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Safety and Injury of US-Certified Organic Crop Producers in the Southwest Region

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ABSTRACT

Objectives: Literature on occupational risks among organic farmers is scarce. This study explored safety practices and non-fatal injuries among organic producers, and the role of sociodemographic, work, and farm characteristics on safety and injury.

Methods: Cross sectional survey of certified organic crop producers in the Southwest (SW) region of the United States (US). The Organic Integrity Database was used for recruitment. Data were collected through an electronic and paper survey.

Results: Analyses were conducted on 115 cases; response rate was estimated at 25%. A high majority of respondents owned their operation and were younger than 65 years, male, educated beyond high-school, and non-Hispanic whites. Less than half had more than 10 years of experience in organic farming; one-third worked off the farm year-round. Safety practices were very basic despite the widespread use of equipment and machinery, and limited to wearing normal clothing and apparel such hats and glasses. About half of respondents (52.6%) reported non-fatal injuries in the past year; and one-third (32.7%) time lost due to injuries. The overall cumulative incidence rate was estimated at 5.3 injuries per 10 workers within the last year. The injury rate decreased with hours worked. Significant differences were found on gender and education level and safety practices, with female respondents and the more educated being more proactive in practicing safety. Those working less than 40 h/week, in farms smaller than 50 acres, using light machinery or compact utility tractors, and tractors without roll-over protection reported significantly higher injury frequency compared to their counterparts.

Conclusion: This study contributes unique data on an essential workforce not captured by current occupational injury and illness surveillance systems. It identifies important personal and contextual factors that may contribute to safety and injury in this population. The findings indicate the need to promote safety and prevent injuries that result in work time lost. This study may also inform future occupational safety and health research and practice, including surveillance, injury prevention programs that target certain workers and production practices, and policies that support and protect the organic farmer.

KEYWORDS
Organic producers; occupational injury; safety; sociodemographic characteristics

Introduction

Organic agriculture has been described "*as the application of a set of cultural, biological, and mechanical practices that support the cycling of on-farm resources, promote ecological balance, and conserve biodiversity*."[1] Organic certification allows farmers to label and sell products as organic. Although still small, global organic farmland and retail sales continue to grow. Compared to 2018, organic farmland increased by 1.1 million hectares or 1.6% in 2019. This constituted 72.3 million hectares of organic agricultural land, or 1.5% of the world's agricultural land.[2]

In the United States, certified organic cropland acres increased by 73% (to 3.5 million acres), pastureland and rangeland increased by 22% (to 2.0 million acres), and certified operations increased by more than 80% (to 16,585) between 2011 and 2019.[3] The US Department of Agriculture (USDA) Organic Integrity Database (OID) lists more than 45,630 certified operations globally, of which 27,267 (60%) are located in the US (as of late April 2023). This growth is driven by consumer demand: in 2018, 40% of US adults said that most or some of the food they eat is organic.[4]

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Furthermore, agricultural producers are considered essential workers,[5] and local systems and small farmers, including organic farmers, play a key role in food availability and access. This was more evident during the COVID-19 pandemic, and data show that sales of organic and fresh produce increased in 2020 and 2021.[6–8]

Agricultural injury and illness data

Agricultural work is recognized as one of the most dangerous occupations,[9] and organic farmers are not immune to harm. However, none of the current injury and illness tracking systems identify organic producers or farmworkers independently from conventional farmers, and little is known about occupational safety and health in this population. The Bureau of Labor Statistics (BLS) and the Department of Labor (DOL) collect workplace data on injury and illness for agricultural workers through the **Injuries, Illnesses, and Fatalities (IIF)** program's Survey of Occupational Injuries and Illnesses (SOII) and the Census of Fatal Occupational Injuries (CFOI).[10] The Occupational Safety and Health Administration (OSHA) collects work-related injury and illness data from employers within specific industries, including agriculture-crop production.[11] The National Institute for Occupational Safety and Health (NIOSH) collects data on incidence and causes of fatal farm-related injuries through the Fatality Assessment and Control Evaluation (FACE) Program.[12] The National Agricultural Workers Survey (NAWS) collects demographic and employment data of hired crop workers by conducting face-to-face interviews. NAWS is comprehensive and covers a variety of characteristics for the workers and their dependents, such as occupational injury and health history.[13]

