Spring 4-2016

Advancing the Knowledge of Organic Farming Data in New Mexico: Health and Injury Surveillance Systems

Virginia Sedore

University of New Mexico, vsedore@salud.unm.edu

Advancing the Knowledge of Organic Farming Data in New Mexico: Health and Injury Surveillance Systems.

By

Virginia Sedore
MPH, University of New Mexico
April 2016

TABLE OF CONTENTS

ABSTRACT

While the concept and practice of organic farming has been around since the mid-1800's, there is little data currently being collected on injury, illness, or fatality within the organic farming population, leaving the health risks unknown. This paper intends to look at the surveillance systems currently in place to collect injury and illness data as it relates to organic farmers, and in particular, the New Mexico organic farmer. Evaluations of the current surveillance systems were conducted, and organic farmer demographics were analyzed using rate ratio comparisons of United States (U.S.), Texas, and New Mexico. The results show that the current surveillance systems do not generally include organic farming in their results, and what is collected is limited to demographic and economic counts. The analysis of the demographic data show that New Mexico organic farmers have a roughly similar demographic make-up as that of both U.S. and Texas organic farmers, but are younger and have been farming their current organic farms less time than New Mexico farmers on the whole. New Mexico farmers also has a significantly larger Hispanic population than is seen in either the U.S. or Texas. Understanding the demographic makeup of New Mexico organic farmers is important in the future to identify injury and illness risk factors within the population. However, without further data collection in the areas of injury and illness among organic farmers, there will be no way to measure the true health risks of this profession, or evaluate any potential interventions.

INTRODUCTION

Organic farming has been a growing trend in agriculture over the past 20 years. Agriculture, in general, has been shown to be one of the most dangerous occupations, with high incidence rates of injury, illness, and fatality (U.S. Bureau of Labor Statistics, 2015). Organic farming, however, involves different practices and mechanisms than conventional farming which may be assisted with different rates of occupational injury, illness, and death. Many assume that a lack of pesticide use makes organic

farming inherently safer. But what is known about the health risks of organic farming? Looking closely at the surveillance systems for injury, illness, and fatality in agriculture will highlight the information that is known, and illuminate any areas that lack sufficient data. By understanding the scope and limitations of the information available, a focus can be put on the organic farmer and any possible health risks facing that profession.

BACKGROUND

HISTORY OF ORGANIC FARMING

Biological, holistic, natural, organic, sustainable, and traditional are all words which can be used to describe one particular farming or agricultural technique. Organic agriculture, as it is most commonly referred to, typically denotes the environmentally and economically safe and supportable production of crops and livestock which utilizes renewable resources and biological processes (Rigby & Caceres, 2001). In order to understand how this type of agriculture came about, the following will briefly outline the history of organic agriculture.

Although historically farmers may have been practicing what are now identified as organic agricultural techniques, the first record of the purposeful use of sustainable or organic techniques was in 1840 when Justus von Liebig of Germany developed the theory that plants only need mineral salts, and not manure, to grow (Kenuncorked, 2008). This theory marked the first time the goal in farming had been to create a more natural system of agriculture.

In the early 20th century Sir Albert Howard (1873 – 1947) and his wife Gabrielle, a plant physiologist, became the first researchers to study traditional farming techniques, and actually moved to India for the study (Kenuncorked, 2008; Heckman, 2006). Howard soon noted the traditional Indian methods were better than his own conventional “European” methods (Kenuncorked, 2008). Later, in

1943, Howard published “An Agricultural Testament”, about natural soil fertility and composting practices, which was the first report to combine modern scientific knowledge with traditional farming practices (Howard, 2010).

In 1924, Rudolf Steiner of Germany began a lecture series advocating for Biodynamic Agriculture; a theory of balance between animals, plants, and soils (Paull, 2011). In his lecture series, Steiner advocated against the use of pesticides and chemical fertilizers and voiced his concern for the sustainability of modern farming practices (Paull, 2011). His agriculture techniques are still being practiced in Europe and Asia today.

The first documented use of the phrase “organic farming” came from Lord Northbourne in his 1940 book “Look to the Land” (Kenuncorked, 2008; Rigby & Caceres, 2001). Lord Northbourne’s ideas of organic farming referred to small self-sustainable entities which utilized methods that considered the environmental impact (Rigby & Caceres, 2001). These ideas of organic farming seem to have persisted through time and remain at the foundation of today’s definition of organic farming.

Lady Eve Balfour of England was the first to scientifically compare organic farming to conventional farming. Her findings were published in the book “The Living Soil” in 1943 (Kenuncorked, 2008). Lady Balfour’s work marks the beginning of an entire genre of scientific, health and public health advocacy, education, policy and research on organic farming.

In the 1950’s J.I. Rodale began to popularize some terms and methods of organic gardening in his book “Pay Dirt”. His publications were largely targeted to consumers, especially gardeners (Edwards, 1990). In the1970’s he began Rodale Press, which publishes how-to books for individuals interested in organic farming and gardening (Geier, 2007). Rodale’s efforts in the 50’s opened minds to the ideas of other organic pioneers like Rachel Carson. Carson’s 1962 book “Silent Spring” educated the

general public about the ill effects of the pesticide DDT on the environment, and incited the advocacy and political movements for environmental protection in the 1970's (Sligh & Cierpka, 2007).

The 1960's and 70s in the United States saw a rise in the environmental movement which became linked to organic farming (Kuepper, 2010; SARE, 2012). This created an increased demand in the organic food industry and the problem of defining the qualifications of being organic; a problem which would not be corrected in the U.S. until 1990 (SARE, 2012).

On the 5th of November, 1972, the International Federation of Organic Agricultural Movements (IFOAM) was founded (Geier, 2007). The five founding countries were the UK, Sweden, South Africa, the US and France (Geier, 2007). This organization came at a time when organic farming was regarded as revolutionary and anti-establishment. By 1975, IFOAM had grown to 50 member organizations from 17 countries (Geier, 2007). By 1987 membership in IFOAM had grown to 500 organizations from 17 countries (Geier, 2007).

In 1980, organic agriculture got recognition and attention in the U.S., with the publication of a report and recommendations on organic farming (Geier, 2007). In 1980, a United States Department of Agriculture (USDA) report by then Secretary of Agriculture, Bob Bergland, endorsed the acceptance of organic farming and offered recommendations on 'organic research, education and extension' (Geier, 2007). In 1981, The American Association for the Advancement of Science (AAAS) published a paper that found organic farming to be highly efficient and economically viable (Lockeretz, 2007).

As a response to the confusion surrounding the definition of organic, the U.S. Congress passed the Organic Foods Production Act (OFPA) in 1990, which called for national standards and regulations for organic foods (Heckman, 2006) (SARE, 2012). The next year saw a spark in the market for organic foods in the U.S. and around the world (Kenuncorked, 2008). Additionally, the USDA created the National Organic Program in 2000; a federal regulation that clearly defines organic and provides a

regulatory framework for organic agriculture (Lotter, 2003). In 2008, the U.S. Congress passed The Farm Bill which increased the funding of organic programs (Organic Farming Research Foundation). In 2009, the National Organic Program budget was actually doubled (Organic Farming Research Foundation). These events mark key governmental support for the organic industry.

DATA AND SURVEILLANCE SYSTEMS

Despite its growing acceptance by government officials and organizations, organic farming hasn't been specifically tracked by any agricultural injury, illness, or fatality surveillance system. For agriculture, there are many different health surveys and surveillance systems. Three organizations operate the five main agriculture surveys and surveillance; The National Institute for Occupational Safety and Health (NIOSH), United States Bureau of Labor Statistics (BLS), and the USDA. NIOSH and BLS collect data on injury, illness, and fatalities in agriculture, while the USDA focuses on the economic and demographic aspects of agriculture.

Although in the 1980's organic farming got USDA recognition, it was left out of agriculture data collection systems until after the 2000. The USDA agricultural census in 2002 first mentioned organic farming was under "market value of agricultural products sold". But organic and non-organic farming data are combined with no distinction made between them in USDA reports. In the 2007 USDA Census of Agriculture, organic agriculture received its own table, which focuses on profitability primarily land used and value of sales.

