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Health and Safety in Organic Farming: A Qualitative Study

Francisco Soto Mas [a], Alexis J. Handal[a], Rose E. Rohrer[b], and Eric Tomalá Viteri[c]

[a]University of New Mexico College of Population Health, Albuquerque, New Mexico, USA; [b]Department of Sociology, University of New Mexico, Albuquerque, New Mexico, USA; [c]Department of American Studies, University of New Mexico, Albuquerque, New Mexico, USA

ABSTRACT

Objective: To explore health and safety issues in organic farming, particularly among small farmers in central New Mexico. Methods: Participants included 10 certified organic producers and 20 workers. Data were collected through semi-structured interviews and observations. Results: The sample consisted of a young, educated, low experienced population that may differ from conventional farmers. Both producers and workers seemed to be aware of the health risks involved with small-scale farming. Producers presented mixed attitudes toward health and safety, while the attitudes of workers were more systematically negative. Perception of risk was generally lower among workers compared to producers. Although health and safety training was not specifically mentioned, most participants seemed to understand the relevance of the work environment for health and safety. Regarding ergonomics, the physical demands of working for long hours and the necessity to perform a multitude of tasks that contribute to physical stress were issues of concern. Conclusions: This is one of the few studies in the United States exploring health and safety among organic farmers. Although participants reported very few actual incidents, the study identified relevant intrapersonal and behavioral factors that may increase or reduce the risk for disease and injury. Results also indicate the need for research that focuses on the psychosocial and contextual factors that may contribute to injury and disease among organic farmers.

KEYWORDS

Agricultural injuries; health and injury; occupational health; organic agriculture; sustainable agriculture

Introduction

According to the United States Department of Agriculture (USDA) there are now 21,700 certified organic operations in the country, representing nearly a 300% increase since 2002.[1] This growth has been facilitated by an increase in demand. Despite the lack of scientific evidence on the health benefits of organic foods (other than the absence of synthetic chemicals), organic products are now available in nearly three of four conventional grocery stores.[2] Recent data also show that crops represent the strongest demand for organic products. Between 2008 and 2014, the sales of organic crops increased by 72%, representing 60% of the total production.[3] Agencies have also shown increased interest in sustainable agriculture. A current goal of the USDA is to increase the number of certified organic operations, and federal support for organic production systems has increased in each of the last three farm acts.[4]

As the number of organic farmers increases, so does the need for data to inform policy, research, and practice. The 2014 Organic Survey was only the third survey on organic production and practices conducted by the National Agricultural Statistics Service (NASS). Previous data collection efforts were the 2011 Certified Organic Production Survey and the 2008 Organic Production Survey.[5] These surveys focused on production, marketing practices, and economics. The 2012 Census of Agriculture included an organic section with demographic items. Although these efforts are important to track trends in the organic industry, there are still considerable gaps. For instance, current surveillance systems for occupational health and injury do not distinguish between organic and conventional producers and workers. Furthermore, organic agriculture is primarily a small family-farm enterprise,[3] and most of the current surveillance systems for occupational health and safety (such as SOII—Survey of Occupational Injury and Illness) exclude self-employed farmers and farms with fewer than 11 employees.[6] Another important gap relates to regulation. Operations with 10 or fewer employees

CONTACT Francisco Soto Mas fsotomas@salud.unm.edu College of Population Health, MSC09 5070, 1 University of New Mexico, Albuquerque, NM 87131-0001, USA.

are exempt from program safety inspections, which may affect whether they adhere to federal safety standards.[7]

The lack of reliable epidemiological and surveillance data on small farms and gaps in regulatory policies on health and safety is not unique to organic farming. A recent study concluded that there is limited and conflicting information on the size and composition of the agricultural workforce, and we still rely on limited observational studies and farmworker health and advocacy organizations for information on the prevalence of agricultural worker injuries and illness.[8] This must be addressed provided that agriculture continues to be one of the most dangerous occupations in the United States. In 2015, the death rate for the agriculture, forestry, fishing, and hunting sector was the highest of all industries, 22.8 per 100.000 full-time equivalent workers. Although logging and fishing considerably contribute to this high rate, the fatality rate for crop production was 18.4, one of the highest of all industries and sectors.[9]

