Spring 2014

Certified safe farm injuries as they pertain to chronic disease

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CERTIFIED SAFE FARM INJURIES AS THEY PERTAIN TO

CHRONIC DISEASE

by

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A thesis submitted in partial fulfillment
of the requirements for the Master of
Science degree in Occupational and Environmental Health (Agricultural Safety and Health)
in the Graduate College of
The University of Iowa

May 2014

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Graduate College
The University of Iowa
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CERTIFICATE OF APPROVAL

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MASTER'S THESIS

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This is to certify that the Master's thesis of

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ACKNOWLEDGMENTS

I'm grateful for the support of my committee. Without Diane's guidance, and (occasional) prodding, Kelley's vision with Certified Safe Farm and Bill's ear and faith, this project would never have been completed.

Others who helped along the way (and probably never thought I'd finish!) include my family (especially my very amazing husband) as well as most of my coworkers and friends.

I am thankful to NIOSH for ensuring my ability to not only to pay for school, but also to focus on it, as well as everything their support entails within OEH.

I am most thankful to the two people who encouraged me to see this through, even when I temporarily lost that vision, without Kelley Donham and Leah Wentworth, well, I think that's best left unanswered.

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INTRODUCTION

As chronic health issues become more common, it is important to understand their impact on occupational injury. There are many risk factors for workers' injuries and the health of the worker has been implicated as one of those factors. Chronic diseases, such as heart disease, are associated with high fatality rates. Little is known, however, whether agricultural workers' injuries and illnesses rates increase in association to chronic diseases such as obesity, cardiovascular disease, hypertension and high cholesterol levels.

Agricultural Injury Rates and Fatalities

Agricultural workers have higher rates of occupational fatalities, injuries and illnesses than other industries. Every day, about 243 agricultural workers in the United States (U.S.) suffer a lost-time injury, with 5% of these injuries resulting in a permanent impairment (US Department of Labor 2013). The injury rate is more than 20% higher for agricultural workers than that for all workers at 4.8 injuries per 100 workers (the injury rate for all workers is 3.8 per 100 workers) (US Department of Labor 2013). In 2010 the fatality rate for agriculture was greater than 24 per 100,000 workers (CDC 2012, Bureau of Labor Statistics 2012), whereas the fatality rate of all industries was 3.5 per 100,000 workers (US Dept of Labor 2013). The rate of agriculture fatalities is much higher than mining, the second most dangerous industry with a fatality rate of 15.8 per 100,000. The primary cause of death annually is work with machinery – specifically tractor roll-overs. More than 90 people a year lose their lives in tractor roll-overs and 9,479 deaths from roll-overs were reported between 1992 and 2009 (CDC 2012).

Chronic Disease

There are many risk factors that contribute to occupational injuries. Recently, the health status of workers has been indicated as a contributor to injury and illness, specifically, cardiovascular disease and its risk factors have been implicated in some of those injuries and illnesses. A potential factor contributing to workplace injuries in all industries is obesity and related health issues and several studies have linked obesity to many subsequent health problems affecting workers (Pollack 2007, Kouvonen 2013, Schulte 2007). According to the Centers for Disease Control (CDC), more than one third of all American adults are obese (CDC 2012), and the American Heart Association (AHA) reported that 154.7 million men and women were classified as overweight or obese by having a Body Mass Index (BMI) over 25 kg/m^2 in 2013. The recommended threshold for body mass is less than 25kg/m^2. Of the 154.7 million people who are overweight, 78.4 million are considered to be obese, having a BMI over 30 kg/m^2. Since 1994, the number of obese individuals has increased for men by 14%, and women by 10%, regardless of education or economic level (Go et al. 2012).

Obesity has been indicated as a risk factor for occupational injury for various reasons, including: loss of mobility, inappropriate fit of Personal Protective Equipment (PPE), and poor ergonomics in regard to work spaces that are not designed for larger employees (Pollack 2007, Schulte 2007). Obese workers are significantly more likely to indicate they have physical limitations in the amount or type of work they are capable of because of physical, mental or emotional problems than those classified as overweight (Hertz 2004). Additionally, obese and overweight workers have been shown to be at higher risk of sprains, strains, dislocations, concussions and internal injuries, bone fractures and may be more susceptible to vibration-induced injuries (Kouvonen 2013, Janssen 2011, Schulte 2007).

Cardiovascular disease (CVD) impacts a large percentage of adults. Excess weight, a CVD risk factor, and other risk factors are common; CVD affected 35% of men and women over 20 years of age in 2010 (Go et al. 2014). Risk factors for CVD are hypertension, high cholesterol levels and diabetes mellitus. Cardiovascular disease has been shown to slightly increase the risk of occupational injury in the manufacturing environment (Kubo 2013). Furthermore, the risk of hypertension is elevated among "blue collar" or hourly workers (Clougherty 2009). High cholesterol levels are defined as total cholesterol ≥240 mg/dL and/or Low Density Lipoprotein (LDL) levels ≥130 mg/dL (Go et al. 2012). Nationwide, 14% of adults exhibit high cholesterol levels, 33% of adults have hypertension and 8% have diabetes mellitus (Go et al. 2012). Hypertension is broken into stages – Prehypertension, Stage 1 and Stage 2. Prehypertensive individuals have a systolic blood pressure of 121-139 mmHg and/or diastolic blood pressure levels of 81-89 mmHg. Stage 1 hypertensive individuals have a systolic blood pressure of 140-159 mmHg and/or diastolic pressure of 90-99 mmHg. Stage 2 hypertensive individuals have systolic pressures over 160 mmHg and/or diastolic levels over 100 mmHg (National Institutes of Health 2003) (Table 1).

High cholesterol and blood pressure are associated with adverse health effects. However, when they are combined, they are some of the components of metabolic syndrome. Metabolic syndrome is the combination of at least three of the following risk factors, abdominal adiposity, increased triglycerides, increased blood pressure, increased blood glucose, and insulin resistance (American Heart Association 2012). Metabolic syndrome increases the risk for CVD and related illnesses, such as diabetes and stroke, and is estimated to affect approximately 34% of all adults in the U.S. (Davila 2010). According to a 2010 study using National Health and Nutrition Examination Survey (NHANES) data from working adults, metabolic syndrome affects "farm operators, managers and supervisors" second only to "other transportation and material occupations" at 28% and 33%, respectively, regardless of whether adjustment for age is included. Overall, 21% of U.S. workers (age-adjusted) meet the criteria for metabolic syndrome, with obese and older worker groups having the highest prevalence at 43% and 32%, respectively (Davila 2010).

Metabolic syndrome appears to disproportionately affect the rural population. In the U.S., 40% of a cohort of rural NHANES residents had metabolic syndrome, compared to 33% of a cohort of urban NHANES residents (Trivedi 2013). Additionally, data from Australia have indicated a higher prevalence of metabolic syndrome in agricultural populations compared to urban populations. The Australian study cohort had an increased incidence of abdominal obesity, hypertension and diabetes than the Australian national averages (Brumby 2012). Furthermore, psychological distress was an additive risk factor for metabolic syndrome in the Australian study.

The use of medicine to treat and control CVD risk factors is common in the U.S. Medication to control cholesterol has increased exponentially in the past 20 years with the introduction of statins in 1987. Statins are drugs used to prevent the body from making cholesterol, and also to lower cholesterol. Their use is thought to lower the risk of heart disease (Mayo Clinic 2012). During 1988 to 1994, 2.4% of the population, aged 45 and over, reported statin use, with 2.3% of males reporting statin use in the previous 30 days. Statin use increased during 2005-2008 to 25.1%, with 26.9% of men reporting statin use in the past 30 days (National Center for Health Statistics 2013). The use of medication to control hypertension is also common. In 2009-2010, 76% of hypertensive individuals reported taking medicine for blood pressure control (Yoon 2012). Similarly, 81% of individuals with diabetes indicated they were treating their disease with medication, such as pills, insulin or both (CDC 2012) (Table 2).

Occupational Risk Factors

Certain farm-related activities have also been shown to be risk factors for both occupational and non-occupational injuries in agricultural and rural settings (Taattola

2012, Sprince 2002, Park 2002, Van den Broucke and Colemont 2011, Merchant 2002). In an agricultural setting these include handling livestock, working with machinery, working with pesticides or working with tools. Also included as risk factors for injury are perceived stress level and hours worked on the farm (Van den Broucke and Colemont 2011, Taattola 2012, Sprince 2002). Heavy workload, long work weeks, as well as hurrying to get work done, are frequently identified as major risk factors behind agriculturally-related injuries (Taattola 2012, Sprince 2002, Rautiainen 2004).

Obesity, hypertension and high cholesterol levels are increasing in prevalence and are linked to injuries, which have been shown to occur more often in rural areas. Interventions are needed to address these health and safety risks, with those that address both safety and health promotion, such as the National Institute for Occupational Safety and Health (NIOSH) Total Worker Health (TWH) intiative (NIOSH 2013). The initiative, introduced in June 2011, integrates health promotion with occupational health protection, to reduce work factors that contribute to injury on the job, and also to reduce those health factors outside of the job that can put workers at risk (NIOSH 2013). Many health programs initiated in industry are specific to the job site, but with 98% of U.S. farms considered to be family farms (Hoppe 2007), many workers do not leave the jobsite at the end of the day.