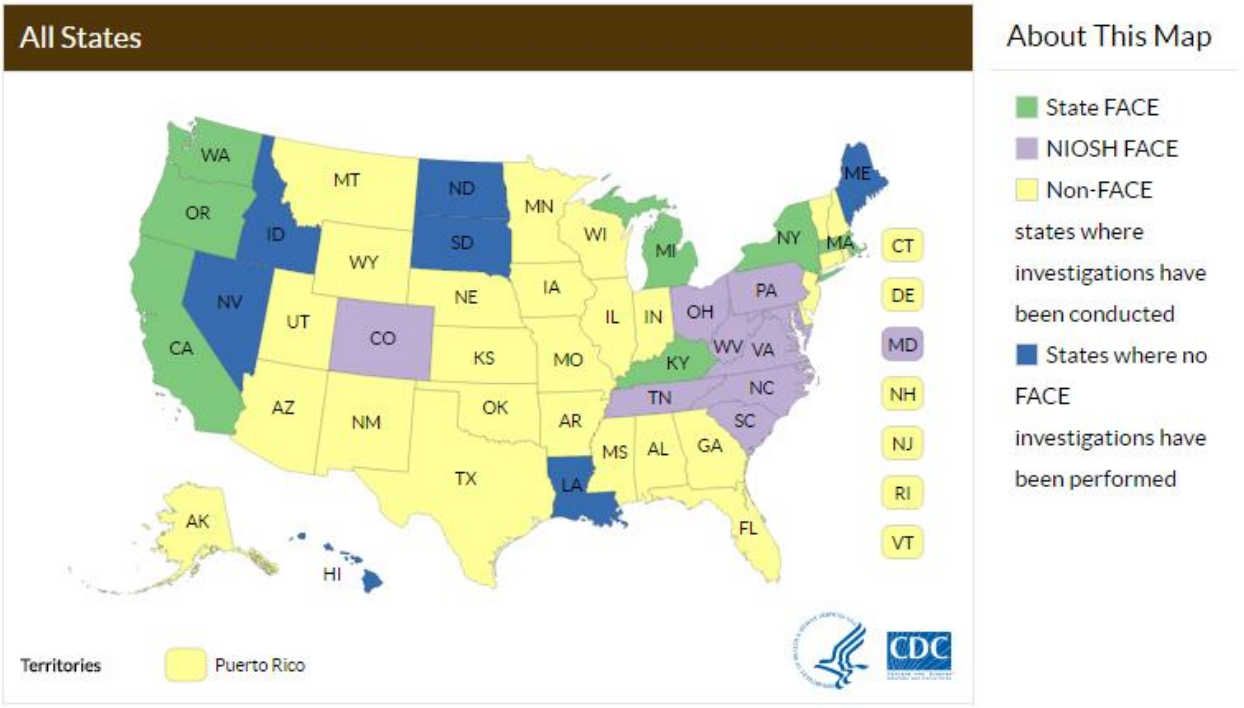
By the 2012 census of agriculture, farms were categorized as certified organic farms, non-certified organic farms or transitioning into organic farming. The value of sales was also first reported as basic demographic information on the primary operators of organic farms. In 2014, the USDA began the Organic Agriculture Survey, which collects data from participating organic farms on a much wider variety of topics, including production practices and challenges. Data surrounding organic farming are

slowly increasing in detail. There are not, however, enough data collected yet to elucidate injury and illness risks and behaviors or other sociocultural and environmental factors affecting health, making analysis of risks and hazards in the work environment of organic farmers difficult, if not impossible.

Surveillance of agricultural injuries was first done by NIOSH between 1993 and 1995 using the Traumatic Injury Surveillance of Farmers (TISF) survey. This survey sampled all farms, not just organic, from 15-19 states each year, mailing out a four page survey collecting data on workplace injuries, time lost, the number of tractors used on each farms, and hours of use for each tractor (Myers, 1997). A total of 1,400 farming operations were surveyed per state in this study, for a total of 32,670 farms. Although the TISF survey was stopped after 1995, it became the basis for the Occupational Injury Surveillance of Production Agriculture (OISPA) project, which began in 2001 (Myers, 1997). OISPA was designed to produce national and regional estimates for the number of adults over age 20 that work on farms and the number of occupational injuries that those workers incur. The results, as calculated by NIOSH, are based on detailed injury information collected from a stratified sample of 25,000 farms selected from the USDA's Census of Agriculture (The National Institute for Occupational Safety and Health, 2014). OISPA does not include a mechanism to separate organic farms from conventional farms in their estimates.

NIOSH also runs the FACE program. This program relies on voluntary state investigative reports of occupational fatalities to perform investigations into specific types of events and identified risks. Only seven states across the nation participate in the State FACE program and report their data to NIOSH; unfortunately New Mexico is not one of those seven (Figure 1). Each report has a short written section describing the nature of the fatality and its circumstances, but there is no notation as to the characteristics of the farm or its status as organic certified.

FIGURE 1. NIOSH FACE AND STATE FACE PROGRAM MAP



SOURCE: THE NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH, 2014

The BLS also conducts an annual Survey of Occupational Injuries and Illnesses (SOII) which collects employer reports from about 176,000 private industry establishments (U.S. Bureau of Labor Statistics, 2015). Employers are asked to give their recorded information along with the number of employee hours worked and average employment. The SOII looks at the injury and illness data from two aspects, industry data and case/worker data. The data include worker demographics, injury/illness characteristics, as well as other data relating to economics, such as days missed from work (U.S. Bureau of Labor Statistics, 2015). While the SOII categorizes all industries on varying levels, from large categories such as Natural Resources and Mining, down to smaller subheadings as Vegetable and Melon Farming, there is no category for organic farms specifically.

The BLS also operates the Census of Fatal Occupational Injuries (CFOI). The CFOI is an annual census compiled through cross-referencing multiple sources, such as death certificates, workers' compensation reports, and state agency administration reports. The CFOI collects information on occupation, equipment used, and circumstances of the event. The industry categories, however, are the same as the SOII, which excludes organic farming.

ILLNESS AND INJURY IN AGRICULTURE

AGRICULTURAL RISKS AND RISK FACTORS

Agriculture has been shown to be one of the most dangerous occupations in the United States. The BLS tracks statistics on occupational illnesses and injuries, and compiles them in an annual report. This report includes incidence rates per 100 employees working 40 hours a week for 50 weeks, or 200,000 hours (U.S. Bureau of Labor Statistics, 2015). The incidence rate is calculated across various occupational categories, in both the private and public sectors.

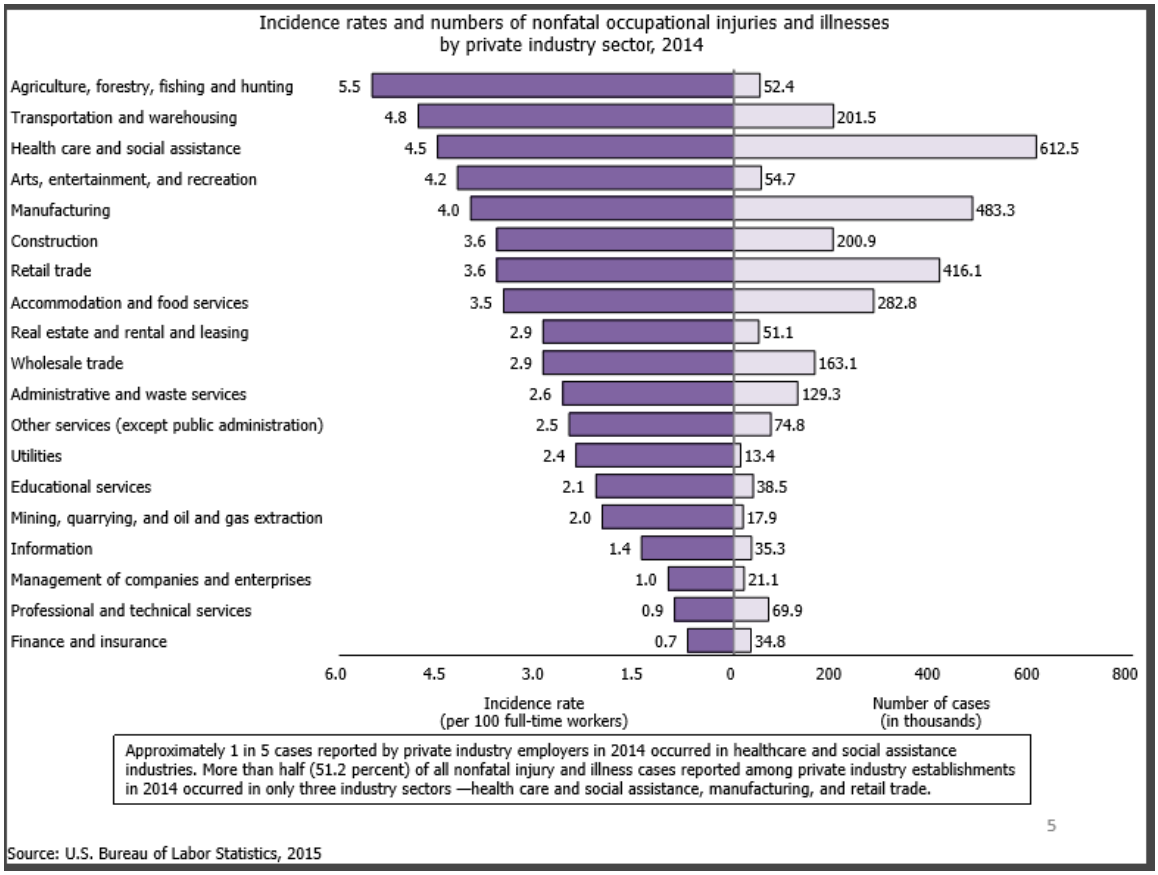
Agriculture has one of the highest incidence rates in the U.S (Table 1). The U.S. Bureau of Labor Statistics (BLS) categorizes Agriculture, Forestry, Fishing, and Hunting together in one occupational heading, which has the highest incidence rate of injury and illness (Figure 2). Within the Agriculture heading, the subcategory of crop farming has an incidence rate of 5.5 which is second to animal production and aquaculture, which has an incidence rate of 7.1 (U.S. Bureau of Labor Statistics, 2015). In New Mexico, crop farming incidence rate is slightly higher at 5.3, but is actually larger than the rate for animal production and aquaculture, which is 4.5 (U.S. Bureau of Labor Statistics, 2015).

