunity to assess the burden of back pain among farmworkers in the United States. Although there were some fluctuations in the back pain prevalence over the study period, back pain was and remains a common problem among farmworkers. It contributes to the significant burden of morbidity observed among the agricultural workforce.

We found varying prevalences of back pain across age categories. Among farmworkers, back pain prevalence yielded a curvilinear relationship, increasing with age among younger adults and then slowly decreasing among middle age and older adults. This was consistent with several studies that have shown a curvilinear relationship between age and back pain.[26–29] Our findings were also in agreement with several studies reporting a slightly higher risk for developing back pain among women;[29–32] we found that women had a higher prevalence of farm work-related back pain than men. Some studies have shown that those married have a lower risk for developing back pain compared to those who were single.[32,33] Similarly, divorced, separated, or widowed individuals have a higher odds of developing disabling back pain compared to those who are single.[30] Our findings concerning the

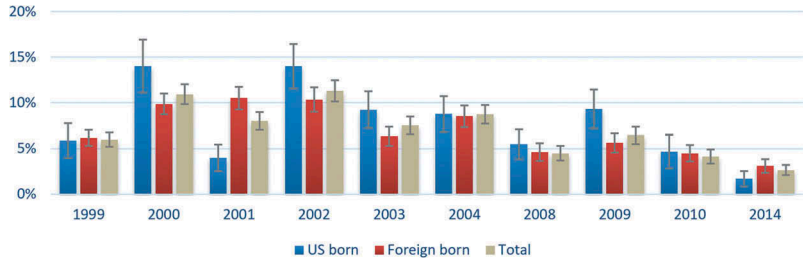

Figure 1. Weighted prevalence of back pain among farmworkers by year (National Agricultural Workers Survey (NAWS)).
Note: The yearly prevalences in the total sample were standardized to the age, gender, and birthplace distribution of the total sample interviewed in 2014, and the birthplace specific prevalence were standardized to the age and gender distribution of the total sample interviewed in 2014.

Table 3. Odds ratio of back pain associated with living residence location and work conditions among hired farmworkers in the US (National Agricultural Workers Survey (NAWS)), 1999–2004, 2008–2010, and 2014.

	Model 1[a]		Model 2[b]		Model 3[c]	
	aOR, (95% CI)	p-value	aOR, (95% CI)	p-value	aOR, (95% CI)	p-value
Living residence location						
Off farm	1 (Reference)		1 (Reference)		1 (Reference)	
On farm	1.12 (0.95–1.31)	0.18	1.12 (0.95–1.31)	0.18	1.12 (0.96–1.33)	0.16
Access to toilet						
Yes	1 (Reference)		1 (Reference)		1 (Reference)	
No	1.34 (1.06–1.70)	0.01	1.16 (0.90–1.48)	0.25	1.15 (0.83–1.60)	0.40
Access to water for washing hands						
Yes	1 (Reference)		1 (Reference)		1 (Reference)	
No	1.29 (1.02–1.64)	0.04	1.22 (0.95–1.56)	0.12	1.04 (0.75–1.43)	0.84
Paying for work equipment						
Employer pays	1 (Reference)		1 (Reference)		1 (Reference)	
Farmworker pays	1.45 (1.22–1.72)	<0.01	1.49 (1.25–1.78)	<0.01	1.46 (1.22–1.75)	<0.01
Farmworker pays some	1.11 (0.86–1.44)	0.43	1.11 (0.86–1.45)	0.43	1.12 (0.86–1.45)	0.42
Others pay	0.83 (0.36–1.77)	0.59	0.86 (0.39–1.91)	0.72	0.88 (0.40–1.94)	0.74
Don't need equipment	0.84 (0.64–1.09)	0.18	0.79 (0.60–1.04)	0.09	0.83 (0.63–1.10)	0.19

aOR, adjusted odds ratio; CI, Confidence intervals.
[a]Mixed-effects logistic regression model, with random intercept for FLAs and fixed effects for interview region and cycle while adjusted for age, gender, birthplace, education, marital status, and below poverty income.
[b]Model 1 + race, work authorization, hired by contractor, and weekly working hours.
[c]Model 2 + all the variables included in this table.

association between marital status and back pain were in line with those studies.

Similar to other studies,[30,34] we also observed a positive association between low education and back pain in our study sample. Studies also showed that there is an inverse relationship between family income and prevalence of back pain[35–37]; however, in our sample, the observed association was in the opposite direction. There are a few possible explanations for this finding. Firstly, below poverty income variable was based on the family income and did not take into account that some of the farmworkers might have been provided with housing by the employer, decreasing their overall living expenses. Secondly, this association was based on crude prevalence estimates, and lack of adjustment for potential confounders such as age and workload could have affected the magnitude and direction of this association.