Safety and Health Interventions for Agriculture

There have been several programs to integrate health protection and health promotion in agricultural communities. Australia, Finland and the United States are just some examples of programs that combine safety education with health promotion. Sustainable Farm Families is an Australian program meant to encourage health and well-being among farmers and their families. The program, focused on BMI, blood pressure, cholesterol levels and fasting glucose levels, used workshops to promote healthy behaviors and demonstrate the downfall of unhealthy ones. At the end of the two year study, all of the variables of interest (BMI, blood pressure, cholesterol levels and glucose levels) were found to have dropped significantly (Blackburn 2009). The Finnish program, Farmers Health and Farmers Occupational Health Services (FOHS), incorporated walk-through surveys of dairy farms for safety and ergonomic hazards. The study utilized occupational health practitioners for their comparison group and trained farmers for an 'Empowered Farmer' intervention group. Farms surveyed by both groups incorporated improvements on their farm, but the farms surveyed by the empowered group incorporated more improvements (Heikkonen 2003).

Certified Safe Farm is the most widely evaluated intervention focused on total worker health. It is a multi-faceted program that proposes to improve the working and living conditions of agricultural workers through education and monetary incentives using an in-depth health screening, on-farm safety audits, and personal and group education events. The purpose of this comprehensive occupational health and safety program is to lower occupational injury and illness rates among its participants.

Certified Safe Farm has had two distinct study cohorts for evaluation of the intervention since its inception in 1996. The 1997-2003 cohort was recruited in a 9 county region in northwest Iowa. The 2004-2008 cohort was distributed throughout Iowa in the 38 counties that are contiguous to the 10 AgriSafe Clinics in the state. The AgriSafe Clinics are part of a network of health clinics which provide specialized preventative occupational health screening as well as checkups for farmers and agricultural workers. The health providers are certified to provide agricultural health screenings through attendance at a 40 hour Agricultural Medicine course taught at the University of Iowa (Kline 2007). The primary focus of the AgriSafe Network is agricultural and rural health and there are clinics in 19 states in the U.S. as well as 2 locations in Canada and 1 in Australia (Agrisafe 2014). Certified Safe Farm (CSF) researchers partnered with AgriSafe to deliver the clinical and occupational health components of the CSF intervention in both cohorts.

Both CSF cohorts were comprised of two study groups, intervention and comparison group, and were designed as cohort studies. In both studies, the intervention group received components of the CSF intervention and outcome measures were then compared to the comparison group, which received none of the intervention components.

Certified Safe Farm Results

Previous publications reporting outcomes of the CSF interventions have examined a range of agricultural health issues, including hearing loss as related to injury, respiratory issues, personal protective equipment (PPE) use, overall injuries, injury costs, implementation of the farm assessment, and a farmer response of the program (Choi 2005, Donham, et al. 2007, Donham et al. 2011, Donham et al. 2012, Kline et al. 2007, Rautiainen et al. 2004, Rautiainen, et al. 2010). Results from multiple reports have shown improvements in the groups receiving the interventions. The CSF intervention has been associated with increased use of PPE, fewer respiratory issues and fewer severe injuries. Only one report, which examined injury rates between the intervention and comparison groups, revealed similar overall rates of injury. However, they also reported a decreased rate of serious injuries in the intervention group (Rautiainen et al. 2004).

Most of the previous CSF reports have examined the health or health-related outcomes of the participants. Several previous CSF reports have focused on PPE use. For example, irregular use of hearing protection and subsequent hearing loss were both found to be significantly related to agricultural injuries in a study of the 1997-2003 group (Choi 2005). The most recent CSF report of the 2004-2008 intervention group examined PPE use and determined that respirator use increased 11% and hearing protection use increased 23% relative to the comparison group over a 5 year period. Some interesting interactions were found between PPE use and health behaviors. For example, wearing a respirator increased the likelihood that the participant also used hearing protection; those engaging in risky health behaviors, such as smoking, were less likely to use hearing protection than nonsmokers; and the number of people using hearing protection was statistically significant when compared to those individuals with a high self-reported health status (Donham et al. 2013). These findings are consistent with a report of the 1997-2003 cohort that found an increased use of PPE in the intervention group, followed by a subsequent drop in respiratory symptoms for Organic Dust Toxic Syndrome (ODTS), a common respiratory ailment among agricultural workers (Donham et al. 2011). In general, the majority of CSF reports were associated with increased health protection and health promotion behaviors and health outcomes.

As previously stated, Rautiainen et al. (2004) did not find a difference in overall injury rates in the 1997-2003 cohort, but the researchers did note fewer severe injuries in the intervention group. This lack of difference in overall injury rates was attributed to several factors, primarily that the participants could choose the components of the intervention in which to participate. Costs associated with injuries were shown to be significantly different between the groups, however. Insurance claims from the 1997-2003 intervention group were 45% less than the comparison group in occupational injury and illness costs and 27% less overall when including out of pocket costs. That number, however, varies according to injury and illness type (Donham, et al. 2007).

Two CSF studies examined the overall design of the program; one study looked at the implementation of the farm safety audit (Rautiainen, et al. 2010) and another sought to quantify the impact of the program (Kline 2007). The farm safety audit component of CSF was designed as a checklist of the working conditions of a farm by a trained reviewer, with the goal of helping the operators identify potentially unsafe conditions. Eighty-two percent of farms in the intervention passed the initial farm audit which required a passing score of 85. Following the audit, 95% of farms involved in the study implemented at least one improvement on the farm (such as adding slow moving vehicle signs and fire extinguishers). A farm that did not pass the initial audit could implement changes and then get a revised score if the identified hazards were removed or mitigated

(Rautiainen, et al. 2010). The goal of the checklist was to identify areas needing safety improvements on the farms. Overall, in the 1997 cohort of 155 farms following the initial audit, 1,292 self-reported improvements were implemented over the 5-year study period, accounting for about $70,000 in total improvements across all farms, or $650 per farm involved in the study. Farm audits were repeated annually during the 5-year period (Rautiainen et al. 2010).

Focus groups comprised of individuals from the intervention group held in 2002 and 2006 helped qualify and understand the role of CSF in farmers' lives. Participants were asked to rate the components of the intervention: farm safety audits & occupational health screening, impact on work and health protection and health promotion behaviors and recommendations for implementation for the future. Health screenings were rated as the most valuable aspect of the program according to group attendees and many participants indicated they would utilize AgriSafe clinics after the studies because the screening services are tailored towards farmers. The farm safety audits were also well received and farmers reported liking the level of detail covered in the audit. In regard to the program's impact, many participants reported they used their PPE more often than they had prior to the intervention (Kline et al. 2007).

Certified Safe Farm has demonstrated the ability to improve safety behaviors and was positively received by farmers. The integration of health protection and promotion in efforts to reduce occupational injury and illness in agriculture is vital in the face of high national numbers of obese, hypertensive and high cholesterol individuals and the impact these health outcomes have on occupational injuries and illnesses.

Knowledge Gap

The integration of safety and health promotion to reduce occupational injuries is important in all industries. With limited data on health characteristics of agricultural workers, the relevancy of health risk factors, such as diabetes, obesity and cardiovascular disease in an agricultural setting is not well defined. Many studies have examined health as it pertains to specific occupational risk factors, such as pesticide use, but there is little information on agricultural workers' occupational risk factors for cardiovascular disease, beyond establishing that metabolic syndrome disprorportionately affects rural populations (Trivedi 2013, Brumby 2012). A potentially comparable cohort is from the Keokuk County Rural Health Study (KCRHS), a longitudinal study following farm and non-farm residents in a rural Iowa county. Although health outcomes were collected from this cohort, there has been no examination of the relationship between obesity and injury (Merchant 2002). Similarly, the Agricultural Health Study, another longitudinal study has examined the role of pesticide exposure to multiple health outcomes such as injuries and cancer, but has not studied the cohort's overall wellness or its relationship to injuries (Park 2002).

This study was conducted to examine BMI, blood pressure, cholesterol levels and occupational risk factors as related to injury in the CSF intervention group. It was also conducted to examine whether the interventions resulted in significant health improvements between the first and second clinical health visits. The aims of this project and the specific hypotheses that will be tested are as follows:

I. Are health risk factors (high blood pressure, high cholesterol and high BMI) noted with increased injuries?
    a. Working hypothesis: more injuries occurred among those with high health risk factors.

II. Do individuals with occupational risk factors, e.g. PPE use, pesticide use, etc. have higher injury rates?
    a. Working hypothesis: more injuries occurred among those with occupational risk factors.

III. Is there an improvement in the two years between the first and second clinical health visits for the intervention group?

a. Working hypothesis: there will be a health improvement for the variables of interest (weight, BMI, blood pressure levels, apical levels and cholesterol levels) that will occur between the first and second clinical health visits as a result of the interventions.