TABLE 1. DANGEROUS U.S. OCCUPATIONAL INDUSTRIES, BY INJURY AND ILLNESS INCIDENCE RATES

Top 5 Occupations with Highest Incidence of Injury and Illness, U.S. 2014		
Industry	Incidence Rate	Number of Cases
1. Agriculture, Forestry, Fishing, and Hunting	5.5	49,400
2. Health Care and Social Assistance	4.2	575,000
3. Arts, Entertainment, and Recreation	4	52,000
4. Manufacturing	3.6	440,500
5. (tie) Construction	3.5	196,300
5. (tie) Trade, Transportation, and Utilities	3.5	770,500

SOURCE: U.S. BUREAU OF LABOR STATISTICS, 2015

FIGURE 2. NATIONAL INCIDENCE RATES FOR OCCUPATIONAL INJURIES IN THE PRIVATE SECTOR



SOURCE: U.S. BUREAU OF LABOR STATISTICS, 2015

In the area of crop farming, the BLS data indicates 6,210 total injuries for 2014, and gives the total for each type of event or exposure (Table 2). The majority of injury events occurring were from "Contact with Objects and Equipment", such as tractors and harvesters.(U.S. Bureau of Labor Statistics, 2015). The second most common injury event was "Falls, Slips, and Trips" and the third most common injury types being "Overexertion or Bodily Reaction".

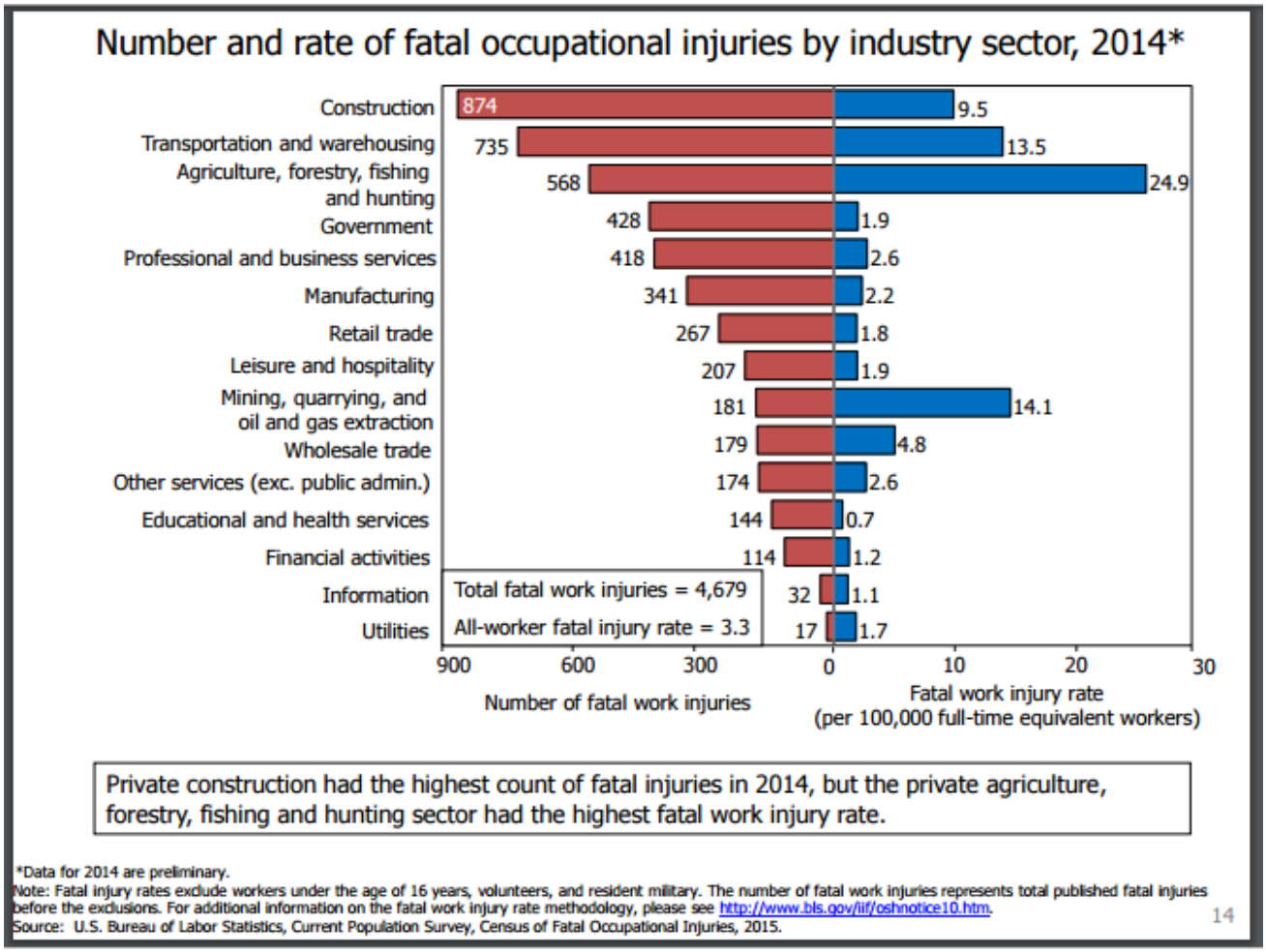
TABLE 2. NUMBERS OF INJURIES AND ILLNESSES IN AGRICULTURE BY EVENT OR EXPOSURE, 2014

Occupational Injuries and Illnesses in Agriculture, 2014	
Event or Exposure	Crop Agriculture, Total Injuries
Transportation Accidents	290
Contact with Objects and Equipment	1840
Falls, Slips, and Trips	1760
Violence/Other Injuries from People or Animals	240
Exposure to Harmful Substances or Environments	290
Fires and Explosions	10
Overexertion or Bodily Reaction	1710
All Other Events	70
Total Injuries	6210

SOURCE: U.S. BUREAU OF LABOR STATISTICS, 2015

Agriculture also has the highest incidence rates of occupational fatality among U.S. occupations (Figure 3). The BLS reports private agriculture as having an incidence rate of 24.9 work-place fatalities per 100,000 full-time workers. This rate is substantially higher than the next highest rate, 14.1 work-place fatalities per 100,000 full-time workers, the rate for mining quarrying, and gas and oil extraction. There were 568 total work-place agricultural deaths in 2014, but looking within that industry, crop farming made up 248 of those total deaths (U.S. Bureau of Labor Statistics, 2015).

FIGURE 3. NATIONAL INCIDENCE RATES FOR OCCUPATIONAL FATALITIES BY INDUSTRY, 2014



Fatality data are also available from the National Institute for Occupational Safety and Health (NIOSH), which runs the occupational fatality surveillance program Fatality Assessment and Control Evaluation (FACE). There are two components to the FACE program, the first is a voluntary notification to NIOSH of a traumatic occupational fatality, and the second is a state cooperative agreement with NIOSH to conduct surveillance and investigations at the State level, using the FACE program model (NIOSH, 2015). Since its earliest reports in 1986, there have been 17 NIOSH-level FACE reports, of which approximately 10 address crop farming (NIOSH, 2014). Within those 10 reports

were 13 work-place deaths of which the greatest number reported were from electrocution. The State FACE report on Agriculture is much larger, listing 408 records since 1989. If livestock agriculture is removed, there are 307 reports that pertain to crop farming. Among those the most common fatality results from machinery-related incidents, such as tractor rollovers or crushing (Table 3). Suffocation was the second most common fatality, followed by falls and electrocutions (The National Institute for Occupational Safety and Health, 2014). Risk cannot be calculated from these numbers however, as FACE is based on voluntary reporting from reporting from states, and there is no total population given.