As injury data on organic farmers is not systematically collected by current surveillance systems, little is known about occupational risks in this group. However, similar to other agricultural workers, organic farmers are exposed to a variety of hazards that are potentially harmful to their health and well-being. Although organic farmers may not be exposed to pesticides with synthetic chemicals (man-made by synthesis, rather than being produced by nature), potential risks include accidents and injuries from operating machinery and equipment, environmental exposures that increase the risk for respiratory diseases, noise-induced hearing loss, skin disorders, certain cancers, chemical toxicity, and heat-related illnesses.[10,11] Many farmers may also be unaware of the risks of "natural pesticides," and may not take preventive actions. Lack of policy and regulatory issues may play a role in these hazards. Another important aspect of agriculture is mental health. Organic farmers may be exposed to the psychological hazards associated with small agriculture, including high levels of stress,[12] depression and anxiety,[13] and increased rates of suicide.[14–16] Furthermore, a body of literature has looked into additional sources of stress among organic farmers caused by the perceived need to embrace the concept of civic agriculture and subscribe to networks that support alternatives to industrialized agriculture and distribution of food such as community supported agriculture (CSA). These concepts are closely linked to the organic movement and imply an active contribution to the community's social and economic development.[17–21] Although this discussion constitutes an important contribution to the literature, it mostly comes from anthropology, ethics, and cultural studies, and does not generally make clear connections to occupational health and safety. The fact is, there exists a gap in the literature on the physical and psychological factors that may contribute to the occupational health and safety of organic farmers. The overall objective of this qualitative study was to explore health and safety issues in organic farming, particularly among small farmers in central New Mexico (NM).

Methods

This was a descriptive study. Data were collected through semi-structured in-person interviews and observations. Owing to the lack of literature on the topic, no theoretical or specific frameworks informed the study. However, it was anticipated that most of the issues that may emerge would be related to environmental exposures (e.g., sun and heat) and ergonomics (e.g., body position and repetitive motion, inappropriate use of tools and machinery). Provided that many relevant variables were unknown, the design and methods of the study were intentionally flexible to facilitate the identification of potential new constructs (ideas) and explanations (theories), leaving the research process open for new questions and issues to evolve from the data. The study was approved by the University of New Mexico Health Sciences Center Institutional Review Board (Study ID 13-0490).

Study site

New Mexico is a large state with just over two million people. Nearly 48% of the population is Hispanic, compared to 17% nationally.[22] Organic farming has significantly increased in NM over the past 10 years, becoming the fastest growing segment of agriculture. Current data indicate that there are 116 certified organic crop producers; approximately 70% of them generate less than

$50,000 in sales.[23] The majority of farms are located along the Rio Grande river (see Figure 1). Major crops are pecans, wheat, apples, and sorghum[24]; local specialty crops include piñon nuts, pinto beans, and chiles.

Participants and recruitment

Interview participants met the following criteria: (a) USDA-certified producer (owner and/or principal operator) in central NM with less than 5 acres operation, fewer than 11 employees, and less than $200,000 in organic sales annually; or (b) worker 18 years-of-age or older, currently working or volunteering on an organic farm, with a minimum of 150 hours of experience in organic field work. Observation sites included five farms purposively selected to represent the diverse size and location of the participating farms across the study area, consisting of Bernalillo County (with Albuquerque, the largest city), Santa Fe County (including the state's capital), and Socorro County (a 2000 square mile rural area near Albuquerque). Other counties were not included owing to budgetary limitations (e.g., travel expenses).

Provided the exploratory nature of this study, a sample size for each approach (e.g., interviews, observations) was pre-estimated. Ten producers and 20 workers at 10 different farms were selected following a snowball sampling technique,[25]which is