CHAPTER 2

ORIGINAL RESEARCH

Agricultural workers have long had higher rates of occupational illness, injuries and fatalities than any other industry. The injury rate for agricultural workers is 20% higher (4.8 injuries per 100 workers) than for workers in all other industries (3.8 injuries per 100 workers; US Department of Labor 2013). Furthermore, the fatality rate for agriculture (24 per 100,000 workers) is much higher than other industries (3.5 per 100,000 workers; CDC 2012, Bureau of Labor Statistics 2012). Each day, approximately 243 agricultural workers suffer a lost time injury and more than 90 people a year lose their lives in tractor roll-overs (US Department of Labor 2013, CDC 2012).

A potential factor contributing to occupational injuries across all industries is obesity and related health issues. More than one third of all adult Americans are obese (CDC 2012) and the American Heart Association reports that 154.7 million men and women were classified as overweight or obese by having a Body Mass Index (BMI) over 25 kg/m^2 in 2013. The recommend threshold for BMI is less than 25kg/m^2. Since 1994, the number of obese individuals has increased for men and women regardless of education or economic level (Go et al. 2012). Obesity has been linked to cardiovascular disease, hypertension and high cholesterol levels, which can affect workers (Pollack 2007, Kouvonen 2013, Schulte 2007).

Obesity is a risk factor for occupational injury in workers because of loss of mobility, inappropriate fit of Personal Protective Equipment (PPE), and poor ergonomics of workspaces that are not designed for larger workers (Pollack 2007, Schulte 2007). Obese workers are at higher risk of sprains, strains, dislocations, concussions and internal injuries, bone fractures and may be more susceptible to vibration-induced injuries (Kouvonen 2013, Janssen 2011, Schulte 2007). Obesity has been shown to slightly increase the risk of injury in the manufacturing environment (Pollack 2007). Additionally, obese workers are more likely to report limitations at work because of physical, mental or emotional problems than those who are overweight (Hertz 2004).

Excess weight is also a risk factor for cardiovascular disease (CVD) which impacts a large percentage of adults, 35% of men and women over the age of 20 (Go et al. 2014). Risk factors for CVD include high cholesterol and hypertension; cholesterol and blood pressure level thresholds are shown in Table 1. High blood pressure (hypertension), a risk factor for CVD, has been shown to be elevated among "blue collar" or hourly workers (Clougherty 2009).

High cholesterol and blood pressure are associated with adverse health effects. When combined, they are the basis of metabolic syndrome. Metabolic syndrome is the combination of at least three of the following: abdominal adiposity, increased triglycerides, increased blood pressure, increased blood glucose, and insulin resistance (American Heart Association 2012). Metabolic syndrome increases the risk for CVD and related illnesses (Davila 2010) and, when adjusted for age, 21% of US workers meet the criteria for metabolic syndrome. Older and obese workers have the highest prevalence of metabolic syndrome at 43% and 32% respectively (Davila 2010). Metabolic syndrome disproportionately affects the rural population. In the US, 40% of a cohort of rural NHANES residents had metabolic syndrome, compared to 33% of urban residents (Trivedi 2013) and similar results have been shown in Australia (Brumby 2012). An additive risk factor for metabolic syndrome in the Australian study was psychological distress.

Medication usage for treating and controlling CVD risk factors is common in the U.S. Statins, used to prevent the body from making cholesterol and to lower cholesterol, are used by 26.9% of men aged 45 and over (National Center for Health Statistics 2013). Medication to control hypertension and diabetes is also common with 76% of hypertensive individuals reporting their use in 2009-2010 (Yoon 2012) and 81% of adults with diabetes indicating they were using medicine to treat their disease (CDC 2012) (Table 2).

Risk factors for occupational injury in agriculture include handling livestock, working with machinery, working with pesticides, working with tools, perceived stress level, and hours worked on the farm (Van den Broucke and Colemont 2011, Taattola 2012, Sprince 2002). Heavy workload, long workweeks, and hurrying to complete work are frequently identified as major risk factors behind agricultural injuries (Taattola 2012, Sprince 2002, and Rautiainen 2004).

Interventions are needed to address health and safety risk factors to subsequently reduce resultant injuries. Interventions that address both safety and health, such as the National Institute for Occupational Safety and Health's (NIOSH) Total Worker Health (TWH) initiative, combine health promotion with occupational health protection to reduce factors that contribute to injury on the job, but also to reduce health factors outside of the job that put workers at risk for injury (NIOSH 2013). One approach to integrating health protection and promotion in agricultural communities is the program called Certified Safe Farm (CSF). This program proposes to improve the working and living conditions of agricultural workers by using an in-depth health screening, on-farm safety audits, and personal and group education events. The purpose of the program is to reduce occupational injury and illness incidents.

Certified Safe Farm was established in 1996 and has been evaluated in farmers in Iowa. The CSF Intervention has been associated with an increase in PPE use, reduction of injuries, hearing loss as related to injury, respiratory issues, personal protective equipment (PPE) use, overall injuries, injury costs, implementation of the farm assessment, and a farmer response of the program (Choi 2005, Donham, et al. 2007, Donham et al. 2011, Donham et al. 2012, Kline et al. 2007, Rautiainen et al. 2004, Rautiainen, et al. 2010). Results from multiple reports have shown improvements in the groups receiving the interventions (Rautiainen et al. 2004, Rautiainen, et al. 2010, Donham, et al. 2007). The CSF intervention has been associated with increased use of PPE, fewer respiratory issues and fewer severe injuries. Only one report, which examined injury rates between the intervention and comparison groups revealed similar overall rates of injury, however, they also reported a decreased rate of serious injuries in the intervention group (Rautiainen et al. 2004). Additionally, the Certified Safe Farm program had positive feedback from farmers (Kline et al. 2007). Utilizing a TWH approach to integrating health protection and promotion in the effort to reduce injuries in agriculture is vital given the national problems of obesity, hypertension and high cholesterol in the workforce.

Research Questions

The integration of safety and health promotion to reduce occupational injuries is important in all industries. With limited data on health characteristics of agricultural workers, the relevancy of chronic disease in an agricultural setting is not well defined. There is little information on agricultural workers' occupational risk factors for cardiovascular disease, beyond establishing that metabolic syndrome disprorportionately affects rural populations (Trivedi 2013, Brumby 2012).

The first aim of this study was to conduct a secondary data analysis to examine BMI, blood pressure, and cholesterol levels as they relate to injury in the CSF intervention group. The corresponding hypothesis was that individuals with high health risk factors (high BMI, high blood pressure and high cholesterol levels) will have increased injuries compared to those with normal range levels. A second aim of this project was to examine occupational risk factors as they relate to injury in the intervention and comparison groups. The hypothesis for this aim was that occupational risk factors (e.g. PPE use, pesticide use, etc.), would be associated with increased self-reports of injuries. The third aim was to determine if health improvements were noted for the intervention group between the first and second clinical health visits. The third hypothesis was that there would be an improvement in the health characteristics (weight, BMI, blood pressure levels, apical levels and cholesterol levels) of the intervention group between the first and second clinical health visits.

Data Set

This is an analysis of data previously collected as part of a cohort study of two groups of Iowa farmers (Donham et al. 2011). Data were collected from 2004 through 2008. The first group, the intervention group, lived in close proximity to 10 AgriSafe Clinics and within the contiguous counties that are home to the clinics, resulting in participants from 38 Iowa counties. The AgriSafe Clinics are part of a network of health clinics which provide specialized preventative occupational health screening and checkups for farmers and agricultural workers. Health providers are certified to provide agricultural health screenings through attendance at an Agricultural Medicine course taught at the University of Iowa (Kline 2007). The primary focus of the AgriSafe Network is agricultural and rural health (Agrisafe 2014).

Two methods were used to recruit these participants. First, mailed invitations were sent by the Farm Bureau to farmers that had been identified as members of a group plan with Blue Cross Blue Shield. Second, clinicians at the AgriSafe clinics recruited participants who were eligible for the study. Eligibility for study participation included meeting U.S. Department of Agriculture farm criteria (at least $1000 in sales of agricultural products per year), being a principal farm operator or spouse, living in targeted counties and farming at least 20 hours/week on average. The CSF intervention had four primary components, which included a clinical and occupational health screening, personalized and group education meetings, a farm safety and health exposure audit and a monetary incentive to encourage safe and healthy behaviors. The interventions were followed by a survey sent to all participants to collect a wide range of information, including PPE use, self-reported injuries and number of acres farmed.

The clinical health screening exam and the occupational health screenings were conducted during the same visit at one of the AgriSafe Clinics. Participants had a basic clinical health screening in 2005 conducted by an agricultural health nurse. Information collected included height, weight, blood pressure, vision, hearing, cholesterol levels, pulmonary function, skin screening, musculoskeletal issues and PPE use. No information about either a diagnosis of diabetes or glucose levels was collected from the participants. In addition to the clinical health screening, information was collected for an occupational health screening that collected data about the participants' farming practices, including types of livestock raised, crops farmed, chemicals applied and medications taken. The AgriSafe nurse worked with individual participants to set personal health goals, such as weight loss, and provided education to the farmer addressing those topics. A subset of the group was asked to come for a second clinical health visit in 2007 by the clinician if follow-up was deemed necessary for markers such as high blood pressure or weight management. Clinical referrals to a physician were given as necessary. The intervention group received follow-up phone calls about their health as well as opportunities to attend education sessions held at lunchtime; topics such as respirator and PPE use were discussed at these events. Farm safety audits were conducted at participants' farms. A trained auditor reviewed the farm for safety, discussed safety concerns and made suggestions for improvements. Scores were assigned to each farm based on the audits with 100 as the highest possible score. An overall score of 85 was required as a passing grade. Farms that failed were allowed to make improvements to subsequently raise their score and pass a follow-up audit. Monetary incentives were given after completion of the health components and a passing farm safety score. The intervention group received $200 after they completed a first clinical health exam and passed the farm safety audit. This study focused on data from the clinical exam and the survey. Data from the occupational health exam and farm safety audit components were not assessed for this study.