While these systems and surveys provide longitudinal injury and health data for agricultural workers, they do not identify the organic farmer; case reports may or may not mention the type of farm or production (e.g., organic). Overall, researchers have pointed out the many challenges and limitations of current surveillance of occupational injuries and call for a more reliable national system, particularly on non-fatal injuries.[14–17] Some have also suggested surveillance efforts should be regionally focused, as farm, workforce, practices, and production differ regionally.[18] Fewer resources and funding have been allocated for the development of organic injury surveillance systems, and data on injury and illness and the safety and health of the organic farmer is scarce, particularly in the US.[16,19,20]

Furthermore, we should not assume that agricultural surveillance and research findings necessarily apply to the organic farmer. In the US, a few studies found relevant differences in sociodemographic characteristics between conventional and organic farmers, such as age, education, sex, experience, and production practices.[21–23] These findings may have implications for safety and health, as small-scale organic farming requires additional manual and physical work, which may constitute a higher risk for musculoskeletal injuries.[16–19] Other studies found greater concern for the environment and long-term sustainability, and a greater willingness to incur present financial risk to gain future benefits among organic farmers compared to conventional.[22,24] These concerns constitute additional sources of stress and may have implications for mental health and social indicators.

Organic farmer data

A source of organic farmers' data is the National Agricultural Statistics Service (NASS), which has been conducting surveys with certified organic producers since 2008. These consist of various surveys (the most recent is the 2021 Certified Organic Survey),[25] and special studies as part of the Census of Agriculture (COA), which is conducted every 5 years. While the organic survey focuses on acreage, production, sales and marketing practices, the COA collects sociodemographic and work and farm data on "all farms" and "farms with organic sales." The 2017 COA (the most recent for which data are available) included items on producer, farm, and work characteristics including sex, age, military service, primary occupation, place of residence, on farm/not on farm-, work off farm, and years in the present farm.[26]

While certain demographic and work and farm characteristics may be linked to occupational injury and illness, there is very little research

exploring risks among organic farmers. As more agricultural workers engage in sustainable practices, additional resources must be dedicated to support and protect these farmers. Research should typify the organic farmer, identify the production practices that may potentially contribute to injury and illness, and explore the intrapersonal, interpersonal, and contextual factors that may relate to safety and health in this population. The aim of this project, the Organic Farmer Safety, Health & Life Study (OFSHLS), was to develop, validate, and administer a comprehensive survey that typifies the certified organic crop producer and identifies multilevel factors that may contribute to occupational safety and health in these farmers. It was funded by the Southwest Center for Agricultural Health, Injury Prevention and Education (SW Ag Center), one of 12 NIOSH agricultural centers throughout the US. It focused on the five states served by the SW Ag Center: Arkansas (AR), Louisiana (LA), New Mexico (NM), Oklahoma (OK), and Texas (TX). This paper presents results on self-reported occupational safety practices and non-fatal injuries.

Methods

This was a cross sectional survey study. Data were collected in late fall 2020 and spring 2021. The study was approved by the Institutional Review Board at the University of New Mexico Health Sciences Center. All participants were provided with an informed consent form and voluntarily consented to participate.

Participants and eligibility

Participants included US certified organic crop producers listed in the OID, a publicly available database of certified organic operations. It includes a variety of operations (e.g., crop, handling, livestock, and wild crops) and certification status (e.g., as surrendered, suspended, revoked, other). Contact information consists of name (producer), phone, email, website, and physical and mailing address. Email address is not a mandatory field, and only a portion of listed operations include it.

The USDA defines the farm producer as the person who runs the farm, making day-to-day management decisions for the farm operation. She/he may be the owner, a member of the owner's household, a hired manager, a tenant, a renter, or a sharecropper.[27] Qualifying criteria for this study included: (a) 18 years of age or older, (b) currently operating an organic crop farm in the five states of the study's region, and (c) listing a valid postal and/or email address in the OID. Excluded were operations that solely engaged in handling and processing organic consumer products.