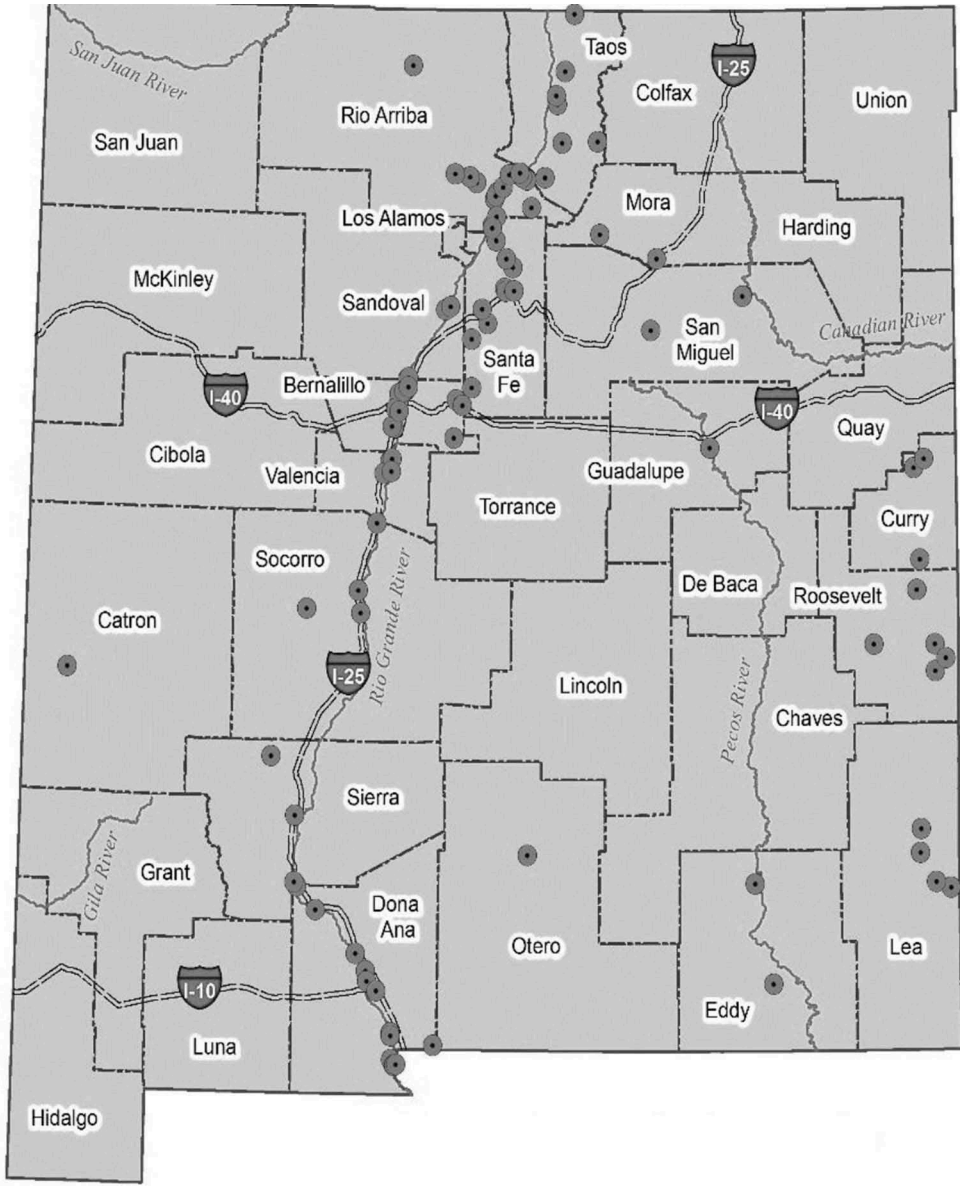

Figure 1. Certified organic farms, New Mexico, 2014.

an appropriate approach for purposive sampling and facilitates the inclusion of informed and interested participants. Potential initial key informants were identified through individual farmers and through agencies and organizations involving organic farmers (e.g., NMDA/NM State University Organic Program, which certifies most of the organic farmers in the state; Farm to Table, an organization based in Santa Fe whose mission is to improve communities' access to nutritious, affordable, locally grown, culturally significant foods; and Agri-Cultura Network, a co-op of small farmers devoted to supporting farming and locally produced foods).

Data collection procedures

Informed consent was collected from all participants. Interviews were conducted from January to August 2014, which included a period of low farm activity and a production season. All participants completed a brief questionnaire with basic demographic items.