The comparison group was recruited by the National Agricultural Statistics Service (NASS) from the same 10 AgriSafe Clinic locations and all contiguous counties to obtain a cohort that was matched to the intervention group on age, sex, acres farmed and type of livestock production. The same criteria for inclusion were used: 1) living in the targeted area, 2) age 18 and above, and 3) current farmer (USDA definition of having at least $1,000 in annual sales). This comparison group received a single survey that was conducted by NASS, and no other components of the CSF intervention. The intervention and comparison groups completed the same surveys, but the comparison group did not receive any of the interventions (clinical health screenings, farm audits or education) (Donham et al. 2012).

Surveys were mailed out in 2007 to the comparison group over several months, with the goal of obtaining 450 responses. The survey was also sent to everyone in the intervention group in 2007 following implementation of the interventions (Donham et al. 2012). Completed by both groups, the survey included information on demographics such as age, number of acres farmed and the type of livestock they raised. Respondents were also asked about their health and safety practices in regards to injury (yes/no), illness (e.g., flu, ODTS symptoms, etc.), use of PPE (e.g., ear plugs, face masks, etc.), costs associated with their injuries or illnesses, and general questions regarding their overall health. The comparison group received $50 after completing and submitting their survey.

The number of unanswered surveys sent to potential comparison group participants is unknown. It is also unknown how many post-clinical health visit calls were made to the intervention group, how many people attended education events, and the specific criteria for inviting individuals back for follow-up clinical health visits.

Data Analysis

To test our hypotheses, the data were analyzed using the FREQ procedure in SAS to compute chi square tests to determine if associations existed between the health risk factors and injuries in the past 12 months. Chi square tests were calculated to look at relationships between injury and the variables thought to be predictors of those injuries.

The American Heart Association's definition of metabolic syndrome includes information on the following risk factors: abdominal adiposity, cholesterol, blood pressure and glucose. Without all the information required to make a specific metabolic syndrome diagnosis, the information collected at the clinical health visit – cholesterol, BMI and blood pressure – was used as a surrogate for metabolic syndrome (Table 4).

Variables analyzed for both the intervention and the comparison groups were self-reported health and stress status, number of acres farmed, pesticide use, welding status and use of various PPE. Pesticide use and welding status were included as occupational risk factors because of the potential for injury or illness. Use of PPE for pesticide application, welding, power tool use, and ear and sun protection were also included as occupational risk factors (Tables 5 & 6, 7, 8).

The self-reported health status question asked respondents to rate their health as compared to others their age; response choices for health status included "poor", "fair", "good", "very good" and "excellent." For the self-reported stress status question, respondents were asked to rate their overall stress level during the past year; response choices for stress status were "very low, low, medium, high and very high." As was done with a previous CSF report (Donham et al. 2013) and to make the responses dichotomous, health status responses were divided in to two groups. The first included participants who responded "poor, fair and good" and the second group responded "very good and excellent." A similar process was used for the stress status variable, with the first group including participants who indicated a stress status of "high or very high" and the second group responded "very low, low and medium".

As with the health and stress status variables, PPE use was dichotomized as per a previous CSF report (Donham et al. 2013). Response options for PPE use were "always, sometimes and never." In this case, the variables were analyzed two ways. In the first case, the first group was always/sometimes and the second was never. In the second case, the first group was always and the second was sometimes/never.

To determine whether there were health improvements in the intervention group between the first and second clinical health visits, paired t-tests were calculated using SAS software. The same clinical variables that were used to calculate chi square for relationships to injury were calculated with t-tests between the first and second round clinical health visits, using data strictly from individuals who made two clinical health visits. First clinical health visit variables were also used to calculate t-tests to determine whether there was a difference between those who came back for a second clinical health visit and those who did not. Ninety five percent confidence intervals were considered to be statistically significant for all calculations.

RESULTS

There were 438 participants enrolled in the intervention group, 36 were lost to follow-up in the second round (Donham 2012). Individuals who had not answered substantial sections of the survey or had not participated in the interventions targeted for this study were also excluded from the analysis. Women (n=35) were also excluded from this study for two reasons: they were found to be over-representing the per farm data and to obtain a consistent male perspective (i.e., the principal operator).

There were 411 farmers enrolled in the comparison group (Donham 2012), 33 were subsequently excluded for the purposes of this study because substantial sections of their surveys were not completed. The final cohort for this study included 301 males in the intervention group and 378 males in the comparison group (Table 3).

Of the 438 participants enrolled in the intervention, 301 completed both the survey and at least one clinical health screening. A subset of the intervention population was asked to come back for a second clinical health screening based on the need for follow-up. Of the 301 intervention individuals who completed the survey and the first clinical health screening, 118 returned for a second clinical health visit (Figure 1). The total number of people requested to make a return visit is unknown.

A substantial percentage of individuals in the intervention group were overweight or obese; 80.1% of the group had a BMI over 25% with 32.7% classified as obese (BMI greater than 30%) (Table 9). The national averages for overweight and obese men are 70.5% and 29.5%, respectively. The percentage of individuals in the intervention group with Stage 1 or Stage 2 hypertension was lower than the national average of 33.2%, at 15.9%, but those in the group classified as being pre-hypertensive was 63.1%. The percentage of individuals with high cholesterol, 44.3%, was also lower than the national average of 47.8% (Table 10).

No statistically significant associations were found between BMI, high cholesterol, high blood pressure and self-reported stress level and self-reported injury. A statistically significant association was found when combining variables for the metabolic syndrome surrogate: individuals who had high blood pressure, high cholesterol and high BMI were associated with increased injuries (odds ratio 5.5, 95% confidence interval 1.2-24.5), but the finding was based on a limited sample size (i.e., 8 people, 3 with injuries). Poor self-reported health status was significantly associated with increased risk of injury with an OR of 2.6 (95% confidence interval 1.4-4.6) for the combined intervention and comparison group. The OR for self-reported health status associated with increased injury for the intervention group was 2.5 (95% confidence interval 1.2-5.6) and the comparison group had an OR of 3.5 (95% confidence interval 1.3-9.1) for the same variable (Tables 11 & 12). To further study the self-reported health status response, the relationship between the variable was examined using chi square with the clinical health variables of interest (BMI, hypertension, and high cholesterol). There were no statistically significant results.

The association between occupational risk factors and injuries was also examined. Use of pesticides within the last 12 months, as well as any welding activity, both dichotomous variables, were not significantly associated with self-reported injuries. There was also no association between injury and use/nonuse of PPE for welding, pesticide application, power tool use, use of sunscreen, wearing a wide-brimmed hat or using hearing protection. These questions had 3 possible answers – always, sometimes and never. These variables were calculated as always/sometimes & never as well as always & sometimes/never with no significance found. The last occupational risk factor, working in and around dust, was combined to run as an ever/never group as well. A summary variable for dust exposure was created for individuals who reported working in any of the following dusty activities: grain or silo dust, dust from moving or processing livestock, dust from power washing or disinfecting, or dust from other activities in the past 12 months. No association was found between exposure to grain dust and injury. This ever/never breakdown is consistent with how the Donham study handled PPE use data in a 2012 CSF study (Donham et al. 2012). These results were consistent between both cohorts – intervention and comparison and there were no differences noted between the groups for these variables and injury (Tables 13, 14 & 15).

Health improvements were noted between the first and second round clinical health visits when analyzing the intervention group as a whole. Cholesterol levels, LDL levels and apical (pulse) values had significant improvements from the first clinical health visit to the second clinical health visit. The median values for cholesterol and LDL dropped 8 points and apical values dropped 4. Cholesterol had a p-value of <.0001, LDL was 0.0148 and apical was 0.0094. There was no change from visit 1 to 2 for weight, BMI or blood pressure.

When analyzing only the data from the first clinical health visit, the group that did not return for a second clinical health visit was significantly different statistically from the group that did return for a second clinical health visit. The group that had a single visit was older (p-value = 0.0496), weighed more (p-value = 0.0096), had a higher BMI (p-value = 0.0145) and had higher diastolic levels (p-value = 0.0020). The group that returned for a second visit had higher cholesterol levels (p-value = <.0001) and higher LDL levels (p-value = 0.0080).

When analyzing the group by age, the <35 years age group had no statistically significant health improvements. The 35-49 years age group had the most improvements of the 4 age brackets with statistically significant improvements in 3 variables – BMI (p-value < 0.01), diastolic blood pressure (p-value = 0.01) and cholesterol levels (p-value = 0.04). The 50-64 and 65+ age groups each had one significant improvement. The 50-64 years group had a statistically significant improvement in cholesterol levels (p-value < 0.01) and the 65+ years group had a statistically significant improvement in systolic blood pressure (p-value = 0.04) (Tables 16, 17, 18, 19, 20 & Figure 2).