TABLE 3. NUMBER OF WORK-PLACE DEATHS REPORTED TO NIOSH FACE PROGRAM, 1986 - 2014

FACE Program Occupational Fatalities in Crop Farming	
Fatal event or Exposure	Deaths Reported
Heat Stroke	1
Equipment Related	4
Suffocation	1
Electrocution	6
Fire	0
Fall	0
Drowning	0
Unknown/Miscellaneous	1
Total	13

State FACE Program Occupational Fatalities in Crop Farming	
Fatal event or Exposure	Deaths Reported
Heat Stroke	0
Equipment Related	245
Suffocation	25
Electrocution	12
Fire	8
Fall	13
Drowning	3
Unknown/Miscellaneous	1
Total	307

SOURCE: THE NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH , 2014

To better understand illness and injury risks in the general farming community it is important to look at other studies done on attitudes and behaviors in farming. In a study by Coury, Kumar, & Jones, they found most of the accidents occurred in the fields. Of all the machinery related accidents, tractors were the leading cause of accidents and accounted for 20% (328 cases) of injuries in that particular study (Coury, Kumar, & Jones, 1999). The study also found that farmers over the age of 60 tend to make more frequent use of older machines and tractors, without any protective devices. Carelessness or slower reflexes seem to play an important role in the older age group of injuries and deaths (Hanson, Dismukes, Chambers, Greene, & Kremen, 2004; Coury, Kumar, & Jones, 1999). Hearing loss is also a potential age-related hazard on the farm, since many people report declining hearing as they age (Choi, et al., 2005). A study done to assess this as a risk factor for agricultural injuries found that there was evidence that hearing loss is an increased risk for injury. The study concluded that "prevention of hearing loss and noise exposure may be important in reducing the burden of agricultural injuries (Choi, et al., 2005; Von Essen & McCurdy, 1998).

Musculoskeletal injuries are also of concern to farmworkers, especially female farmworkers (Mobed, Gold, & Schenker, 1992). For example, McCoy, Carruth, and Reed found that women were predisposed to ergonomic-related injuries due to their differences in size and stature, reduced maximal oxygen uptake and the increased physical strain of farming activities (McCoy, Carruth, & Reed, 2002). In the migrant and seasonal farmworker population, 29 percent are female (National Center for Farmworker Health, Inc., 2016).

Although this review of the literature shows that some research has been done on prevention and risk factors for farm workers, little research has specifically focused on organic farmers. With popularity and demand on the rise, given that conventional farming is a relatively dangerous occupation,

describing and documenting differences in health risks will be critical to ensure the health and safety of organic farm workers.

PURPOSE

The purpose of this paper is to identify and quantify the health risks that face organic farmers. Because of the nature of the holistic connotations of organic, these farmers see themselves at less risk of injury, illness, or fatality than conventional farmers (Soto Mas, Rohrer, Viteri, & Cacari-Stone, Forthcoming). To understand the risks of organic farming, however, requires careful evaluation of collection methods currently in use, their effectiveness at capturing what health risks, if any, organic farmers face, and analysis of those data.

METHODS

SURVEILLANCE SYSTEMS EVALUATION

Five surveillance systems were evaluated for their effectiveness and suitability in identifying risks and hazards of organic farming. Using the Center for Disease Control's Updated Guidelines for Evaluating Public Health Surveillance Systems, each surveillance system was evaluated and a simple report was written on each (MMWR, 2001). The reports covered the stakeholders of each system, a system description, which included the public health importance, purpose and operation of each, an evaluation of the design as it applies to organic farming, credible evidence for the usefulness of the system, and a conclusion (MMWR, 2001). Information about each surveillance system was gathered from official websites for each system, and examining webpages relating to the system's missions, objectives, and history. Data available for each system were also analyzed for value in public health research and its applicability to the purpose of this project. Reports were then compared and overall

conclusions drawn about the usefulness of the current systems in identifying risks of organic farming. Recommendations for improvements are then made based on the overall evaluation.

DATA SOURCES AND DATA

For the purposes of this paper, organic farms refers to those farms that the USDA has either certified organic or declared as exempt organic. Exempt organic farms follow the same requirements as the certified organic producers but make less than $5,000 annually (United States Department of Agriculture, 2016). The exemption allows them sell their products as organic, but they may not use the USDA Certified Organic seal, or have their products used as ingredients in another producer's certified organic food product. Certified and Exempt organic farms must adhere to strict regulations about production practices. Soil must be fertilized using compost, animal manures, or green manures, and sludge or biosolids are prohibited. Organic seeds and planting stock must be used, and if not obtainable, regular seeds and stock cannot be genetically modified or treated with substances, like fungicide. Crop rotation is also a required practice to help interrupt insect lifecycles, suppress soil borne plant diseases, prevent erosion, fix nitrogen, and increase a farm's biodiversity. Pest, weed, and disease management bans the use of cannot be done using fertilizers and pesticides. If a farm has organic and non-organic crops, these prohibited substances must be contained by use of barriers, like hedgerows or other crops, to ensure there is no spray drift. Organic crops cannot be located next to roadways without one of the barriers in place. If transitioning to organic land, prohibited materials must not be used for 36 months prior to harvesting an organic crop. Pest control is primarily done through prevention, avoidance, monitoring, and suppression, or PAMS. If suppression becomes necessary, organic farms can use mechanical or physical tactics, like releasing predatory insects, applying a thick layer of mulch, or they may work with their organic certifier to use an approved pesticide. The approved pesticides are

microorganisms, insecticides derived from plants, or a few synthetic substances. (United States Department of Agriculture, 2015).

Tables were compiled from the USDA 2012 Census of Agriculture comparing principal operators of New Mexico Organic Farms to principal operators of US Organic Farms in the categories of gender, age, and years of farm operation. These categories were selected to show the variation in principal operators, and to begin to highlight areas where there may exist the potential for injury and illness along social and cultural lines, for example male to female injury differences, inexperience operating machinery, or advancing age. Subsequent tables were then created comparing the same categories of principal operators of New Mexico Organic Farms with Texas Organic Farms and all New Mexico Farms. A fourth table was then created from the 2012 Census of Agriculture data set that compares the number of all Hispanic, Latino, or Spanish Principal Operators of farms between New Mexico with Texas and the United States overall.

In order to make more specific comparisons in the Southwest region, Texas was selected as a comparison state. Across the Southwest, Texas has been most comparable to New Mexico in number of organic farms operated in 2014 (USDA National Agricultural Statistics Service, 2014). Texas organic farmers were roughly the same as New Mexico's, and therefore the U.S. (Table 4). The only area that showed a statistical difference was principal operators, ages 35-44 years. This is roughly the same as was noted between New Mexico and the U.S.

TABLE 4. ORGANIC FARMING DEMOGRAPHICS: NEW MEXICO COMPARED TO TEXAS

	New Mexico Organic Farmers	TX Organic Farmers	Rate Ratio	95% CI
Gender of Primary Operator				
Males (%)	149 (76.80)	288 (83.24)	0.9227	0.8428, 1.01
Age of Primary Operator				
<25 years (%)	—		—	—
25-34 yrs (%)	20 (10.31)	25 (7.23)	1.427	0.8141, 2.501
35-44 yrs (%)	16 (8.25)	53 (15.32)	0.5384	0.3167, 0.9154
45-54 yrs (%)	37 (19.07)	84 (24.28)	0.7856	0.5567, 1.109
55-64 yrs (%)	70 (36.08)	113 (32.66)	1.105	0.8684, 1.406
65-70 yrs (%)	26 (13.40)	34 (9.83)	1.34	0.8445, 2.203
>70 yrs (%)	25 (12.89)	33(9.54)	1.351	0.8286, 2.203
Farm Time in Operation				
2 yrs or less (%)	14 (9.15)	36 (10.41)	0.6936	0.3838, 1.253
3-4 years (%)	20 (13.07)	24 (6.94)	1.486	0.8433, 2.62
5-9 years (%)	48 (31.37)	75 (21.68)	1.141	0.8316, 1.567
10 or more years (%)	112 (73.20)	211 (60.98)	0.9467	0.8173, 1.097

NM Organic Farmer total - 194
TX Organic Farmer Total – 346

SOURCE: USDA, 2012 CENSUS OF AGRICULTURE

The USDA 2014 Organic Survey results were compared between New Mexico and Texas, and New Mexico and the United States. Data were derived from Table 21. Production Practices – Certified and Exempt Organic Farms: 2014, where eleven of the thirteen production practices listed in the Organic Survey pertained to crop farming.