Semi-structured interview guides for both categories of participants were developed prior to the study based on the health and safety literature and anecdotal information provided by individuals related to organic agriculture (e.g., Organic Commodity Advisor). Interview guides focused on general themes of health and safety, covering categories and constructs from prior literature included in Table 1. Interviews were conducted at convenient locations that met the requirements for privacy and confidentiality; they lasted from 30 to 90 minutes. A minimum of two trained investigators were involved in each interview, an interviewer and a note taker. A Spanish-speaking researcher was available as needed.

Observations lasting a minimum of 2 hours per site were independently conducted by two investigators. They focused on the physical conditions of the site and field activities, with emphasis on ergonomics and environmental, chemical, and mechanical exposures. Observations were scheduled to capture diverse conditions (e.g., early morning and afternoon hours) and activities (e.g., planting and weeding).

Data management and analysis

Interviews were digitally recorded and manually annotated. Taped interviews were transcribed verbatim in their original language (English or Spanish) and uploaded to NVivo (*QSR International*), a qualitative data analysis software. Data were examined for pre-determined, emerging, and deviant categories and themes (see Table 1).

Table 1. Constructs and thematic elements.

Overarching categories and constructs from prior literature	Thematic elements that emerged from the data
Demographics	Consumer safety
Attitudes	Contextual factors
Awareness	Perspectives: producer vs worker
Behaviors	Formal training
Ergonomics	Informal training
Incidents (injuries)	Other dimensions of health
Knowledge	Physical health
Machinery	Protective/risky behaviors
Perception of risk	Social relations
Practices	
Training	

Data reliability was addressed by developing interview and observation scripts and training investigators to ensure that the data were collected consistently and systematically. Different approaches were implemented in order to provide a multidimensional perspective of the issues, as well as rich and unbiased data. These included the combination of two or more data sources (e.g., producers and workers), the involvement of multiple investigators (a minimum of two investigators), and the use of mixed methodological approaches (observations and interviews). This methodology generates data that can be interpreted with a comfortable degree of assurance.[26]

A line-by-line coding approach was adopted. Data were coded independently by two investigators. Coding first focused on predetermined themes from previous studies. Thematic elements that emerged from the data were discussed and either discarded or incorporated into the emerging thematic constructs depending on their relevance to the primary focus of the study. Disagreements were discussed and revisited by the research team until consensus was reached. Observation notes were compiled, compared, and discussed by the two observers until consensus was obtained on conflicting information.

Results and discussion

To the best of our knowledge, this was the first study systematically exploring health and safety issues in organic farming. To facilitate a better

understanding of the consistency of the findings, the following section reports on the demographic data and includes the results of the observations and the qualitative analysis. To make the narrative more cohesive and facilitate reading, both the constructs under the overarching categories from prior studies and the thematic elements that emerged from the data were combined (see Table 1). Similarly, the discussion of the relevance of the findings was incorporated into this section.

Demographics

Operations were described as open fields, greenhouses/hoop houses, and covered beds. Female participation was lower among producers (10%) compared to workers (25%). Participants were relatively young (average age was 38 years), and only 5% of the workers and 20% of the producers were older than 60 years of age. The majority of workers were single (75%); however, only one (5%) lived alone. More producers were born outside the United States (30%), compared to workers (15%). More than half of all participants had a college degree; and nearly half had been in organic agriculture for 5 years or less (see Table 2). These data indicate a young, educated sample with limited experience in agriculture. The high percentage of foreign-born producers is notable. This information is important, as understanding farmers' characteristics constitutes a first step in the process of developing comprehensive, systemic approaches to disease and injury prevention among agricultural workers.[27] Biological factors such as sex and age should also be considered when exploring the health of farmers,[28] as they relate to behavior and play a role in many health conditions, mortality rates, and even health disparities. Intrapersonal and interpersonal level factors, such as beliefs, perceptions, and social relations may also differ by demographics.

Table 2. Demographic characteristics of participants by category.