DISCUSSION

As has been shown in other studies (Donham et al. 2013; Rautiainen et al. 2004), individuals with good, fair and poor health status are 2.6 times more likely to experience an injury. Similar results have appeared in previous studies and need to be examined more to fully understand the reason. This study did not find an association between poor self-reported health status and poor health according to the clinical health variables cholesterol, BMI and hypertension.

A relationship was not found in this study between hearing protection use and injury, which is not consistent with a 2013 Donham study on respirator and PPE use.

While the study cohort was the same, the Donham study had a larger sample size and included both males and females in the analysis (Donham et al. 2013). The current study only included males and excluded participants with incomplete responses.

Although a significant association between our surrogate for metabolic syndrome and injury was found, this finding was based on an extremely small sample size. No other significant associations between clinical risk factors (BMI, blood pressure, apical, or cholesterol) and injuries were found. To understand this relationship and test its validity, a larger population would need to be assessed.

Cholesterol, pulse and LDL levels were all significantly lowered between the first and second clinical health visits for individuals asked to come back for further monitoring, demonstrating the impact of the intervention on health. Two major possibilities exist for the change: education received at the clinical health exams may have been sufficient to change the habits or lifestyles of the individuals or, following, the first clinical health screening, individuals obtained prescriptions for cholesterol lowering drugs (statins) from their primary care physicians. Information on medication and lifestyle habits were not collected for the purposes of this study. Statistics on statin use are not available for age groups other than >45 years of age, so for this study's purposes it is assumed that this population follows the national trends. While apical values did drop significantly, the median values were still well within the normal range of 60-100 (Mayo Clinic 2012) both prior to and following the intervention. The apical values may have changed because participants were more comfortable or less anxious for the second clinical health screening. Also, they could have followed the goals provided by the occupational health nurses, which included dietary and exercise recommendations. The number of individuals asked to return for a second clinical health visit versus the number of individuals who did return is unknown. While the reasons some participants chose to not return for a second clinical health visit are unknown, it may have been as a result of lack of adherence to the intervention strategy, such as lack of progress or poor health status.

CONCLUSIONS

There were significant improvements made between clinical health visits both within the group as a whole, but also within age groups. While this study was strengthened by the overall range of data collected, there may have been more improvements made than those noted, but this cannot be determined because second round clinical data were not available for all individuals. Individuals who had a second clinical health exam did not always have full exams and the sample size changed between variables.

Since the intervention group was a population of the health insured from Farm Bureau and the comparison group was chosen based on location, farm size, type and age, it is likely the safety practices are similar to the general population of farmers in Iowa. However, the possibility that this study contained a non-representative sample of Iowa Farmers cannot be excluded and is a limitation of this study. For example, because the objective of the study was known to the participants, it is possible that only those farmers who consider their farm and practices ‘safe’ would enroll, thus biasing the groups (Rautiainen 2004, Rautiainen 2010).

Although frequently used as a biological marker and risk factor, BMI can be misrepresentative as a measure of obesity. Body mass index numbers are not necessarily comparable between age (older individuals tend to have more body fat than younger people at the same BMI) and body mass index can also be misleading when measuring individuals with lean muscle mass, such as athletes or others who regularly engage in strenuous workloads, such as farmers (CDC 2011, Prentice and Jebb 2001). As has been discussed in studies of lung capacity with farmers (Donham 2006), the development of a different set of metrics or standards for BMI and lung capacity would be advantageous for clinicians working with the agricultural community. If farmers truly have higher BMIs than the average population, BMI as a metric of overall health or as an indicator of the presence of a disease or illness can lead to inaccurate conclusions. Because the prevalence of hypertension and high cholesterol are less in the study population than the national averages, and if BMI is actually misleading as a metric and is resulting in overrepresentation of obesity, this population could possibly have better overall health than the general population. Further studies would be needed to validate this idea.

Table 1.
Hypertension and Cholesterol Thresholds for Wellness*

Hypertension	**Systolic**	**Diastolic**
Prehypertension	121-139	81-89
Stage 1	140-159	90-99
Stage 2	160+	100+
	mmHg	
Cholesterol	**CHL**	**LDL**
High Cholesterol	≥240	≥130
	mg/dL	

*Go et al 2012, National Institutes of Health 2003

Table 2.
National Medication Use Statistics*

Statins, overall population	
Men ≥45 years old	%
1988-1994	2.3
1999-2002	17.5
2005-2008	26.9
Hypertension, affected population	
Adults >18 years	%
2009-2010	76.4
Diabetes, affected population	
Adults >18 years	%
1997	77.3
2005	78.8
2011	81.0

*Mayo Clinic 2012, National Center for Health Statistics 2007

Table 3. Participation in Interventions

Study Groups	n	1st Clinic	2nd Clinic	1st Audit	2nd Audit	Survey
Intervention	301	301	118	268	258	301
Comparison	378	--	--	--	--	378

Table 4.
Biological Risk Factor Thresholds for Wellness

High Cholesterol	>200 total CHL or >130 LDL
High Blood Pressure	>140 systolic or >90 diastolic
BMI	>30

Table 5.
Injuries, Pesticide and Welding Use By Group

Variable	n	Yes	%
Self-Reported Injuries			
Intervention	301	29	9.6%
Comparison	378	23	6.1%
Pesticide Use in past 12 Months			
Intervention	301	173	57.5%
Comparison	378	169	44.7%
Welding Activity in past 12 Months			
Intervention	301	227	75.4%
Comparison	378	259	68.5%

Table 6. CSF Survey - PPE Use - All

PPE Use & Pesticides		**Always**	**Sometimes**	**Never**	**NR**
eye protection	Intervention	30 (52)	46 (79)	23 (40)	1 (2)
	Comparison	31 (53)	36 (61)	33 (55)	0
gloves	Intervention	71 (122)	24 (42)	4 (7)	1 (2)
	Comparison	62 (104)	31 (52)	7 (11)	1 (2)
boots	Intervention	14 (24)	29 (50)	55 (95)	2 (4)
	Comparison	13 (22)	23 (38)	62 (104)	3 (5)
coveralls	Intervention	4 (7)	12 (21)	82 (142)	2 (3)
	Comparison	6 (10)	13 (22)	79 (133)	2 (4)
Respirator	Intervention	3 (6)	31 (53)	64 (110)	2 (4)
	Comparison	4 (7)	18 (31)	75 (127)	2 (4)
PPE Use & Power Tools					%(n)
Goggles	Intervention	15 (45)	57 (172)	22 (66)	6 (18)
	Comparison	17 (63)	46 (173)	26 (98)	12 (44)
Safety Glasses	Intervention	35 (106)	49 (146)	11 (33)	5 (16)
	Comparison	33 (124)	45 (171)	13 (50)	9 (33)
Shield/Mask	Intervention	15 (44)	47 (141)	29 (87)	10 (29)
	Comparison	13 (48)	42 (160)	31 (119)	13 (51)
Welding Mask	Intervention	71 (214)	8 (25)	11 (32)	10 (30)
	Comparison	67 (255)	10 (39)	13 (50)	9 (34)
Other	Intervention	5 (15)	17 (52)	15 (45)	63 (189)
	Comparison	6 (21)	16 (60)	21 (81)	57 (216)
PPE Use & Welding					%(n)
Mask/Goggles	Intervention	98 (222)	2 (4)	0 (1)	0
	Comparison	98 (253)	2 (6)	0	0
Apron/Jacket	Intervention	6 (13)	30 (69)	62 (140)	2 (5)
	Comparison	8 (20)	23 (60)	64 (167)	5 (12)
Leather Gloves	Intervention	31 (73)	50 (113)	17 (38)	1 (3)
	Comparison	36 (92)	46 (118)	18 (46)	1 (3)
Other					%(n)
Ear Muffs	Intervention	18 (54)	62 (186)	20 (60)	0 (1)
	Comparison	12 (45)	40 (151)	46 (172)	3 (10)
Sunscreen	Intervention	8 (25)	51 (153)	39 (117)	2 (6)
	Comparison	7 (26)	42 (158)	46 (174)	5 (20)
Wide Brimmed Hat	Intervention	20 (60)	44 (131)	36 (107)	1 (3)
	Comparison	24 (91)	39 (149)	34 (129)	2 (9)
					%(n)