A percentage is provided in the tables for each variable, and the counts in each category were compared using the 2x2 Tables function in OpenEpi.com to derive Rate Ratios and 95% Confidence Intervals. A Rate Ratio with a 95% Confidence Interval that includes it was considered not significantly different.

RESULTS

SURVEILLANCE EVALUATION

Five surveillance systems were evaluated with the purpose of determining the suitability of each in identifying health risks and hazards of organic farmers (Table 5). Two systems collect data on injury and illness, two collect data on occupational fatalities, and one collects data on characteristics, demographics and economics of agriculture. These surveillance systems are all run by governmental agencies and data are made available to the public in a variety of forms, including tables, charts, or summary reports.

TABLE 5. SURVEILLANCE SYSTEMS EVALUATED

Surveillance Systems Overview				
System	Operated By	Types of Variables	Data Given	Organic Farming
Census of Agriculture, Organic Survey	USDA	Production Practices (organic only), Economics, Primary Farmer Demographics,	Counts, Dollar Values	Yes
Occupational Injury Surveillance of Production Agriculture (OISPA)	NIOSH	Worker Demographics, Injury Characteristics	Counts	No
Fatality Assessment and Control Evaluation (FACE) and State FACE	NIOSH	Investigative Reports on fatalities Reported to FACE Program	Full Reports Available	No
Survey of Injury and Illness (SOII)	BLS	Industry, Injury Characteristics, Worker Demographics, Time of Injury Event	Counts, Percentages, Incidence Rates	No
Census of Fatal Occupational Injury (CFOI)	BLS	Industry, Injury Characteristics, Worker Demographics	Counts, Incidence Rates	No

The first system evaluated was the survey system used by the USDA, which informs both the Census of Agriculture and new 2014 Organic Survey. This survey system gives the numerical counts of the total agricultural population, and looks at variables regarding primary operators' demographics, farm characteristics and economics (USDA National Agriculture Statistics Service, 2012). In the organic survey variables for organic production practices are also included (USDA National Agricultural Statistics Service, 2014). These population counts are uniform and consistent across national and state levels, and provide a count of the at-risk population for creating incidence rates, if combined with data from other sources. The USDA doesn't survey variables pertaining to injury, illness, or fatality rates. This survey gives a useful basis for understanding the total agriculture population, and understanding key farmer demographics.

The OISPA was the next system evaluated for its suitability in capturing injury and illness data for organic farmers. This telephone survey of employers can occur up to 15 months post-injury. Yet it provides ongoing surveillance of the magnitude of farming injury and illness by giving national and regional estimates of the number of farm workers, and estimates of the occupational injuries they incur (NIOSH, 2015). Although, this system gives a better understanding of the risks associated with farming, the variables do not include organic farming.

The other injury and illnesses surveillance system evaluated is the SOII. This system is run by the BLS, and collects data from surveyed employers' reports and takes a sample to analyze for counts and incidence rates. The variables assessed include injury and illness characteristics, farmworker demographics, and number of work days missed. The incidence rates are standardized across industries, as well as within industry headings. Agriculture has a subheading for crop farming, which is broken down into subcategories for types of crops produced. Organic farming, however, is not listed separately in any subcategory

The BLS also produces the CFOI to gather national, state, and metropolitan small area fatality data across industries. This system gives the total number of deaths for each industry, which it collects from multiple sources, including death certificates and workers' compensation records, and then cross-references with source documents or a questionnaire. The data set includes variables on industry at varying levels, as well as, fatality event, employee hours worked, and worker demographics. This system offers a standardized data set across industries, but, similar to the SOII, covers Agriculture at many subcategories that do not include organic farming.

The last system evaluated is the FACE and State FACE programs, operated by NIOSH. This system is voluntary and has limited cooperative participation in many states. Traumatic deaths are reported voluntarily by the state, and an investigation results in a written report detailing the event, the location and industry, the company type and numbers of employees, tools used, the role of the management, and other pertinent facts (NIOSH, 2015). Interviews with management, co-workers, and witnesses are conducted, as well. Reports are published upon completion, and every report is available to be viewed online. The system posts every full report collected since 1986, which can be accessed by limited headings under location, industry, cause, or population (NIOSH, 2014). Beyond those limited headings, however, there is no way to search the results by organic farms, other than to read each detailed report. This system is useful to understanding why a particular fatality occurred, but does little to advance the epidemiologic understanding of organic farming fatalities.

COMPARISONS OF NEW MEXICO ORGANIC FARMERS

The most current data available on the organic farming population is from the USDA's 2012 Census of Agriculture. This data breaks down principal organic farmers by age, gender, and years working on present farm, as well as a few other categories (USDA National Agriculture Statistics

Service, 2012). This data is available for the total U.S. Organic Farming population, as well as the individual states. By looking at the categories of gender, age group, and years at present farm, it is the hope of this researcher to identify possible areas of concern for New Mexico. Each one of the categories can be used to look at certain risks of injury and illness, and can improve our understanding of New Mexico's organic farming population overall health.

In comparing New Mexico to the United States' organic farmers there are no differences in most categories. Fewer New Mexico organic farmers are principal operators in their middle ages (ages 35-44 years), have been present at their current farms for 3-4 years, or were at their present farm 10 years or more (Table 6).

TABLE 6. ORGANIC FARMING DEMOGRAPHICS: NEW MEXICO COMPARED TO UNITED STATES

	New Mexico Organic Farmers	US Organic Farmers	Rate Ratio	95% CI
Gender of Primary Operator				
Males (%)	149 (76.80)	13503 (81.71)	0.9399	0.8697, 1.016
Age of Primary Operator				
<25 years (%)	—	145 (0.88)	—	—
25-34 yrs (%)	20 (10.31)	1652 (9.99)	1.031	0.6792, 1.566
35-44 yrs (%)	16 (8.25)	2346 (14.20)	0.5809	0.3628, 0.9303
45-54 yrs (%)	37 (19.07)	3962 (23.96)	0.7955	0.5946, 1.064
55-64 yrs (%)	70 (36.08)	5226 (31.63)	1.141	0.9448, 1.378
65-70 yrs (%)	26 (13.40)	1627 (9.85)	1.361	0.9491, 1.952
>70 yrs (%)	25 (12.89)	1567 (9.48)	1.359	0.9398, 1.965
Farm Time in Operation of Current Farm				
2 yrs or less (%)	14 (7.22)	869 (5.26)	1.372	0.8252, 2.282
3-4 years (%)	20 (10.31)	1560 (9.44)	1.092	0.7192, 1.658
5-9 years (%)	48 (24.74)	3267 (19.77)	1.252	0.9773, 1.603
10 or more years (%)	112 (57.73)	10829 (65.53)	0.881	0.7807, 0.9942

= Rate Ratio statistically significant at the p=0.05 level

NM Organic Farmer total - 194
US Organic Farmer Total - 16525

SOURCE: USDA, 2012 CENSUS OF AGRICULTURE

New Mexico organic farming was then compared to total New Mexico farming data. Using the 2012 Census of Agriculture data again, total New Mexico principal operators were compared to New Mexico Organic principal operators (see Table 7). There were many more categories that showed a statistical difference. Organic farmers were about 2.6 times more likely than the total farmers to be 25-34 years old, and 1.3 times more likely to be 55-64 years old. They were also about half as likely to be 65-70 years old than the total farmer group in New Mexico. When evaluating years spent on current farm, New Mexico organic farmers in general had spent fewer years than all of New Mexico farmers. There were about 2 times as many organic farmers at their present farms for 2 years or less, 3-4 years, and 5-9 years. Organic principal operators were less likely to be at their current farms for 10 or more years.