Characteristic	Producer n (%)	Worker n (%)
Sex		
Male	9 (90)	15 (75)
Female	1 (10)	5 (25)
Age group (years)		
18–20	-	4 (20)
21–30	3 (30)	9 (45)
31–40	1 (10)	3 (15)
41–50	2 (20)	2 (10)
51–60	2 (20)	1 (5)
61+	2 (20)	1 (5)
Marital status		
Single	5 (50)	15 (75)
Married	3 (30)	4 (20)
Divorced	1 (10)	-
Other	1 (10)	1 (5)
Place of birth		
United States	7 (70)	17 (85)
Other	3 (30)	3 (15)
Level of education		
Graduated from high school	3 (30)	3 (15)
Some college	2 (20)	6 (30)
Graduated from college	5 (50)	8 (40)
Other		3 (15)
People living with you at home		
None	1 (10)	1 (5)
1–2	5 (50)	13 (65)
3–5	4 (40)	4 (20)
5+	-	2 (10)
Language spoken at home		
English	4 (40)	13 (65)
Spanish	2 (20)	1 (5)
Both	3 (30)	6 (30)
Other	1 (10)	-
Years in agriculture		
1 or less	-	7 (35)
2–5	4 (40)	2 (10)
6–9	-	8 (40)
10–20	2 (20)	1 (5)
20+	3 (30)	1 (5)
Missing	1 (10)	1 (5)
Years in organic agriculture		
1 or less	1 (10)	6 (30)
2–5	3 (30)	4 (20)
6–9	2 (20)	8 (40)
10–20	2 (20)	1 (5)
20+	1 (10)	-
Missing	1 (10)	1 (5)

Awareness

In general, both producers and workers (identified as "P" and "W" in quotes below) seemed to be aware of the health risks involved with small-scale farming. Participants discussed physical risks related to production and distribution: "there is a lot of physical, strenuous activity involved with agriculture of any kind [...], whether it's the actual growing of the food, the delivery..." (P5); "there's lifting involved, getting down on the ground, bending my knees, bending my back, leaning over, in part added to like the health issues that I already have of like my joints and stuff" (W16). Producers also emphasized psychological risks through comments such as "this is the toughest thing I've ever done, and the stress, both mental and financial are pretty intense" (P4).

Social relationships

The impact of the physical and psychological stress goes beyond the individual farmer to include the interpersonal level, particularly among producers. A producer indicated as follows: "they were a couple and they're like splitting and when a young couple or not so young, farming, there's like no romantic life, that's really something to be concerned about" (P4). These results are consistent with the studies that emphasize that the social relationships of farmers include both work and family relationships, and also political and economic networks.[29] How these individual, family, and social level variables impact the health and safety of farmers is not well understood.[30] Studies looking into the mental health of farmers have identified high levels of psychosocial distress and risk of suicide that are not only related to production issues such as drought and finances, but also to social factors and community characteristics,[31–33] including geographic and social isolation.[15]

Attitudes and perception

Producers presented mixed attitudes toward health and safety. Comments conveyed a positive attitude toward protecting workers and consumers: "trying to make sure that people [employees, volunteers] pace themselves, keep themselves hydrated and, in terms of lifting and things like that," (P9); "the only thing that is really constant is the safety control of the food going out into the public" (P1). However, most producers did not seem to be so concerned about their own protection as they felt that the risks are just part of being a farmer: "yes, there's extreme fatigue in the spine from bending and squatting, there's a problem with my carpal tunnel, from weeding, hand weeding. Those are elements and parts of what we do, and there's not much you can do about it" (P1). On the other hand, the attitudes of workers toward health and safety were more systematically negative as reflected in comments such as "they're [organic inputs] kind of not that great to inhale. Especially the bone [meal]. But I already knew that [...] and I don't think that anyone else that is working in agriculture really cares about it" (W4); "even though there's lightning strikes hitting the ground, we still need this harvested, and so you can't leave the field. You've got to take your chances of getting struck by lightning" (W5).

Regarding perception of risk, it was generally lower among workers compared to producers: "I don't really think about it [injury, disease]. It is like subconsciously that I think it's organic and maybe it won't affect me as much" (W16). "I feel like in organic farming there is less of a health risk because we don't use the poisons and pesticides" (W19). To the contrary, a producer stated "having to work in the greenhouse in hot weather, because temperatures can go up to 120 degrees in the greenhouse [...]. Traffic is a major issue [...]. Any time you're dealing with any of the petroleum products you're always at risk" (P1).