Table 7. CSF Survey - PPE Use - Always/Sometimes vs Never

PPE Use & Pesticides		Always/Sometimes	Never	NR
eye protection	Intervention	76 (131)	23 (40)	1 (2)
	Comparison	67 (114)	33 (55)	0
gloves	Intervention	95 (164)	4 (7)	1 (2)
	Comparison	93 (156)	7 (11)	1 (2)
boots	Intervention	43 (74)	55 (95)	2 (4)
	Comparison	36 (60)	62 (104)	3 (5)
coveralls	Intervention	16 (28)	82 (142)	2 (3)
	Comparison	19 (32)	79 (133)	2 (4)
Respirator	Intervention	34 (59)	64 (110)	2 (4)
	Comparison	22 (38)	75 (127)	2 (4)
PPE Use & Power Tools				%(n)
Goggles	Intervention	72 (217)	22 (66)	6 (18)
	Comparison	63 (236)	26 (98)	12 (44)
Safety Glasses	Intervention	84 (252)	11 (33)	5 (16)
	Comparison	78 (295)	13 (50)	9 (33)
Shield/Mask	Intervention	62 (185)	29 (87)	10 (29)
	Comparison	55 (208)	31 (119)	13 (51)
Welding Mask	Intervention	79 (239)	11 (32)	10 (30)
	Comparison	77 (294)	13 (50)	9 (34)
Other	Intervention	22 (67)	15 (45)	63 (189)
	Comparison	22 (81)	21 (81)	57 (216)
PPE Use & Welding				%(n)
Mask/Goggles	Intervention	100 (226)	0 (1)	0
	Comparison	100 (259)	0	0
Apron/Jacket	Intervention	36 (82)	62 (140)	2 (5)
	Comparison	31 (80)	64 (167)	5 (12)
Leather Gloves	Intervention	81 (186)	17 (38)	1 (3)
	Comparison	82 (210)	18 (46)	1 (3)
Other				%(n)
Ear Muffs	Intervention	80 (240)	20 (60)	0 (1)
	Comparison	52 (196)	46 (172)	3 (10)
Sunscreen	Intervention	59 (178)	39 (117)	2 (6)
	Comparison	49 (184)	46 (174)	5 (20)
Wide Brimmed Hat	Intervention	64 (191)	36 (107)	1 (3)
	Comparison	63 (240)	34 (129)	2 (9)
				%(n)

Table 8. CSF Survey - PPE Use - Always vs Sometimes/Never

PPE Use & Pesticides		Always	Sometimes/Never	NR
eye protection	Intervention	30 (52)	69 (119)	1 (2)
	Comparison	31 (53)	69 (116)	0
gloves	Intervention	71 (122)	28 (49)	1 (2)
	Comparison	62 (104)	38 (63)	1 (2)
boots	Intervention	14 (24)	84 (145)	2 (4)
	Comparison	13 (22)	85 (142)	3 (5)
coveralls	Intervention	4 (7)	94 (163)	2 (3)
	Comparison	6 (10)	92 (155)	2 (4)
Respirator	Intervention	3 (6)	85 (163)	2 (4)
	Comparison	4 (7)	93 (158)	2 (4)
PPE Use & Power Tools				%(n)
Goggles	Intervention	15 (45)	79 (238)	6 (18)
	Comparison	17 (63)	72 (271)	12 (44)
Safety Glasses	Intervention	35 (106)	60 (179)	5 (16)
	Comparison	33 (124)	58 (221)	9 (33)
Shield/Mask	Intervention	15 (44)	76 (228)	10 (29)
	Comparison	13 (48)	73 (279)	13 (51)
Welding Mask	Intervention	71 (214)	19 (57)	10 (30)
	Comparison	67 (255)	23 (89)	9 (34)
Other	Intervention	5 (15)	32 (97)	63 (189)
	Comparison	6 (21)	37 (141)	57 (216)
PPE Use & Welding				%(n)
Mask/Goggles	Intervention	98 (222)	2 (5)	0
	Comparison	98 (253)	2 (6)	0
Apron/Jacket	Intervention	6 (13)	92 (209)	2 (5)
	Comparison	8 (20)	87 (127)	5 (12)
Leather Gloves	Intervention	31 (73)	67 (151)	1 (3)
	Comparison	36 (92)	64 (164)	1 (3)
Other				%(n)
Ear Muffs	Intervention	18 (54)	82 (246)	0 (1)
	Comparison	12 (45)	86 (373)	3 (10)
Sunscreen	Intervention	8 (25)	90 (270)	2 (6)
	Comparison	7 (26)	88 (332)	5 (20)
Wide Brimmed Hat	Intervention	20 (60)	80 (238)	1 (3)
	Comparison	24 (91)	73 (278)	2 (9)
				%(n)

Table 9. CSF Clinical Variables

Variable	n	Yes	%	Definition
Injuries	301	29	9.6%	Injury in past 12 months?
>25 BMI	297	238	80.1%	overweight, BMI >25
>30 BMI	297	97	32.7%	obese, BMI >30
>35 BMI	297	23	7.7%	severely obese, BMI >35
Hypertensive Stages 1&2	301	48	15.9%	Hypertensive, systolic >140, diastolic >90
PreHypertensive & HPT	301	190	63.1%	Pre-Hypertensive, systolic >120, diastolic >80
High BP+CHL	264	84	31.8%	High BP & CHL
High CHL	264	117	44.3%	Cholesterol >199 or LDL >129
CHL >200	264	102	38.6%	CHL over 200
BMI+BP+CHL	262	8	3.1%	High BP, CHL & BMI

Table 10.
National Averages 2004

Overweight >25% BMI	**%**
CSF	80.1
National Average	66.0
Men 20+ (National)	70.5
Obesity >30% BMI	
CSF	32.7
National Average	31.4
Men 20+ (National)	29.5
Pre-Hypertension & Hypertension	
CSF	63.1
Hypertension Stages 1&2	
CSF	15.9
National Average	33.6
Men 20+ (National)	33.2
Cholesterol	
Cholesterol >199 or LDL >129	44.3
CSF CHL>199	38.6
National Average	48.4
Men 20+ (National)	47.8
Cardiovascular Disease	
National Average 2004	37.1
Men 20+ (National) 2004	37.5
National Average 2010	35.3
Men 20+ (National) 2010	36.7

Table 11. Clinical Risk Factors and Injury

Variable	n	Yes	%	OR	95% CI
Injuries	301	29	9.6		
BMI ≥ 30	297	97	32.7	1.15	.51-2.60
PreHPT & HPT	301	190	63.1	1.35	.52-3.52
High CHL	264	117	44.3	2.19	.97-4.93
≥ 2 High Risk Factors	295	57	19.3	1.69	.71-4.03
BMI ≥ 30+BP+CHL	262	8	3.1	5.5	1.23-24.51

Table 12. CSF Self-Reported Health and Stress

Health Status	**Poor**	**Fair**	**Good**	**Very Good**	**Excellent**	**NR**
Intervention	1 (2)	6 (18)	23 (69)	48 (145)	21 (62)	2 (5)
Comparison	1 (3)	9 (34)	37 (139)	44 (165)	9 (35)	1 (2)
Stress Status	**Very Low**	**Low**	**Medium**	**High**	**Very High**	**NR**
Intervention	7 (20)	22 (67)	51 (153)	15 (46)	4 (11)	1 (4)
Comparison	3 (12)	21 (80)	54 (205)	16 (59)	5 (19)	1 (3)
	%(n)					

Table 13. CSF Dusty Working Conditions

	Grain & Silo	**Livestock**	**Cleaning**	**Other**	**None**
Intervention	80 (240)	55 (166)	41 (123)	37 (111)	7 (22)
Comparison	68 (257)	50 (190)	37 (140)	30 (114)	14 (53)
Respirator Use	***Always***	***Sometimes***	***Never***	***NR***	
Intervention	28 (85)	60 (180)	10 (29)	2 (7)	
Comparison	18 (68)	58 (219)	20 (74)	6 (17)	
	%(n)				

Table 14. Intervention and Comparison Group:
Injury and Occupational Risks Using Never/Sometimes vs Always

Variable	**n**	**OR**	**95% CI**
BMI Risk (>30)	291	1.14	.51-2.58
Lipid Risk (>200, >130)	259	2.17	.97-4.89
BP Risk (>140, >90)	294	1.35	.52-3.50
Any of Previous 3	294	1.52	.65-3.55
All 3 Risks	294	**6.00**	**1.36-26.54**
Poor, Fair Good Health	670	2.55	1.42-4.58
High, Very High Stress	370	1.43	.71-2.86
Farm >500 Acres	651	1.17	.65-2.13
Eye Protection, Pesticides	341	2.69	1.01-7.18
Glove Use, Pesticides	339	2.84	1.38-5.84
Boots, Pesticides	334	.55	.22-1.36
Coveralls, Pesticides	338	4.20	.25-71.40
Respirator, Pesticides	337	1.54	.20-12.14
Goggles, Tool Use	613	1.24	.54-2.85
Glasses, Tool Use	627	1.07	.58-1.98
Shield, Tool Use	595	1.42	.55-3.71
Mask, Tool Use	611	.88	.43-1.83
Other, Tool Use	272	.77	.25-2.39
Goggles, Welding	497	1.07	.13-8.51
Jacket, Welding	479	.91	.27-3.13
Gloves, Welding	491	.74	.38-1.43
Use of Ear Protection	665	.67	.32-1.38
Wide Brimmed Hat in Sun	665	1.27	.62-2.59
Use of Sun Screen	650	1.02	.35-2.96
Respirator, in Dust	651	1.32	.64-2.69

Table 15. Intervention and Comparison Group:
Injury and Occupational Risks Using Never vs Sometimes/Always