TABLE 4. ORGANIC FARMING DEMOGRAPHICS: NEW MEXICO ORGANIC FARMERS COMPARED TO TOTAL NEW MEXICO FARMERS

	New Mexico Organic Farmers *	NM Total Farmers*	Rate Ratio	95% CI
Gender of Primary Operator				
Males (%)	149 (76.80)	19944 (80.68)	0.952	0.809, 1.029
Age of Primary Operator				
<25 years (%)	-	218 (0.88)		
25-34 yrs (%)	20 (10.31)	982 (3.97)	2.595	1.706, 3.948
35-44 yrs (%)	16 (8.25)	1896 (7.67)	1.075	0.6712, 1.723
45-54 yrs (%)	37 (19.07)	4662 (18.86)	1.011	0.756, 1.353
55-64 yrs (%)	70 (36.08)	7070 (28.6)	1.262	1.045, 1.523
65-70 yrs (%)	26 (13.40)	5916 (23.93)	0.56	0.3914, 0.8014
>70 yrs (%)	25 (12.89)	3977 (16.09)	0.801	0.555, 1.156
Farm Time in Operation of Current Farm				
2 yrs or less (%)	14 (7.22)	897 (3.63)	1.989	1.196, 3.307
3-4 years (%)	20 (10.31)	1188 (4.81)	2.145	1.411, 3.261
5-9 years (%)	48 (24.74)	3307 (13.38)	1.85	1.444, 2.369
10 or more years (%)	112 (57.73)	19329 (78.19)	0.7384	0.6545, 0.833

= Rate Ratio statistically significant at the p=0.05 level

NM Organic Farmer total - 194
Total NM Farmer – 24721

SOURCE: USDA, 2012 CENSUS OF AGRICULTURE

In looking at New Mexico farming principal operators, a comparison was drawn between the Texas population and the U.S. population (Table 8). In both cases New Mexico had more principal operators identify as Hispanic, Latino/a, or Spanish. There were no ethnicity data available for organic farmers, but comparisons were made across total farming populations. New Mexico organic farmers were almost 3.98 times more likely than Texas organic farmers to identify as Hispanic, and 11.94 times more likely than the US farmers.

TABLE 5. ETHNICITY DEMOGRAPHICS: NEW MEXICO FARMERS COMPARED TO TEXAS AND THE UNITED STATES

Ethnicity of Principal Operator - Hispanic, Latino, Spanish			
New Mexico Farmers (%)	US Farmers (%)	Rate Ratio	95% CI
9377 (37.93)	67000 (3.18)	11.94	11.73, 12.15

Ethnicity of Principal Operator - Hispanic, Latino, Spanish			
New Mexico Farmers	Texas Farmers (%)	Rate Ratio	95% CI
9377 (37.93)	23689 of 248,809 (9.52)	3.984	3.905, 4.065

Total New Mexico Farmers – 24,721
Total US Farmers – 2,109,303
Total Texas Farmers – 248,809

SOURCE: USDA, 2012 CENSUS OF AGRICULTURE

DIFFERENCES IN PRODUCTION PRACTICES

Using the USDA 2014 Organic Survey data, New Mexico organic farming production practices were compared to the prevalence of the same practices in Texas, and across the U.S. New Mexico organic farmers showed a higher use of most of the listed practices (Table 9). The practices of releasing beneficial organisms, maintaining beneficial insects and vertebrate habitats, selecting planting locations to avoid pests, choosing pest resistant varieties of plants, planned plantings to avoid cross contamination, produced or used organic mulch or compost, used green or animal manures, used no-till or minimum till farming, and using water management practices were each used, on average, 1.28 times more often by New Mexico organic farmers than by organic farmers across the U.S.

TABLE 6. ORGANIC PRODUCTION PRACTICES: NEW MEXICO AND THE UNITED STATES

	New Mexico Organic Farms	US Organic Farms	Rate Ratio	95% CI
Production Practices - By Farms (%)				
Biological Pest Management	48 (43.24)	4,779 (35.32)	1.224	0.9881, 1.517
Released Beneficial Organisms	32 (28.83)	2,510 (18.55)	1.554	1.158, 2.086
Maintained Beneficial Insect/Vertebrate Habitat	51 (45.95)	4,840 (35.77)	1.284	1.048, 1.574
Selected Planting Locations to Avoid Pests	54 (48.65)	5,405 (39.95)	1.218	1.005, 1.476
Chose Pest Resistant Varieties	55 (49.55)	5,035 (37.29)	1.331	1.102, 1.608
Planned Plantings to Avoid Cross Contamination	34 (30.63)	4,302 (29.8)	0.9633	0.72373, 1.276
Produced/Used Organic Mulch/Compost	81 (72.97)	7,082 (52.34)	1.394	1.243, 1.563
Used Green or Animal Manures	89 (80.18)	9,409 (69.54)	1.153	1.05, 1.266
No-Till or Minimum Till	75 (67.57)	5,724 (42.31)	1.597	1.402, 1.82
Maintained Buffer Strips	66 (59.50)	9,259 (68.43)	0.8689	0.7448, 1.014
Used Water Management Practices	94 (84.69)	7,506 (55.48)	1.526	1.408, 1.655
				= Rate Ratio statistically significant at the p=0.05 level
NM Organic Farmer total - 111				
US Organic Farmer Total - 13,530				

SOURCE: USDA, 2014 ORGANIC SURVEY

When comparing the same organic practices with regional Texas organic farmers, results were similar. New Mexico organic farmers had increased usage of the majority of organic production practices (Table 10). Compared to Texas organic farmers, New Mexico organic farmers used biological pest management, maintaining beneficial insect and vertebrate habitats, selecting planting locations to avoid pests, choosing pest resistant plant varieties, producing and using organic mulch and compost,

using green or animal manures, and practicing no-till or minimum till farming an average of 1.34 times more often. The biggest difference, though, was in the no-till practice. New Mexico organic farmers were 2.1 times more likely to use this practice than Texas organic farmers.

TABLE 7. ORGANIC PRODUCTION PRACTICES: NEW MEXICO AND TEXAS

	New Mexico Organic Farms	Texas Organic Farms	Rate Ratio	95% CI
Production Practices - By Farms (%)				
Biological Pest Management	48 (43.24)	74 (31.49)	1.373	1.033, 1.825
Released Beneficial Organisms	32 (28.83)	61 (25.96)	1.111	0.7722, 1.597
Maintained beneficial Insect/Vertebrate Habitat	51 (45.95)	72 (30.64)	1.5	1.135, 1.982
Selected Planting Locations to avoid pests	54 (48.65)	87 (37.02)	1.314	1.02, 1.693
Chose Pest resistant varieties	55 (49.55)	90 (38.3)	1.294	1.009, 1.658
Planned Plantings to Avoid Cross Contamination	34 (30.63)	76 (32.34)	0.9471	0.6772, 1.325
Produced/Used Organic Mulch/Compost	81 (72.97)	124 (52.77)	1.383	1.172, 1.632
Used Green or Animal Manures	89 (80.18)	133 (56.60)	1.417	1.225, 1.638
No-Till or Minimum Till	75 (67.57)	75 (31.92)	2.117	1.687, 2.656
Maintained Buffer Strips	66 (59.50)	139 (59.15)	1.005	0.834, 1.212
Used Water Management Practices	94 (84.69)	159 (67.66)	1.252	1.112, 1.409

= Rate Ratio statistically significant at the p=0.05 level

NM Organic Farmer total - 111
TX Organic Farmer Total – 235

SOURCE: USDA, 2014 ORGANIC SURVEY

DISCUSSION

SURVEILLANCE SYSTEM EVALUATION AND THE HEALTH RISKS OF ORGANIC FARMERS

There is no surveillance system currently in place that identifies the health risks of organic farmers versus the health risks of conventional farmers. The agencies that do collect health data for

agriculture do not categorize farms by organic or conventional. Without data it is not possible to analyze the health risks of organic farmers.

The current surveillance systems that look at agriculture work give snapshots of the health risks that all farmers face. Of the five systems, four of them actually capture health data for all farmers. The USDA Census of Agriculture does not survey health outcomes or risks. Two systems rely on solely survey response from farmers to gather data on injury and illness in farmers. The completeness of the data is unknown. Some of the data collected is not suitable for detailed analysis, such as the detailed reports of the FACE and State FACE program. Data are not computerized in a standardized fashion. This leaves researchers unable to draw conclusion on a population level. The reports focus on individuals and particular events rather than generalizable data. The other systems do collect data in a way that would make it possible to develop risk estimates, although it remains that data for organic farming is not collected.

CHARACTERISTICS OF THE NEW MEXICO ORGANIC FARMER

New Mexico organic farmer demographics are similar to the U.S. and Texas populations of organic farmers. Even with less principal operators between 35 and 44 years than would be expected, New Mexico still has 26 percent of its population over the age of 65 years (Table 5). Age increases the risks for machinery-related injuries, as well as ergonomic and fatigue-related injuries (Hanson, Dismukes, Chambers, Greene, & Kremen, 2004).

Within the scope of New Mexico farmers, we see that organic farmers are more demographically diverse than conventional farmers. There is a greater likelihood of New Mexico organic farmers to be younger and to have worked on their current farm for fewer years (Table 7). Since organic farming has been increasing in popularity in the last 20 years, it is not surprising to find that the majority of organic

farm principal operators have been working at their current farms for 5-9 years in both the U.S. and New Mexico. Young farmers are more at risk to be undertrained and inexperienced with machinery, which could increase their risk (Arcury, Rodriguez, Kearney, Arcury, & Quandt, 2014).