Recruitment

Email and postal mail were used for recruitment. An advanced search of the OID to identify crop operators in the study's region returned 599 records (TX: 348; NM: 91; AR: 85; OK: 56; LA: 19). Since less than half listed an email address, an internet search (Google and Facebook) of organic operations was conducted to obtain additional emails. An initial invitation message was sent to 219 operators with information on the study and a link to the informed consent and electronic survey. A postal mail recruitment was also launched for 399 producers who only listed a postal address or did not complete the electronic survey in the first recruitment wave. It consisted of a packet containing a cover letter, a copy of the informed consent, the paper survey, and a stamped self-addressed return envelope. Various institutional websites and social media outlets were also used for recruitment; as well as scheduled reminders via email, phone, and postcards. The participation incentive consisted of a $25 merchandise card from a national hardware and home improvement store. It was offered to all participants who completed either the paper or electronic survey, and mailed to those who explicitly accepted the incentive. Overall (after subtracting non-delivered emails and letters), a total of 499 unduplicated invitations were sent out.

Data collection

Data were collected through the OFSHLS Survey, a theory-based, population-specific electronic and paper tool developed by the research team. The development process consisted of: (a) a search of

the literature to identify domains of potential interest; (b) reiterated draft versions of the survey; (c) review by experts in public health, social and behavioral sciences, epidemiology, occupational health, and agricultural research; and d) pilot testing and feedback session with actual organic farmers. This process contributed to the face and content validity of the instrument. The final version consists of 179 items on a variety of domains, including four multi-item questions on safety practices and non-fatal injuries. The survey also includes a sociodemographic section, as well as work and farm characteristics. Details on the OFSHLS Survey and its psychometric properties are forthcoming.

REDCap (Research Electronic Data Capture), a secure web application, was used for recruitment and data collection. Paper survey data were manually entered into the database by trained project staff. Respondents were assigned a unique ID number. The final dataset included 125 records, 53 paper and 72 electronic surveys. Of those, 10 were excluded from the analysis because they did not meet qualifying questions or provide answers to sociodemographic questions.

SPSS 27.0 (IBM SPSS Statistics, Armonk, NY: IBM Corp.) was used for analysis, which consisted of descriptive and bivariate statistics on all sociodemographic characteristics, work and farm characteristics, safety practices, and injury prevalence. Key sociodemographic, work, and farm variables are presented in Tables 1 and 2. Assessment of safety practices on the farm consisted of ten items (Table 3). A mean score was calculated to estimate the frequency of using any or all of the safety practices. Lower scores indicate less frequent use and/or use of fewer practices and higher scores more frequent use and/or use of more safety practices. To measure self-reported non-fatal injuries, respondents were asked if they had experienced different types of injuries during the last 12 months while doing activities on the organic farm to the extent that it required time away from work, restricted work activity, or necessitated medical treatment from a healthcare provider. Consistent with the BLS' Occupational Injury and Illness Classification System (OIICS), injury type refers to nature, source, and event/exposure (see Table 4). For the present analysis, we created a dichotomous variable indicating whether or not the respondent had experienced at least one of these injury types. Pearson Chi-square and T-tests were used to assess the statistical significance of differences between safety practice score means and report of any injuries by work and farm characteristics.

Table 1. Social demographic characteristics of respondents.

	Count	Percent	Valid N
Age			
Under 35	11	1.8%	102
35–44	21	2.6%	102
45–54	20	19.6%	102
55–64	16	15.7%	102
65 and over	34	33.3%	102
Gender			
Female	38	37.6%	101
Male	62	61.4%	101
Another gender	0	.0%	101
Prefer not to disclose	1	1.0%	101
Race/Ethnicity			
Hispanic or Latino	15	16.0%	94
Non-Hispanic White	71	75.5%	94
Non-Hispanic Asian, Black, Native American, or Multi-Racial	8	8.5%	94
Education Level			
Less than High School Diploma	2	2.0%	101
High School Diploma	11	1.9%	101
Some College or 2-Year Degree	20	19.8%	101
4-Year College Degree	38	37.6%	101
Graduate Degree	30	29.7%	101
Annual Household Income			
Under $25,000	8	8.5%	94
$25,000–$49,999	13	13.8%	94
$50,000–$99,999	30	31.9%	94
$100,000–$249,999	43	45.7%	94
Household Size			
Lives alone	15	14.9%	101
Lives with 1 other person	40	39.6%	101
Lives with 2 other people	17	16.8%	101
Lives with 3 or more other people	29	28.7%	101
Marital Status			
Married or cohabitating	76	74.5%	101

Results

Response rate was estimated at 25%; NM and TX had the highest rates (40% and 39% respectively); AR and LA the lowest (5% and 1%). Table 1 presents the sociodemographic characteristics of the sample. A high majority of respondents were younger than 65 years; male; and non-Hispanic whites. More than 85% had an education level beyond high school, and nearly 46% reported a household income of more than $100,000.