Variable	**n**	**OR**	**95% CI**
Eye Protection, Pesticides	341	1.33	.62-2.87
Glove Use, Pesticides	339	.51	.07-3.98
Boots, Pesticides	334	.80	.39-1.64
Coveralls, Pesticides	338	1.40	.52-3.76
Respirator, Pesticides	337	.70	.33-1.49
Goggles, Tool Use	613	.63	.30-1.34
Glasses, Tool Use	627	.42	.13-1.39
Shield, Tool Use	595	.89	.46-1.73
Mask, Tool Use	611	.98	.40-2.39
Other, Tool Use	272	.68	.29-1.62
Goggles, Welding	497	3.86	.15-96.34
Jacket, Welding	479	1.00	.50-2.01
Gloves, Welding	491	.38	.11-1.25
Use of Ear Protection	665	.43	.21-.88
Wide Brimmed Hat in Sun	665	.73	.39-1.37
Use of Sun Screen	650	.83	.47-1.48
Respirator, in Dust	651	.69	.29-1.67

Table 16. Intervention Clinical Means

	N	Age	Weight	Height	BMI	Systolic	Diastolic	Apical	CHL	HDL	LDL
All Ages											
Visit 1	301	56.5	202	70.4	28.73	127	76	69	189	47	117
Visit 2	118	56.3	195	70.4	27.67	126	74	67	189	46	120
Paired Visit1	118	54.9	196	70	27.87	128	74	70	201	48	125
Paired Visit2	118	56.4	195	70	27.67	126	74	67	189	46	120
*p values**			*0.1241*		*0.0968*	*0.1187*	*0.8964*	***0.0094***	***<.0001***	*0.2586*	*0.0148*

**paired t-test values*

Intervention Clinical Means by Age

Visit 1	**N**	**Age**	**Weight**	**Height**	**BMI**	**Systolic**	**Diastolic**	**Apical**	**CHL**	**HDL**	**LDL**
<35	11	29.4	195	73.1	25.59	118	70	67.2	173	51	108
35-49	76	45.5	196	71	26.97	120	74	68	190	46	121
50-64	131	56.7	207	70.7	29.08	127	77	69	191	49	118
65+	83	70.9	197	69.1	29.12	134	77	68.9	184	44	116
Visit 2	**N**	**Age**	**Weight**	**Height**	**BMI**	**Systolic**	**Diastolic**	**Apical**	**CHL**	**HDL**	**LDL**
<36	4 (5)	32.6	171	72.6	22.79	111	63	70	178	53	111
37-51	32 (38)	45.8	202.6	70.4	29.03	125	75	68	195	46	122
52-65	41 (48)	58.6	202.1	70.3	29.08	127	75	67	192	45	121
66+	23 (27)	71.8	179.4	69.5	25.89	134	74	67	179	46	113
	% (n)										

Table 17. Unpaired t-test, All Clinic Participants

	Clinic Visit 1			**Clinic Visit 2**				
Parameter	**n**	**mean**	**std**	**n**	**mean**	**std**	**t**	**p**
Age	301	56.5	11.8	115	56.4	11.80	78.3	**<.0001**
Weight	299	202	33.4	98	195	32.98	0.44	0.6631
BMI	297	28.73	4.82	97	27.67	4.11	2.03	**0.0430**
Systolic	301	127	15.04	118	126	13.49	0.83	0.4062
Diastolic	301	76	10.26	118	74	9.90	2.09	**0.0372**
Apical Pulse	299	69	8.60	100	67	9.48	1.79	0.0750
Cholesterol	264	189	37.31	83	189	40.20	0.09	0.9260
HDL	237	47	15.18	82	46	14.18	0.18	0.8573
LDL	235	118	35.33	82	120	33.69	-0.50	0.6143

Table 18. Paired t-test, First Round Only

	Group 1			**Group 2**				
Parameter	**n**	**mean**	**std**	**n**	**mean**	**std**	**t**	**p**
Age	183	57.6	11.8	118	54.9	11.7	1.97	**.0496**
Weight	182	206.3	33.8	117	196.1	31.8	2.61	**.0096**
BMI	182	29.3	5.0	115	27.9	4.4	2.46	**0.0145**
Systolic	183	126.6	14.2	118	127.6	16.2	-.57	0.5675
Diastolic	183	77.4	9.6	118	73.7	10.9	3.11	**0.0020**
Apical Pulse	182	68.3	9.4	117	69.9	7.3	-1.65	0.1008
Cholesterol	160	181.9	34.6	104	200.8	39.5	-4.10	**<.0001**
HDL	139	46.2	14.9	98	47.8	15.5	-0.77	0.4421
LDL	139	112.4	34.7	96	124.8	35.5	-2.67	**.0080**

Table 19. Paired t-test, Paired Participants

	Group 1			**Group 2**				
Parameter	**n**	**mean**	**std**	**n**	**mean**	**std**	**t**	**p**
Age	183	57.6	11.8	118	54.9	11.7	1.97	**.0496**
Weight	182	206.3	33.8	117	196.1	31.8	2.61	**.0096**
BMI	182	29.3	5.0	115	27.9	4.4	2.46	**0.0145**
Systolic	183	126.6	14.2	118	127.6	16.2	-.57	0.5675
Diastolic	183	77.4	9.6	118	73.7	10.9	3.11	**0.0020**
Apical Pulse	182	68.3	9.4	117	69.9	7.3	-1.65	0.1008
Cholesterol	160	181.9	34.6	104	200.8	39.5	-4.10	**<.0001**
HDL	139	46.2	14.9	98	47.8	15.5	-0.77	0.4421
LDL	139	112.4	34.7	96	124.8	35.5	-2.67	**.0080**

Table 20. Paired t-test By Age Group, Paired Participants

Age<35		**Clinic Visit 1**		**Clinic Visit 2**					
Parameter	**n**	**mean**	**std**	**mean**	**std**	**Change**	**std**	**t**	**p**
Age	5	31.2	1.92	32.6	2.19	1.40	0.55	5.72	0.005
Weight	5	170	16.07	171	16.34	1.40	2.19	1.43	0.23
BMI	5	22.60	0.99	22.79	1.23	0.19	0.30	1.45	0.22
Systolic	5	115	7.60	111	8.07	-3.40	5.98	-1.27	0.27
Diastolic	5	69	8.67	63	1.79	-6.00	8.00	-1.68	0.17
Apical Pulse	5	65	0.89	70	15.01	4.80	15.27	0.70	0.52
Cholesterol	2	180	27.26	178	47.62	2.50	24.75	0.14	0.91
HDL	2	54	15.92	53	13.08	-6.00	1.41	-6.00	0.11
LDL	2	113	20.73	111	31.05	2.50	27.58	0.13	0.92
35-49		**Clinic Visit 1**		**Clinic Visit 2**					
Parameter	**n**	**mean**	**std**	**mean**	**std**	**Change**	**std**	**t**	**P**
Age	36	43.9	3.49	45.76	3.75	1.58	0.60	15.74	<.0001
Weight	30	195	28.77	203	34.02	7.40	22.53	1.80	0.08
BMI	29	27.30	3.99	27.95	3.58	0.56	1.02	2.97	**0.006**
Systolic	36	118	8.22	120	8.63	2.92	10.04	1.74	0.09
Diastolic	36	70	6.78	73	9.02	3.22	7.47	2.59	**0.01**
Apical Pulse	29	69	6.16	67	5.36	-2.45	6.66	-1.98	0.06
Cholesterol	21	203	33.77	192	36.05	-13.14	26.63	-2.26	**0.04**
HDL	18	46	8.50	47	13.18	-0.22	5.61	-0.17	0.87
LDL	17	126	35.19	124	32.76	-6.29	17.00	-1.53	0.15
50-64		**Clinic Visit 1**		**Clinic Visit 2**					
Parameter	**n**	**mean**	**std**	**mean**	**std**	**Change**	**std**	**t**	**P**
Age	47	57.5	5.04	59.3	4.77	1.47	0.62	16.22	<.0001
Weight	39	207	31.94	202	32.49	0.31	9.17	0.21	0.84
BMI	39	29.43	4.27	28.85	4.37	0.17	1.42	0.76	0.45
Systolic	50	129	14.57	127	13.47	-2.12	11.69	-1.28	0.21
Diastolic	50	75	12.59	74	11.01	-0.76	12.67	-0.42	0.67
Apical Pulse	41	71	7.92	67	11.65	-3.41	11.24	-1.95	0.06
Cholesterol	36	203	42.58	191	29.93	-22.19	35.79	-3.72	**0.0007**
HDL	35	49	19.88	45	12.97	-3.51	19.87	-1.05	0.30
LDL	34	123	35.11	120	29.25	-9.50	37.33	-1.48	0.15
65+		**Clinic Visit 1**		**Clinic Visit 2**					
Parameter	**n**	**mean**	**std**	**mean**	**std**	**Change**	**std**	**t**	**P**
Age	27	71.6	5.09	73.1	4.98	1.41	0.57	12.78	<.0001
Weight	23	177	27.92	174	23.37	-0.78	7.87	-0.48	0.64
BMI	22	25.89	3.89	25.62	3.23	-0.16	1.32	-0.56	0.58
Systolic	27	143	18.39	133	15.50	-8.15	20.06	-2.11	**0.04**
Diastolic	27	77	10.8	74	8.72	-2.33	9.38	-1.29	0.21
Apical Pulse	24	70	8.18	66	8.22	-2.50	6.85	-1.79	0.09
Cholesterol	13	196	41.98	192	42.62	-26.92	54.11	-1.79	0.10
HDL	12	47	8.40	51	14.65	-0.42	11.93	-0.12	0.91
LDL	13	130	40.92	122	35.09	-20.92	43.57	-1.73	0.11