Negative attitudes toward health and safety and low perception of risk among organic farmers are issues in need of further research, as agriculture continues to be a dangerous occupation. Similarly, it will be important to further assess whether attitudes and risk perception differ between producers and workers, and between organic and conventional farmers. Although the literature lacks discussion on organic farmers' attitudes toward health and safety, a few studies have explored the issue among conventional farmers. A previous study showed that farmers had a "neutral" attitude toward safety, probably because they did not perceive a short-term benefit in taking preventive actions.[34]A more recent survey study involving farmers in Canada found that more than 55% of the participants considered that farming was more dangerous than other occupations, and the majority worried more about health and safety than other things, such as the quality of the environment or crop yield.[27]

How important is it for agricultural research and practice to assess attitude and perception? Attitude is a strong predictor of behavior and a main construct in several behavior theories such as the Theory of Reasoned Action (TRA),[35] and the Theory of Planned Behavior (TPB).[36,37] According to these theories, attitude is determined by personal beliefs related to the behavior and the outcome that would result for that behavior. Perception is a main construct in the Health Belief Model.[38] It refers to subjective assessment of risk, severity, and benefits and barriers. Researchers have also emphasized the importance of how establishing

"safety culture" may affect attitudes and behavior in relation to an organization's ongoing health and safety.[39–41] A review study found beliefs that injuries can be avoided and a positive attitude toward safety to be related to protective behavior.[28] Similarly, programs in Australia and Denmark have used attitude-based interventions to address the poor health status and injuries of farmers.[42–44] However, the direct association between attitudes and behaviors has been questioned, and other factors such as risk perception, locus of control (feelings about power to control events affecting one's life), and chronic stress may play a role in the behavioral change process.[45] Outcome beliefs that may not be directly related to health and safety such as production, self-efficacy, perceived social norms, and the physical environment may also influence attitudes toward preventive behaviors.[28] Both researchers and practitioners should consider the role of attitude, perception, and other intrapersonal and environmental factors that may have an effect on behavior, whether risky or protective. Health behavior theories may inform the design of studies involving organic farmers and the planning, implementation, and evaluation of interventions to address occupational safety and health in this group.

Knowledge and training

Most participants seemed to understand the relevance of the work environment for health and safety, including weather conditions, exposures, use of machinery and equipment, and other common work practices: "we try to avoid working on very cold days [...], especially jobs that are tedious or that require continual motion" (P1); "the most dangerous equipment is that which is powered by the tractor and is separate from the tractor" (P9); "you have to dress appropriately because you can create your own accident by not dressing appropriately" (W1); "of course in NM the safety thing would also be making sure you stay well hydrated" (W18).

Knowledge about safety precautions and the health implications of agricultural practices is a relevant factor in agricultural research and practice. Although there may not be a direct connection between knowledge and behavior,[46–49] most authors consider knowledge to be essential on the learning hierarchy and that knowledge gaps negatively influence behaviors.[50,51] Many variables may mediate the knowledge–behavior relationship, not only personal characteristics but also the social/community environment.[50,52] Relevant health behavior theories, such as the Health Belief Model,[38] Theory of Reasoned Action,[35] and Social Learning Theory[53] incorporate personal and environmental constructs that may be facilitated by increased knowledge, including attitudes, self-efficacy, and perceived social norms. These determinants of behavior are essential to the prevention of injuries and disease in agriculture, and the application of these theories and models could significantly contribute to more effective interventions.[28]

Related to knowledge is training. Both categories of participants discussed training, but almost exclusively related to farming and organic production. Producers referred most often to formal farming training they received at conferences and meetings: "I took a year's training [...] on every aspect of how the modern facilities and the modern infrastructure can benefit the traditional farmers" (P1); "I took a 6 month course at a university in organic farming and gardening" (P8). On the other hand, most workers described activities that illustrate informal training such as occasional one-on-one and small group interactions with experienced farmers: "I feel like that I know quite a bit just by listening [...], not formal training" (W1).