Table 2. Work and farm characteristics of respondents.

	Count	Percent	Valid N
Operator Type			
Owner operator	93	83.0%	112
Worker (non-owner)	19	17.0%	112
Years of Experience in Farming			
More than 10 years in farming	84	77.8%	108
More than 10 years in *organic* farming	45	41.3%	109
Work Commute			
Live on the farm/home is the farm	60	55.6%	108
More than 10 mile commute to farm	37	34.3%	108
Hours per Week of Work on the Farm			
40 or fewer hours per week	36	33.3%	108
41–60 hours per week	35	32.4%	108
more than 60 hours per week	37	34.3%	108
Work Off of the Farm			
Work a job off of the farm	33	31.1%	106
Work job off the farm 12 months/year	19	61.3%	31
Hours per week work job off of farm			
1–20 hours per week	21	63.6%	33
21–40 hours per week	8	24.2%	33
More than 40 hours per week	4	12.1%	33
Organic Acres Currently in Production			
50 or more acres	52	48.6%	107
Methods of Growing Crops			
Under cover (with or without open field)	36	34.0%	106
Open field ONLY (no crops grown under cover)	70	66.0%	106
Livestock			
Animals present on the farm	55	41.4%	107
Tools and Machinery in Use			
Hand tools	68	59.1%	115
Light machinery (tiller, walk behind tractors)	43	37.4%	115
Sub-compact and compact utility tractors	35	3.4%	115
Heavy machinery (utility tractors, etc.)	71	61.7%	115
Other	4	3.5%	115
Tractor			
Roll-over protection or enclosed cab	78	86.7%	90
Front-end loader	62	68.9%	90

Regarding work and farm characteristics (Table 2), a very high majority owned their operations, and less than half had more than 10 years of experience in organic farming; more than 60% worked off the farm year-round, and of those nearly one-fourth worked between 21 and 40 hours/week. A slight majority operated less than 50 acres of organic production at the time of the survey, nearly 62% used heavy machinery (e.g., utility tractor), and 30% sub-compact and compact utility tractors. Practically, all used hand tools or light machinery such as tillers and walk behind tractors.

Table 3 presents the frequency of use of basic protective equipment. Face mask and ear protection were less frequently reported; long sleeves and pants, gloves, hats, and eye protection were more frequent.

About half of respondents (52.6%; $n = 51$) reported non-fatal injuries in the past year, and one-third (32.7%; $n = 33$) time lost due to injuries. Of those, 78% ($n = 78$) indicated they missed none or less than 1 day; 18% ($n = 18$) between 1 and 7 days; and 5% ($n = 5$) more than 1 week. The three top reported injuries related to weather exposure, body mechanics/ergonomics, and wounds (Table 4).

Significant differences on gender and safety practices were found, with female respondents being more proactive in practicing safety ($p < .047$). While the more educated (with a 4-year degree or more) scored significantly higher on safety practices compared to their less educated counterparts (less than 4-year college degree) ($p < .009$), they also reported more injuries ($p < .037$) and work time lost ($p < .011$) than the less educated.

Table 5 presents associations between safety practices, non-fatal injuries and work and farm characteristics. Those using hand tools scored significantly higher in safety practices compared to those who did not use hand tools ($p < .004$). Those working less than 40 hours/week, in farms smaller than 50 acres, using light machinery or compact utility tractors, and tractors without roll-over protection reported significantly higher injury frequency compared to their counterparts ($p < .013$; $p < .019$; $p < .031$; $p < .036$ respectively).

Table 3. Frequency of using basic protective equipment.