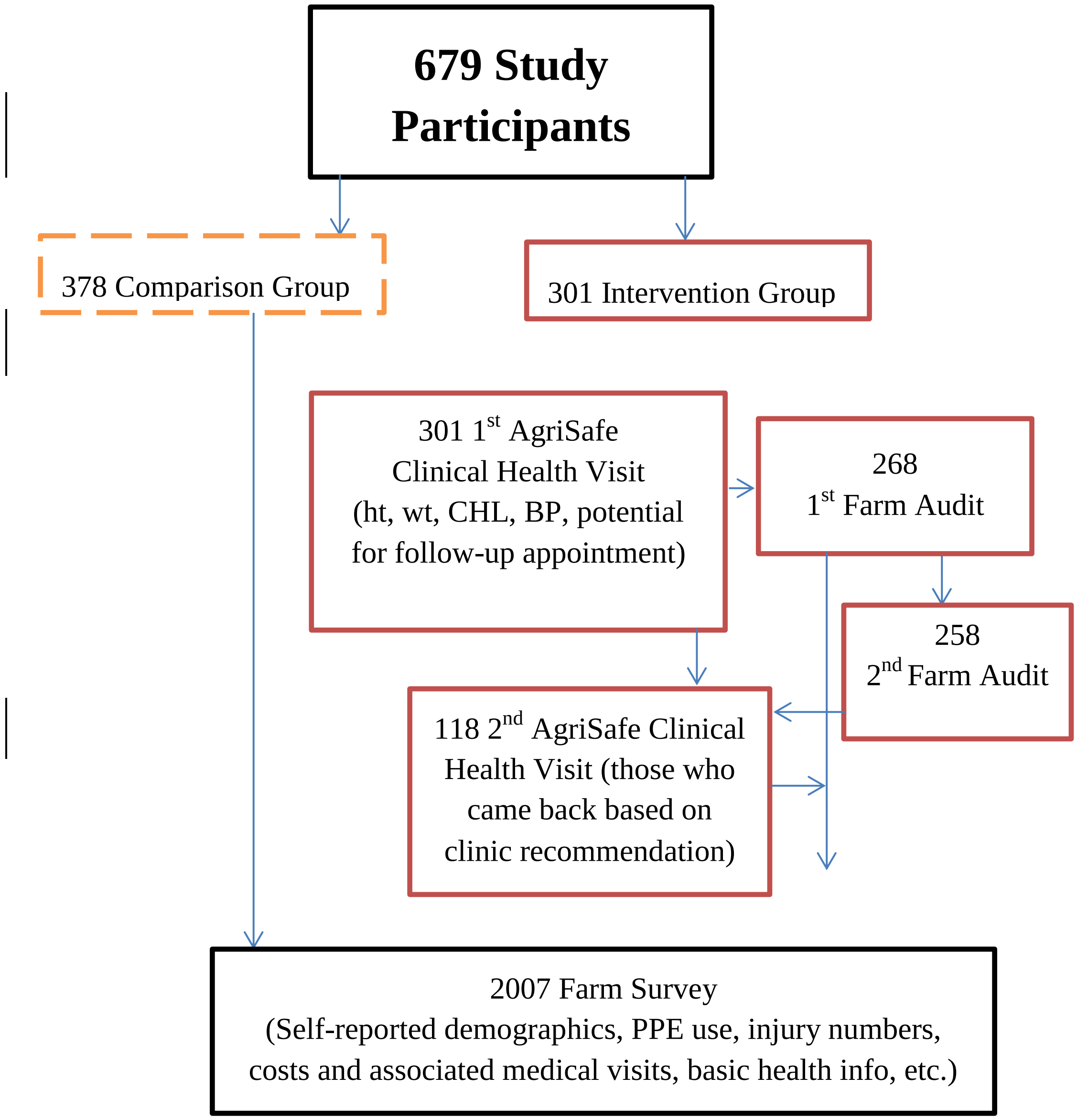

Figure 1: CSF Study Flow Chart

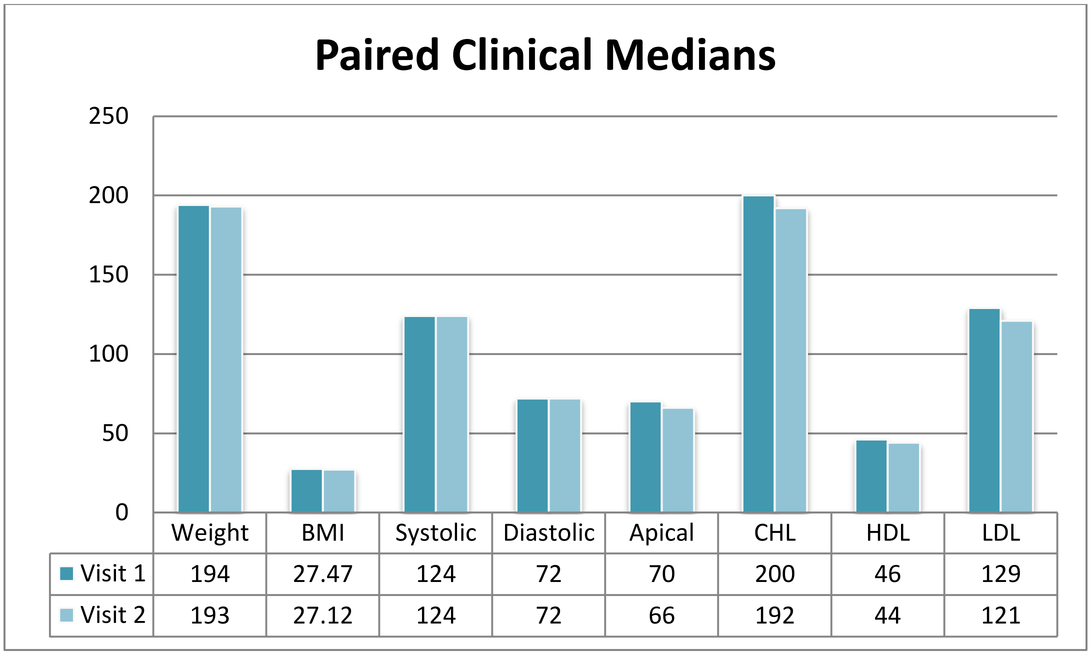

Figure 2: Health Measures, Visit 1 and Visit 2
***Statistically significant differences between visits for Apical, CHL and LDL values**

CHAPTER 3

THESIS SUMMARY, DISCUSSION, CONCLUSIONS

Although many studies have been conducted examining risk factors associated with occupational injury, a substantial amount of the research is limited to specific methods leading to injuries, such as needle sticks, falls, etc. Very little research has focused on the individual's health as a predictor of injury and most previous work focuses on specific body parts or occupational or industry types, such as healthcare. Even less research focuses on cardiovascular health or chronic disease and its impact on occupational injury. This study suggests the need for more clinical health research in agricultural and rural communities specific to injuries. This study also highlights health issues facing the agricultural community and the need for interventions integrating health protection with health promotion. With BMI 10% higher in rural populations than the national average for men and 63% of the CSF intervention group fitting the definition of prehypertensive, there is a potential need for interventions focused on these populations. These facts are ominous when compounded with previous research linking obesity and CVD to increased risk of occupational injury (Pollack 2007). Cholesterol levels and the number of individuals with hypertension are less in the study group than they are in the general population. More research is needed to make that determination.

While not addressed in this study, it is possible that more significant improvements were made as a result of the interventions received than are noted. This study specifically examined clinical and occupational data related to injury, but there were multiple areas improvement could be measured, both within the intervention group and between the intervention group and the comparison group.

Public Health Significance

This study strongly ties in to the Total Worker Health initiative launched by the National Institute for Occupational Safety and Health (NIOSH) in June 2011 (NIOSH 2013). The TWH initiative is a strategy that combines health promotion with occupational health protection, to reduce work factors that contribute to injury on the job, and also to reduce those health factors outside of the job that can put workers at risk. Many health programs initiated in industry are specific to the job site, but with 98% of US farms considered to be family farms (Hoppe 2007), leaving the work site at the end of the day isn't always possible.

Heart disease, the number one cause of death in the U.S. as of 2009 and the cause of 600,000 deaths a year (CDC 2013), is a major public health concern. Interventions such as this one are important to not only help define health risks in subsets of the general population, but the interventions themselves are important to the target group.

Future Research

With limited previous studies on chronic disease in farmers and agricultural workers and no previous studies on chronic diseases and injuries in farmers and agricultural workers, there is great potential for future studies. This study provided preliminary data that parallels that seen in other industries. Larger scale studies with a variety of agricultural types are needed to expound on this topic and these results. More research is needed to understand the full impact of health interventions and promotions on health outcomes and to more clearly define and understand the true role of chronic disease as it relates to agricultural injury and illnesses. Future studies should include more biological data, such as information on glucose levels and medication use, as well as full follow-up clinical health visits. While this study focused solely on men, future studies should include women in the analysis.

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