After standardizing for age and gender, we did not see any specific pattern or systematic differences when comparing the back pain prevalence between US-born and foreign-born farmworkers. Although the prevalence of back pain fluctuated during the study period, the standardized prevalence estimates suggested a decreasing trend in the burden of back pain among farmworkers. Nevertheless, a notable proportion of farmworkers experienced back pain during the recent years.

Farmworkers are at high risk for musculoskeletal disorders including back pain, and future studies are required to investigate the potential causal factors. Additionally, it is also important for future studies to examine the back pain trend in subsequent NAWS cycles to verify and highlight possible changes in the back pain trends in this population.

Farmworkers living at an on-farm residence had slightly higher back pain prevalence, suggesting a possible weak positive association after controlling for socio-demographic characteristics and work conditions. The observed trend might be partially attributable to the poor living conditions in residences located on-farm. Similarly, the adjusted models suggested a possible weak association between back pain and access to sanitary facilities (i.e., access to toilet and water for washing hands) at work. Nevertheless, the small number of farmworkers lacking access to toilet and water at work resulted in low statistical power, contributing to the high level of uncertainty in the estimated associations. Although associations between these factors and back pain had not been examined previously, studies have shown that such poor conditions were negatively associated with employees' retention and were often accompanied with other occupational risks and hazards.[22,23] The potential associations observed in our study could partly be due to the underlying broader workplace risks and hazards for which these specific variables served as proxy measures.

Farmworkers paying for work equipment were at a higher risk for farm work-related back pain. Similar to access to water and sanitary facilities, this variable also serves as a proxy for the general work conditions. It is also reasonable to assume that farmworkers paying for the work equipment are less likely to afford equipment that is ergonomic, safer to work with, and of higher quality. Moreover, workers paying for equipment who decide to use their equipment and tools for a longer period of time to minimize their expenses might end up using equipment in sub-optimal condition, and have affected functionality. Various studies have demonstrated impact of equipment and work tools on health outcomes, including back pain and other musculoskeletal disorders.[38–41] Providing the proper work equipment to workers and bearing the burden of cost of obtaining such equipment by employers can have positive impacts on work conditions and consequently health outcomes of farmworkers.

Several studies have previously highlighted strengths and limitations of NAWS data.[42,43] A potential limitation could be selection bias due to non-response and refusals by the employers or the employees. However, workers participation rate in the study was over 90%, decreasing likelihood of such a selective non-response bias. Nonetheless, a healthy worker effect due to workers potentially missing work because of severe back pain or any other reason during the survey may have resulted in potential underestimation of back pain burden among farmworkers. Similarly, the recall bias seen in studies that rely on participants' memory to report events during specific time also applies to the NAWS data. Since back pain was assessed using a question requiring a 12-month recall period, it could have resulted in some bias, perhaps underestimating the back pain burden. Nevertheless, since recalling work-related back pain causing pain or discomfort for at least five consecutive days may require less effort compared to shorter episodes of back pain, it could have minimized the effect of recall bias. The cross-sectional nature of the study makes the assumptions about temporality of events less definitive. Moreover, data on some of the variables were collected during the respondent's job at the time of interview, but these variables could have been different at the time the farmworker developed back pain. However, given that back pain prevalence was limited to the 12-month period prior to the interview, this issue should not pose a significant problem in this study. Several prevalence estimates among different subgroups were crude and did not account for other covariates, including potential confounders, hence, they should not be interpreted as or used to construct measures of causal effects. This is not a limitation, as the main objective of these estimates was not to provide causal effect estimates but to present the burden of back pain among farmworkers and quantify its associations with living residence location and work conditions.

The identification of high-risk groups along with factors associated with farm work-related back pain

can contribute to the awareness of back pain and burden of other musculoskeletal problems among farmworkers. This could foster future research on the topic. Additionally, the results of this study can support public health practitioners and policymakers in targeting poor work conditions to decrease the burden of back pain among high-risk populations. Future research should focus on finding the underlying risk factors for and the sub-groups of workers at higher risks of farm work-related back pain.

Authors contributions

VK conceived the study, performed data analysis and drafted the manuscript. OAA supervised the study, contributed to study conception, provided consultation for data analysis and critically reviewed and revised the manuscript drafts for important intellectual content. All authors approved the final.

Disclosure statement

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Institution and Ethics approval and informed consent

The University of California, Los Angeles office of the Human Research Protection Program deemed the study exempt.

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