PRODUCTION PRACTICES

Looking specifically at organic production practices, New Mexico organic farmers are utilizing several organic practices at higher rates than the US or Texas. Some of these practices would be more beneficial to use in New Mexico, like water management practices, since the climate is dry and water is a more scarce resource. Understanding water use in New Mexico can also explain why no-till farming is more popular, since it requires fewer passes of equipment, and leaves more crop residue in place. This in turn prevents evaporation and leaves water in the soil longer (Laukkanen & Nauges, 2011). This practice, in turn may lessen the risk of experiencing machinery-related injuries since tractors and other machinery are used less often. Other practices, however, might have similar risks to conventional farming practices, such as using organic compost. Organic compost can include animal manures and bone meal, which become dust particulates (Compost Components, 2015). Compost workers have shown a significantly higher of mucosal membrane irritation in their eyes and airway, chronic bronchitis, and conjunctivitis, with a significant decrease in the percent of forced vital capacity in non-smoking compost workers (Bunger, Schappler-Scheele, Hilgers, & Hallier, 2007). But using organic mulch might decrease some risks for body overexertion, as the mulch acts as a weed barrier and would require less frequent weeding. Until data are collected specifically on organic farmer injury, illness, and death rates, it will be hard to fully understand the relationship between organic production practices and possible assorted injuries and illnesses.

Body overexertion is the third most common health risk facing farmers. Organic farms are also at risk for body exertion injuries from ergonomic strains and sprains. A qualitative study conducted in 2014 on small organic farms in the Central New Mexico found that organic farmers experienced fatigue and stress to body parts, like their backs, hands, and wrists (Soto Mas, Rohrer, Viteri, & Cacari-Stone, Forthcoming). The organic farmers interviewed also noted that they often worked in greenhouses during hot weather, where the temperatures could reach as high 120° Fahrenheit, which increases their risk of heat-related injury (Soto Mas, Rohrer, Viteri, & Cacari-Stone, Forthcoming).

It is important to note that while pesticide use is much more limited among organic farmers, these workers are still at risk of injury, illness, or death. The farmers' perception, however, is that the risks are less because they are working with organic foods (Soto Mas, Rohrer, Viteri, & Cacari-Stone, Forthcoming). Understanding how organic farmers engage in their working environment can help inform the behavioral risks for illness and injury. The organic farmers surveyed in the Central New Mexico saw the risks of agriculture as being inherent in the nature of the professions, and rarely took simple steps to alleviate health hazards (Soto Mas, Rohrer, Viteri, & Cacari-Stone, Forthcoming). Understanding the culture of safety in the organic farming population is crucial to understanding the injury and illness data, and will eventually help inform the next steps of intervention.

In a study done on farm injuries in Alberta, Coury, Kumar and Jones noted the reluctance of farmers to report farm injuries, given that they are accustomed to hard work and injuries are accepted as a part of the job (Cummings, 1992). Currently organic farming is not well regulated beyond the area of certification practices. Injury and illness regulations fall under the Occupational Safety and Health Act, which doesn't require reporting of minor injuries not requiring medical attention or resulting in loss of work, and small farms (those with less than 11 employees) to report injuries (United States Department of Labor, 2001).

A recent policy change in New Mexico has mandated worker's compensation for farm and ranch workers, which would lead to improved reporting. This may be a beneficial policy change for the employees, but small farm owners are concerned that they may not be able to afford to operate their farms and pay for worker's compensation (Rasmussen, 2016). Therefore a tax credit or subsidy offered to small farm operators could allow them to cover these additional expenses, and still offer their employees the protection of worker's compensation. Having this small change in policy may allow worker's and farm operators to feel more secure in reporting injuries and illnesses, giving the data more reliability.

LIMITATIONS

Several limitations are present in the available data on New Mexico and organic farmers. Most data are not specific to organic farming. For example, the Department of Labor (DOL) and North American Industry Classification System (NAICS) does not separate organic agriculture death and illness from non-organic agriculture and occupational injury statistics group agriculture, forestry, fishing and hunting together. In addition, the DOL statistics which are collected, provide little or no information about the conditions or environments of circumstances leading to up to these occupational injuries and deaths (U.S. Bureau of Labor Statistics, 2015). Often times, the statistics of injuries and fatalities fail to collect such basic information on the demographic characteristics of the individuals reported (U.S. Bureau of Labor Statistics, 2015). Furthermore, none of the occupational injury or fatality data differentiate between small and large farms. A review of the literature indicates that there has been some work to compare the risks of organic agriculture to non-organic agriculture but again this does not specifically examine small organic farms (Hanson, Dismukes, Chambers, Greene, & Kremen, 2004).

Another possible limitation of this study is that many injuries among farmers, in general, may not be reported, especially if those farms are small and not required to report injuries. In order to protect farmworkers on small organic farms, this policy should be reevaluated and restructured to account for small farms.

RECOMMENDATIONS

The best systems to incorporate organic farming data are the SOII and the CFOI. The SOII should incorporate a question in their surveys to account for organic farms. By identifying injury events as taking place on an organic farms, the SOII would be able to calculate incidence rates for injuries and illnesses among organic farmers. The CFOI faces different challenges in obtaining fatality information from sources such as death certificates. But as they cross-reference various sources to obtain accurate fatality information regarding industry, “Organic Farm” should be an obtainable variable. In addition to better organic farming injury and illness data nationwide, New Mexico should establish a statewide survey of organic farmers. This survey should go beyond demographic collection and include a questionnaire pertaining to farming practices and risk/safety behaviors.

Some health risks facing farmers could be lessened if precautionary safety measures are followed. But these behaviors may not be practiced by the individual or enforced by the employers. The Theory of Reasoned Action looks at behavioral beliefs and intentions as predictors of behavior. By intervening at either the behavior or normative beliefs level, it is believed that behaviors can be changed (Madden, Ellen, & Ajzen, 1992). In the context of organic farming safety practices, this theory can help inform interventions relating to the beliefs that organic farming is safer due to less pesticide use. The Theory of Reasoned Action can be supplemented with the Theory of Planned Behavior to help solidify changes in behviors. The Theory of Planned Behavior is built on the basis of the Theory of Reasoned

Action, but it includes a component of perceived behavioral control (Madden, Ellen, & Ajzen, 1992). For organic farmers, this would mean an education component in an intervention designed to increase knowledge of risks and importance of safety behaviors.

CONCLUSION

There is no surveillance system in current operation that effectively captures the health risks faced by organic farmers. It is important that as the government organizations begin to take more notice of organic farming as a growing occupational field, the data collection on injury and illness expands as well. A preliminary study has given some insight into psychosocial risk factors that affect small organic farmers in central New Mexico, but more data and studies need to be conducted to get a more accurate picture of the health risks facing organic farmers. With organic farming increasing in popularity, it is important to begin examining the health risks of this population, so that future interventions can be implemented.

ADDENDUM

SELF-REFLECTION

Public health has become the filter through which I live my life and view the world. I have become more aware of how I interact with different communities in a way that goes beyond cultural sensitivity. I understand that I, as a public health practitioner, will be a facilitator between a community and an organization, bringing knowledge to a community and asking them what they need. I see myself using the knowledge I've gained to help develop interventions or programs alongside a community, and seeing the project through to evaluation, where the knowledge gained can be gathered and passed onto others. I would like to think that I will make an impact in the larger world of public health, but I am content to make an impact in New Mexico's underserved communities.

Working across a wide variety of projects in this program has helped me focus a desire for social justice into a career where I can help underserved communities. My passion for Maternal, Child, Health remains strong, and I would like to continue studying and designing interventions for that population. As a veteran of the U.S. Army, I can also see myself giving back to my community. I believe women veterans can find themselves in unique situations, especially in matters of pregnancy and sexual health care as well as mental health care. There may be a point in the future where I can transition my passion for Maternal, Child, Health into the women veteran community, which I would consider personally fulfilling.

This paper, however, has been very different from most of the topics I have chosen to study while in the public health program. I am grateful for the opportunity, though, as it has helped me expand my understanding of all the principles and knowledge I have learned these last three years. I have had challenges in working around a lack of data to support this topic, but I feel more accomplished in being able to work around that type of deficiency now. I have found the group aspect of the Integrative Experience invaluable, as well. It can be challenging to collaborate with others, especially in writing, however I feel that each of us brought a strength, perspective and connections to this project that have been invaluable. In the beginning it was difficult to try to understand how this paper would ultimately contribute to the work done by Dr. Soto-Mas on organic farming in central New Mexico, but I see this as a real-world application of the skills I've developed in the public health program. Not every project I encounter will be a perfect case-study, with a full data set. I have enjoyed the challenge, and look forward to continuing my learning as I venture out as a public health practitioner.