	Never	Rarely	Occasionally	Often	Always	Valid N
Gloves	5.0%	5.0%	22.8%	38.6%	28.7%	101
Wide brimmed hat	11.0%	6.0%	21.0%	29.0%	33.0%	100
Long sleeves	3.0%	8.0%	21.0%	29.0%	39.0%	100
Long pants	2.0%	1.0%	7.0%	17.0%	73.0%	100
Mask	19.0%	23.0%	33.0%	16.0%	9.0%	100
Water resistant sunscreen-SPF 30+	27.6%	17.3%	11.2%	22.4%	21.4%	100
Ear protection	29.0%	22.0%	30.0%	14.0%	5.0%	100
Eye protection	10.0%	11.0%	26.0%	30.0%	23.0%	100
Safety shoes	31.0%	12.0%	16.0%	13.0%	28.0%	100

Table 4. Self-reported non-fatal injuries in the last 12 months while doing activities on the organic Farm×.

	Count	Percent	Valid N
Exposure to environmental heat or cold (e)	26	26.0%	100
Lifting, lowering, bending, pushing, pulling, turning, twisting (e)	22	22.0%	100
Cuts, lacerations, punctures, bruises, or contusions (n)	22	21.8%	101
Bites or stings (e)	18	17.6%	102
Sprains, strains, or tears (n)	13	12.9%	101
Exposure to noise (e)	12	12.0%	100
Falls (e)	10	9.8%	102
Contact with hot or cold objects or substances (e)	7	7.0%	100
Being struck by object or equipment (e)	6	6.0%	100
Tendonitis or carpal tunnel syndrome (n)	6	5.9%	102
Being struck by animal (e)	4	4.0%	101
Exposure to harmful substance-skin, eyes, nose, other exposures (e)	3	3.0%	100
Handheld object or equipment (s)	3	3.0%	100
Multiple traumatic injuries with fractures (n)	2	2.0%	102
Roadway accident (e)	1	1.0%	99
Amputations (n)	0	.0%	102
Chemical burns and corrosions, heat, or thermal burns (n)	0	.0%	101

*n= nature, s=source, e=event/exposure.

Table 5. Safety practices and non-fatal injuries by work and farm characteristics.

	Safety Practices Scale		Any Injuries	
	Mean	Sig.	Percent	Sig.
Years of Experience in Farming				
10 or less years of experience	2.60	0.150	54.5%	0.792
11 or more years of experience	2.34		51.4%	
Hours per Week Worked on the Farm				
<40 hours per week	2.47	0.511	71.0%	**0.013**
40 + hours per week	2.37		43.9%	
Farm Size				
<50 acres	2.42	0.617	65.3%	**0.019**
50 + acres	2.35		41.3%	
Method of Growing Crops				
Under Cover	2.38	0.862	58.8%	0.328
Open Field ONLY (none grown under cover)	2.41		48.4%	
Presence of Livestock on the Farm				
No animals on the farm	2.48	0.265	54.2%	0.683
Animals on the farm	2.31		50.0%	
Tools & Machinery Used on the Farm				
Hand Tools				
No hand tools	2.11	**0.004**	51.5%	0.880
Hand tools	2.56		53.1%	
Light Machinery/Sub-Compact & Compact Utility Tractors				
No light machinery or sub-compact /compact utility tractors	2.28	0.086	42.0%	**0.031**
Light machinery or sub- compact/ compact utility tractors	2.54		63.8%	
Heavy Machinery/Utility Tractors				
No heavy machinery or utility tractors	2.56	0.128	64.7%	0.079
Heavy machinery or utility tractors	2.32		46.0%	
Tractors: Front-End Loader				
No front-end loader	2.22	0.147	37.0%	0.050
Tractor with front-end loader	2.47		60.0%	
Tractors: Roll-Over Bar				
Tractor does not have roll-over protection	2.65	0.207	81.8%	**0.036**
Tractor equipped with roll-over protection bar or enclosed cab	2.35		47.9%	

*Bolded items had p-values <0.05.

Discussion

This study aimed at exploring occupational safety practices and injuries among US certified organic crop producers in the SW region. It also analyzed the role of sociodemographic, work, and farm characteristics on safety practices and injury.

Results show a young, educated, married, or cohabitating, and white sample with a medium to high annual household income. Of significance is that 67% of the respondents were younger than 65 years of age; and nearly 11% were "young producers," defined as those younger than 35 years of age. These results are consistent with national data showing that the share of young farmers continues to increase,[28] and reports indicating that farm operators are younger in the organic sector than in the overall agriculture sector.[29,30] This is important as the US farm producer population continues a long-term trend of aging;[31] organic producers may supply a much-needed workforce replacement.