Participation in safety or injury and disease prevention trainings or interventions was not mentioned by producers: "I have received like formal workshops and such [for production] but not relating to health" (P7). Nor did they generally mention providing safety education or materials to workers. Their attitude toward health and/or safety training was generally negative, as agricultural experience and tradition was perceived to be more determinant for injury and disease prevention: "I try to stay away from like formal classes and all that and stick to more talking with our elders" (P10). The literature is not consistent on the importance of health and safety training. A systematic review of farm safety interventions conducted in 2000 found limited evidence that training reduces occupational injuries.[7] However, there is general agreement that many injuries are caused by behaviors that are under the control of the individual, and that

contextual and psychological factors facilitate those behaviors. Producers, who have the authority to modify some of these factors (e.g., physical environment, work conditions), may be able to influence the intrapersonal level factors of workers (e.g., attitudes) by creating a work environment that supports a positive safety culture. Safety knowledge has been associated with variables such as self-esteem, self-concept, time spent working, and other variables that may influence behavior and injury prevention.[54,55] As knowledge acquisition typically begins with the process of receiving and understanding new information, safety knowledge may be improved through training. Safety training may positively affect the workers' perception of management practices and self-reported safety knowledge, safety motivation, safety compliance, and safety participation.[56] However, safety training is not generally required for farmworkers. Although pesticide safety training for agricultural workers is required by the US Environmental Protection Agency Worker Protection Standard,[57] other types of training on use of machinery or tools are not required. Injury studies with youth farmworkers have identified low level of training to be a relevant factor.[39,55]

Practices and behaviors

Farm practices commonly mentioned that constitute a potential risk included the use of hand tools, shovels, knives, hoses, racks, weeding tools, sprayers, and light and heavy machinery. Potentially unsafe work behaviors were mentioned by several participants, including using tools and equipment that may lack safety features: "I bought a few knives [for harvesting] at the flea market, three knives for 3–4 dollars" (P2). Similarly, although breathing dust was mentioned as a frequent problem and a source of eye and lung irritation, the use of masks or respirators was hardly mentioned: "The wind blows back on you [while applying inputs]… I don't necessarily know that I'm gonna put the mask on" (P6). Nor was the availability of protective equipment: "there's no shade structure out there" (W18). These practices and behaviors were confirmed by the observations, and in most cases fields lacked sanitary facilities, drinking water, resting areas, or other accommodations. Observers documented the use of hand tools and small equipment and practices that involved repetitive motions, kneeling and bending, lifting and other field activities that constitute a potential risk for accidents and musculoskeletal injuries. The presence of heavy machinery was not generally reported by observers.

Regarding environmental hazards, exposure to heat and the sun is probably the main concern for all farmers in the southwest. Most participants seemed to be concerned about weather conditions, and many reported avoiding work in extreme temperatures (both heat and cold) and other protective behaviors such as using gloves, safety googles, sun blockers, and protective clothing: "we'll stop like now when it gets to the hottest point of the day and, just go relax in the house […]. For health and safety, you always want to tell people: wear your hat" (W10). This is relevant, as heat stroke and skin cancer are two main risks among agricultural workers. Data indicate that heat-related death rates among crop workers might be increasing, and that the heat-related average annual death rate for crop workers is higher than that of all US civilian workers.[58] Similarly, farmers are at greatest risk of skin cancer compared to other groups because of sun exposure.-[59,60] Previous research reported that farmers are unlikely to be able to avoid working in the sun but more likely to engage in sun protection behaviors, such as wearing sunscreen and hats.[61] However, other studies found that skin cancer is not a high concern among farmers, compared to other occupational threats,[62] as well as low use of sunscreen and other sun protection behaviors.[63,64] Whether these perception of risk related to skin cancer and sun protective behaviors are true for organic farmers is an issue in need of further research. Most of the participants in this study reported avoiding peak sun hours and wearing protective clothing. Observation data confirmed that the most common protective behaviors involved sun protection, including wearing long sleeve shirts and hats.

Ergonomics

The physical demands of working long hours and the necessity to perform a multitude of tasks that contribute to physical stress were concerns among participants: "you're like bending over the whole time because sinks are never quite right […], you sit

there rubbing and pulling dirty leaves and it takes forever" (P7). Small-scale organic farming mostly relies on hand cultivation and harvesting, which are recognized as strenuous manual material handling tasks. The ergonomic risks associated with hand cultivation and harvesting include heavy lifting, awkward sustained postures, highly repetitive tasks, and frequent use of force.[65] Observation data confirmed that the participants in this study were exposed to these risks. Authors have also reported that the psychological and physical stressors put farmworkers at considerable risk for musculoskeletal injuries,[66] the most common of all occupational injuries among farmworkers.[67] Sprains/strains/tears are the most common disabling injury in agriculture.[68] Another relevant issue discussed in the literature is rest time and the lack of control over one's time, both of which have been shown to affect musculoskeletal symptoms and injury rates among a variety of workers.[69–71]