REFERENCES

Arcury, T. A., Rodriguez, G., Kearney, G. D., Arcury, J. T., & Quandt, S. A. (2014). Safety and Injury Characteristics of Youth Farmworkers in North Carolina: A Pilot Study. *Journal of Agromedicine*, *19*(4), 354-363.

Choi, S.-W., Peek-Asa, C., Sprince, N. L., Rautiainen, R. H., Donham, K. J., Flamme, G. A., . . . Zwerling, C. (2005, October). Hearing Loss as a Risk Factor for Agricultural Injuries. *American Journal of Industrial Medicine*, *48*(4), 293-301.

Compost Components. (2015). Retrieved from organicsoiltechnology.com: http://organicsoiltechnology.com/compost-components.html

Coury, H. G., Kumar, S., & Jones, E. (1999). Farm Related Injuries and Fatalities in Alberta. *International Journal of Industrial Ergonomics*, *23*(5), 539-547.

Edwards, C. (1990). *Sustainable Agricultural Systems.* Ankeny, IA: Soil and Water Conservation Society.

Geier, B. (2007). IFOAM and the History of the International Organic Movement. In W. Lockeretz (Ed.), *Organic Farming: An International History*. Cambridge, MA: CABI.

Hanson, J., Dismukes, R., Chambers, W., Greene, C., & Kremen, A. (2004). Risk and Risk Management in Organic Agriculture: Views of Organic Farmers. *Renewable Agriculture and Food Systems*, *19*(4), 218-227.

Heckman, J. (2006). A History of Organic Farming: Transistions from Sir Albert Howard's War in the Soil to USDA National Organic Program. *Renewable Agriculture and Food Systems*, *3*(21), 143-150.

Howard, A. (2010). *An Agricultural Testament.* New York: Oxford University Press.

Kenuncorked. (2008). *History of Organic Farming and Agriculture - 1840 to Present*. Retrieved from www.kenuncorked.com: http://kenuncorked.com/organic_history.html

Kuepper, G. (2010). A Brief Overview of the History and Philosophy of Organic Agriculture. Poteau, OK: Kerr Center for Sustainable Agriculture.

Laukkanen, M., & Nauges, C. (2011, August 1). Environmental and Production Cost Impacts of No-Till in Finland: Estimates from Observed behavior. *Land Economics*, *87*(3), 508-527.

Lockeretz, W. (2007). What Explains the Rise of Organic Farming. In W. Lockeretz (Ed.), *Organc Farming: An International History.* Cambridge, MA: CABI North America.

Lotter, D. (2003). Organic Agriculture. *Journal of Sustainable Agriculture*, *21*(4), 59-128.

Madden, T. J., Ellen, P. S., & Ajzen, I. (1992). A Comparison of the Theory of planned Behavior and the Theory of Reasoned Action. *Personality and Social Psychology Bulletin*, *18*(1), 3-9.

McCoy, C. A., Carruth, A. k., & Reed, D. B. (2002). Women in Agriculture: Risks for Occupational Injury within the Context of Gendered Role. *Journal of Agricultural Safety and Health*, *8*(1), 37-50.

MMWR. (2001). *Updated Guidelines for Evaluating Public Health Surveillance Systems.* CDC. Retrieved from http://www.cdc.gov/mmwr/preview/mmwrhtml/rr5013a1.htm

Mobed, K., Gold, E. B., & Schenker, M. B. (1992). Occupational Health Problems Among Migrant and Seasonal Farm Workers. *Western Journal of Medicine, 157*(3), 367.

Myers, J. (1997). *Occupational Traumatic Injury Surveillance of Farmers.* Retrieved from National Academies NIOSH Program Review : Agriculture, Forestry, and Fishing, Project Reports: http://www.cdc.gov/niosh/nas/agforfish/pdfs/app3.2-01.pdf

National Center for Farmworker Health, Inc. (2016, January). *Demographics.* Retrieved from Farmworker Health Factsheet: http://www.ncfh.org/uploads/3/8/6/8/38685499/naws_ncfh_factsheet_demographics_final_revised.pdf

Organic Farming Research Foundation. (n.d.). *2012 Farm Bill and Organic Agriculture.* Retrieved from www.orfr.org: http://ofrf.org/sites/ofrf.org/files/docs/pdf/facts-farmbill.pdf

Paull, J. (2011). The Lost History of Organic Farming in Australia. *Journal of Organic Systems, 3*(2), 2-17.

Rasmussen, B. (2016). Coordinator, Regional Food Policy Council . (A. Reyna, Interviewer)

Rigby, D., & Caceres, D. (2001). Organic Farming and the Sustainability of Agricultural Systems. *Agricultural Systems, 68*(1), 21-40.

SARE. (2012). *History of Organic Farming in the U.S.* Retrieved from www.sare.org: http://www.sare.org/Learning-Center/Bulletins/Transistioning-to-Organic-Production/Text-Version/History-of-Organic-Farming-in-the-United-States

Sligh, M., & Cierpka, T. (2007). Organic Values. In W. Lockeretz (Ed.), *Organic Farming: An International Holidy.* Cambridge, MA: CABI North America.

Soto Mas, F., Rohrer, R. E., Viteri, E. T., & Cacari-Stone, L. (Forthcoming). The Central New Mexico Organic Farming Study.

The National Institute for Occupational Safety and Health . (2014). *NIOSH FACE Reports: Agriculture*. Retrieved from Fatality Assessment and Control Evaluation (FACE) Program: http://wwwn.cdc.gov/NIOSH-FACE/Default.cshtml?state=ALL&Incident_Year=ALL&Category2=0001&Submit=Submit

The National Institute for Occupational Safety and Health. (2014, June 25). *Occupational Injury Surveillance of Prdouction Agriculture Survey*. Retrieved from Agricultural Safety: http://www.cdc.gov/niosh/topics/aginjury/oispa/injtables.html

The National Institute for Occupational Safety and Health. (2014). *State FACE Reports: Agriculture*. Retrieved from Fatality Assessment and Control Evaluation (FACE) Program: http://wwwn.cdc.gov/NIOSH-FACE/Default.cshtml?Category=0001&Category2=ALL&Submit=Submit

The National Institute for Occupational Safety and Health. (2015, September 17). *Mission, History, and Objectives*. Retrieved from Fatality Assessment and Control Evaluation (FACE) Program: http://www.cdc.gov/niosh/face/brochure.html

U.S. Bureau of Labor Statistics. (2015). *Handbook of Methods, Chapter 9. Occupational Safety and Health Statistics.* Retrieved from United States Bureau of Labor Statistics: http://www.bls.gov/opub/hom/pdf/homch9.pdf

U.S. Bureau of Labor Statistics. (2015). *TABLE 1. Incidence rates1 of nonfatal occupational injuries and illnesses by industry and case types, 2014.* United States Department of Labor. Retrieved from http://stats.bls.gov/iif/oshwc/osh/os/ostb4343.pdf

U.S. Bureau of Labor Statistics. (2015). *Table 6. Incidence Rates of Nonfatal Occupational Injuries and Illnesses by Industry and Case Types, New Mexico, 2014.* U.S. Department of Labor. Retrieved from http://stats.bls.gov/iif/oshwc/osh/os/pr146nm.pdf

U.S. Bureau of Labor Statistics. (2015). *TABLE A-1. Fatal occupational injuries by industry and event or exposure, all United States, 2014.* U.S. Department of Labor. Retrieved from http://www.bls.gov/iif/oshwc/cfoi/cftb0286.pdf

U.S. Bureau of Labor Statistics. (2015). *TABLE R4. Number of nonfatal occupational injuries and illnesses involving days away from work1 by industry and selected events or exposures leading to.* Retrieved from http://stats.bls.gov/iif/oshwc/osh/case/ostb4370.pdf

United States Department of Agriculture. (2015, September). Introduction to Organic Practices. Retrieved from https://www.ams.usda.gov/sites/default/files/media/Organic%20Practices%20Factsheet.pdf

United States Department of Agriculture. (2016, March 3). USDA Organic Regulations. *Regulations of the Department of Agriculture*. United States of America: Office of the Federal Register.

United States Department of Labor. (2001, January 19). Occupational Injury and Illness Recording and Reporting Requirements. *Federal Register 66:5916-6135*.

University of Wisconsin-Madison. (2007). *About the Project*. Retrieved from Healthy Farmers, Healthy Profits Project: http://bse.wisc.edu/HFHP/backgroundpage.htm

USDA National Agricultural Statistics Service. (2014). 2014 Organic Survey - Certified and Exempt Organic Farm Data.

USDA National Agriculture Statistics Service. (2012). Table 54. Organic Agriculture: 2012. *Census of Agriculture*.

Von Essen, S. G., & McCurdy, S. A. (1998). Health and Safety Risks in Production Agriculture. *Western Journal of Medicine, 169*(4), 214.