To put these results into perspective, Table 6 presents selected sociodemographic and work and farm characteristics for this study's sample and 2017 COA organic producer data for the US and SW region. However, any comparison may be made cautiously as organic farming is a rapidly evolving practice and 3–4 years may be a significant data gap.

On ethnicity and race, Hispanic/Latino participants were overrepresented in this study (16%) compared to 2017 COA data for all US farms (3.3%); and non-Hispanic whites were underrepresented (75% vs. 95%).[32] Data show that a majority of Hispanic, Latino, or Spanish origin participants

Table 6. Study's sample and 2017 census of agriculture US and SW region certified organic producer data.

	Sample (*N* = 115) %**	SW* (*N* = 761) %**	US* (*N* = 33,000) %**
Age			
Under 35	11%	19%	17%
Under 65	56%	74%	80%
65 and over	33%	22%	19%
Sex			
Female	38%	36%	30%
Male	61%	64%	60%
Prefer not to disclose	1.0%	-	-
Race/Ethnicity			
Hispanic/Latino Spanish origin	16%	11%	4%
White	75%	91%	91%
Multi-racial	8%	-	<1%
Owned/Rented Land			
Owner operator/Land owned	83%	42%	42%
Non owner/Land rented/ Leased	17%	29%	24%
Years of Experience in Farming			
More than 10 years	78%	68%	62%
Place of Residence			
Live on the farm/farm is home	56%	72%	69%
Work Off Farm (Days)			
None	69%	56%	39%

*Estimates from: 2017 Census of Agriculture. Characteristics of All Farms and Farms with Organic Sales. United States Department of Agriculture, National Agricultural Statistics Service. Issued October 2019. Available at https://www.nass.usda.gov/Publications/AgCensus/2017/Online_Resources/Organics_Tabulation/organictab.pdf. Accessed April 12, 2023.

**Rounded to the nearest whole number.

in the 2017 COA were in Texas and NM; they were also mostly white, younger, and more likely to have recently started farming in the US.[31]

These results add to the limited sociodemographic data on the US organic producer and to understand the work and farm conditions of this workforce. Demographic and social characteristics have potential safety and health implications, and data show that individual factors relate to biologic processes (e.g., mortality and morbidity) and influence behavior, which are strong predictors of health outcomes.[33] For instance, studies have found that younger, less educated, and older workers have an increased risk for injury; in part due to experience, access to resources, and functional limitations such as musculoskeletal disorders and hearing loss.[34,35] Similarly, female farmers may face unique occupational risks due to physiology and gender norms.[36,37]

Regarding work and farm characteristics, new and beginning producers (those who have farmed for 10 years or less) constituted 22% of this study's sample. This percentage is slightly lower than that estimated by the 2017 COA for all US farms (27%), but data show that beginning farmers are mostly on the East and West coasts, and that they are generally younger than the average age of all farmers (57.5 years).[38] A much lower percentage of participants in this study reported living on the farm (56%) and working off the farm (31%), compared to 2017 national estimates for all farms (76% and 61% ,respectively); and a majority operated less than 50 acres of organic production at the time of the survey, which is much higher than the 25% estimated for all US farms.[30] These results suggest that the organic farm in the SW region is mostly small and family owned. National data indicate that family farms remain a key part of US agriculture, making up 98% of all farms.[39] Finally, a high majority of respondents used heavy and light machinery (e.g. utility tractor, tillers, walk behind tractors).

Results on safety practices show that they were very basic despite the widespread use of equipment and machinery, and limited to wearing normal clothing and apparel such hats and glasses. This may relate to low perception of risk among small organic farmers, which has been reported previously.[16] Nevertheless, more than half of respondents reported injuries in the past year, which for one-third resulted in time lost. The overall cumulative incidence rate was estimated at 5.3 injuries per 10 workers within the last year; and 3.4 for injuries involving days away from work. The injury rate decreased with hours worked: 7.1 per 10 workers for those working less than 40 hours/week; 5.0 for those working 41–60 hours/week; and 3.8 for those working 60+ hours/week. Future studies should explore these differences, perhaps those working less hours are less experienced or take on more risky tasks. Studies should also look at how injury rates among organic producers compare to those of conventional farmers. This may be challenging as surveillance reports usually combine injury and illness data,[40] and studies on non-fatal work-related agricultural injuries have estimated inconsistent incidence rates, between

1.4 and 16 per 100 full-time workers annually.[41,42] Others have emphasized the challenges in counting injuries in this industry, and estimated undercounts as high as 74%.[43] Furthermore, occupational injury and illness surveillance and reporting systems, like the SOII, exclude farms with less than 11 employees. This leaves out a very high majority of organic farms. In any case, considering that there are more than 27,000 certified producers in the US, a 50% incidence adds up to a considerable number of injuries in this population.