Incidents

Finally, the participants were asked about accidents, injuries, and health problems. They reported experiencing or witnessing minor accidents and injuries, including punctures, skin conditions, eye and lung irritation, and cuts and lacerations: "my hands get really cracked, the soil is alkaline and you get a one crack and it doesn't heal" (P4); "personally, I got stubbed on my foot by nail on the soil while working on the field" (P2); "I've gotten bit by ants, maybe one or two spider bites…, I've even got a little sunburn right here this year" (W2)" "I was mulching with some really old hay… it was moldy and then I took my mask off for two minutes and wind picked up and mold spores blew straight into my face and 15 minutes later I was lying in bed" (W6).

Accidents that resulted in death and serious health conditions were only described as anecdotal incidents heard about or experienced by others (e.g., skin cancer, a tractor accident). Overall, musculoskeletal injuries were the most frequently mentioned problems: "backaches have been the primary source of work-related pain… from all those repeated like kneeling over or bending over, weeding all crouched" (W8). This is consistent with the literature, as many hazards faced by agricultural workers relate to the physical environment, equipment, tools, noise, wild plants, and animals.

Limitations

The results and conclusions of this exploratory qualitative study were based on the information provided to the investigators by the participants, which only included producers and workers. The observations were limited to the specific times the investigators visited the sites, which may not properly reflect a normal activity or routine. Although participants were classified into two distinctive categories, in most cases, producers were also qualified as workers. Their answers may have been provided from either perspective without researchers' knowledge. Although methodological efforts were made to increase the validity of the data and interpretative strength of the study, and decrease investigator biases, there was no guarantee that informant subjectivity or investigator biases did not affect the collection, analysis, and interpretation of the data. Finally, the results and conclusions of this study might not generalize to other settings and wider populations. Findings might be unique to the relatively few people and sites included. Despite these limitations, this study has several important strengths. This is the first study, to the best of the authors' knowledge, that systematically explores health and safety issues among organic farmers in the United States. It identifies intrapersonal and interpersonal level factors that may relate to the prevention of injury and illness in this population. The study also provides directions for future research.

Conclusions

The most obvious difference between organic and conventional agriculture may relate to practices. Current regulations forbid the use of synthetic fertilizers, sewage sludge, irradiation, and genetic engineering in organic production. Therefore, exposure to certain hazardous chemicals, pathogens, and radioactive materials is reduced among organic farmers. Other risks relate to farm size. Organic farming is a small-scale production, which mostly relies on one or just a few people performing a multitude of tasks for cultivation, harvesting, and distribution. Physical stressors put small farmers at risk for musculoskeletal injuries. However, the results of this study suggest that other relevant safety/health-related factors may be unique to

organic farmers. These include demographics (organic farmers may be more educated but less experienced than conventional farmers), training needs (lack of experience may increase the need for safety training), and individual level factors (low perception of risk and negative attitudes toward prevention and self-protection). Further research is essential to explore whether these local differences are generalizable, and whether they actually constitute an increased risk for injury and disease among organic farmers. This may be achieved by revising the existing data collection systems.

Current occupational health surveillance systems collect only limited demographic and contextual data among organic farmers, such as sex, age group, race and ethnicity, household composition, and income. These systems should be updated to monitor multilevel factors, including behavioral factors shown to contribute to agricultural injury and health problems such as handling of machinery, fatigue and stress, and substance abuse. Contextual factors may include macro level (e.g., socioeconomic status; community support, market demand, economic subsidies and support, farm size and type, season, climate, and weather), and micro level (e.g., presence of machinery/tractors; animals; and pesticides) factors. Other factors such as local demographics, social relations, and the physical environment[27,72] should also be considered when developing prevention and health promotion interventions. Similarly, the setting and working conditions have a strong influence in the health of the farmer.[73–75] It is important to understand that farming must be studied not just at the individual and family levels, but rather within larger social, political, and economic contexts.

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ORCID

Francisco Soto Mas http://orcid.org/0000-0001-9621-2283

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