A high majority of reported injuries related to environmental exposure, ergonomics, and wounds. While sprain or strain constitute the majority of crop worker injuries,[9] injury data on organic farmers are very scarce and just recently US researchers have begun to point to the lack of data on this important subgroup of agricultural workers.[16,19,20] Only a few studies have explored occupational safety and health issues, other than pesticide exposure, in this population,[15,16,20,44–46] and literature comparing occupational risk for injury and illness between organic and conventional farmers is very limited. Internationally, a Thai study found differences in age and sex between conventional and organic farmers, and in the use of machinery and equipment but not in self-reported injuries. The study also found significantly higher musculoskeletal injuries in the organic farming group.[47] A United Kingdom study with organic horticulture workers found no difference in self-reported overall health between farmers following organic and conventional practices, but those who worked on organic farms were happier than their counterparts.[48] This warrants further research, as studies have found a positive correlation between happiness and physical health.[48–50] A regional study on agricultural injury in the US identified "organic farming" as a risk factor for injury.[15]

Finally, results on associations between sociodemographic characteristics and outcomes of interest point to sex and education as the main variables related to safety practices, with female and more educated respondents being more conscious about safety. On injuries, use of machinery seems to be relevant. These results are consistent with recent research indicating that agricultural-related injuries are more frequent in males, and that tractors and other agricultural vehicles continue to be major sources of injury in this population.[14,15] Regarding work and farm conditions, smaller farms and less dedicated producers reported more injuries compared to their counterparts. Other studies found that full-time and larger farms constitute increased risks for injuries among agricultural workers.[15,51]

This study makes a strong contribution to the limited data on the certified organic crop producer and the personal and contextual factors that may contribute to safety and injury. Organic farmers are key contributors in the development of sustainable, local food systems, which have the potential to promote community well-being by facilitating economic viability, strengthening social networks, increasing human and social capital, and promoting community resilience.[19,52–54] According to the USDA, *organic farming is a strategy to make agriculture sustainable and responsive to consumer demand* (https://www.usda.gov/oce/sustainability).

Limitations

This cross-sectional study does not provide longitudinal data on safety and injury and trends and practices may change over time. Data on variables of interest were only available for those who completed the survey, a comparative analysis of respondents and non-respondents was not possible. The sample may not represent the entire US or regional organic producer population. However, using both postal mailing and electronic approaches for recruitment and data collection may have accommodated disparate preferences and resulted in a more diverse and representative sample. Participants were asked to report injuries "while doing activities on the organic farm" and it is possible that some reported injuries not necessarily related to occupational work. However, the item is consistent with the BLS's definition of occupational injury: "any wound or damage to the body resulting from an event in the work environment," The response rate was typical of survey studies and results on certain sociodemographic and work and farm characteristics were

consistent with data reported by national surveillance systems. Responses were self-reported, which may reflect respondents' personal biases as well as the individual characteristics and experiences of only those who chose to participate, but self-reported questionnaires are widely used in observational studies.

Conclusion

Organic farmers constitute an essential workforce. While reliable data is critical to prevent occupational injuries and illness, national surveillance systems do not collect data on organic farmers. Since risk factors for agricultural injury vary by region, there is a need for regional occupational studies and data on this population. The results of this study contribute to typify the certified organic producer in the SW region of the US, and to identify important personal and contextual factors that may contribute to injury in these farmers. Findings indicate the need to promote safety and prevent injuries that result in work time lost, which may be a significant challenge for the economic sustainability of the farm. Although a high majority are non-fatal, injuries still constitute a public health problem in small-scale agriculture as they impact not only the farmer but also the entire family. This study highlights the need for systematic collection of safety and injury data in this population. The results may inform future occupational safety and health research and practices, including surveillance and injury prevention programs that target certain sociodemographic and production practices, and policies that support and protect organic farmers.

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