

Spring 2014

Trends and characteristics of occupational suicide and homicide in farmers and agriculture workers, 1992-2010

Wendy Jeannette Wehrman Ringgenberg
University of Iowa

Copyright 2014 Wendy Jeannette Wehrman Ringgenberg

This thesis is available at Iowa Research Online: <https://ir.uiowa.edu/etd/4734>

Recommended Citation

Ringgenberg, Wendy Jeannette Wehrman. "Trends and characteristics of occupational suicide and homicide in farmers and agriculture workers, 1992-2010." MS (Master of Science) thesis, University of Iowa, 2014.
<https://doi.org/10.17077/etd.3k25y6k2>

Follow this and additional works at: <https://ir.uiowa.edu/etd>

Part of the [Occupational Health and Industrial Hygiene Commons](#)

TRENDS AND CHARACTERISTICS OF OCCUPATIONAL SUICIDE AND HOMICIDE IN
FARMERS AND AGRICULTURE WORKERS, 1992-2010

by

Wendy Jeannette Wehrman Ringgenberg

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

Thesis Supervisor: Associate Professor Marizen Ramirez

Graduate College
The University of Iowa
Iowa City, Iowa

CERTIFICATE OF APPROVAL

MASTER'S THESIS

This is to certify that the Master's thesis of

Wendy Jeannette Wehrman Ringgenberg

has been approved by the Examining Committee
for the thesis requirement for the Master of Science
degree in Occupational and Environmental Health (Agricultural Safety and Health) at
the May 2014 graduation.

Thesis Committee:

Marizen Ramirez, Thesis Supervisor

Kelley Donham

Corinne Peek-Asa

ACKNOWLEDGEMENTS

This research was conducted with restricted access to Bureau of Labor Statistics (BLS) data. The views expressed here do not necessarily reflect the views of the BLS.

TABLE OF CONTENTS

LIST OF TABLES.....	iv
LIST OF FIGURES.....	v
CHAPTER I: INTRODUCTION.....	1
CHAPTER II: LITERATURE REVIEW.....	4
Farmers and Agriculture Workers.....	4
Suicide.....	8
Homicide.....	11
CHAPTER III: METHODOLOGY.....	15
Population and Sample.....	15
Design.....	15
Data Source.....	15
Data and Instrumentation.....	15
Variables.....	17
Analysis.....	19
CHAPTER IV: RESULTS.....	21
Farmers, Agriculture Workers, and Other Occupations.....	21
Farmer and Agriculture Worker Homicide and Suicide by Region.....	27
Demographics and Worker Characteristics of Farmers and Agriculture Workers Who Died of Occupational Homicide or Suicide, 1992-2010.....	29
Gender and Method of Occupation Homicide or Suicide for Farmers and Agricultural Workers.....	31
Gender and Homicide by Firearm.....	33
Farmer and Agricultural Worker Homicide.....	33
CHAPTER V: DISCUSSION.....	35
Future Research.....	40
Limitations.....	40
CONCLUSIONS.....	41
REFERENCES.....	42

LIST OF TABLES

Table 1.	Occupational Fatalities, Homicides, and Suicides for Farmers, Agricultural Workers, Fishing, Forestry, and All Occupations from 1992 to 2010.....	22
Table 2.	Occupational Homicides and Suicide Rates for Farmers and Agricultural Workers and All Occupations from 1992-2010.....	22
Table 3.	Occupational Homicides Rates/100,000 for Farmers and Agricultural Workers and All Occupations from 1992-2010.....	24
Table 4.	Occupational Suicide Rates/100,000 for Farmers and Agricultural Workers and All Occupations from 1992-2010.....	26
Table 5.	Farmer and Agricultural Worker Occupational Homicide and Suicide by Region, 1992-2010.....	28
Table 6.	Demographics and Worker Characteristics of Farmer/Ag Workers Who Were Victims of Homicide and Suicide, 1992-2010.....	30
Table 7.	Predictors for Occupational Homicide and Suicide for Farmers/Ag Workers.....	31
Table 8.	Occupational Homicide and Suicide for Farmers and Agricultural Workers by Gender, 1992-2010, Compared to Current Gender Distribution of Farm Ownership.....	32
Table 9.	Death by Shooting for Occupational Homicide for Farmers and Agricultural Workers by Gender, 1992-2010.....	33

LIST OF FIGURES

Figure 1.	Occupational Homicide & Suicide Rates for Farmers and Agriculture Workers Compared to All Occupations from 1992 through 2010.....	23
Figure 2.	Occupational Homicide Rates per 100,000 Farmer and Agriculture Workers Compared to Occupational Homicide Rates per 100,000 Workers in All Occupations from 1992 through 2010.....	25
Figure 3.	Occupational Suicide Rates per 100,000 Farmers and Agriculture Workers Compared to Occupational Suicide Rates per 100,000 Workers in All Occupations from 1992 through 2010.....	27
Figure 4.	Regional Differences in Farmer and Agricultural Worker Homicide and Suicide Percentages.....	28
Figure 5.	Gender Distribution of Farmers and Agriculture Workers Who Died from Occupational Homicide and Occupational Suicide Compared to U.S. Farmer Owner Gender Distribution.....	32
Figure 6.	Event Resulting in Occupational Homicide for Farmers and Agriculture Workers, 1992 through 2010.....	34

CHAPTER I: INTRODUCTION

American farmers are iconic representations of American values, including hard work, strong morality, family-centered, low materialism, purposeful living, and fair business dealings. Farming families are frequently intergenerational and connected to the same piece of land they have owned for generations. Neighbors work together during planting and harvest. While facing challenges, farming communities pull together to help out their friends. It is, therefore, surprising when farmers are victims or perpetrators of homicide or suicide.

Perhaps not so surprising, the idealized version of the farmer is somewhat different than reality. Farming and agricultural work is considered a dangerous occupation due to the multiple risks for injury and illness (Chapman and Schuler, 1990; Krueger, 2011). In agriculture, homicide is lower than in other occupations, while suicide is higher than in other occupations. Rural male deaths are higher from both causes in comparison to rural female homicide and suicide deaths (Alston, 2012; Gunderson et al, 1993; Nisbett, 1993; and Stallones, 1990). Little research has been undertaken to better understand farmer homicide, especially as an occupational risk. Research has been undertaken to better understand risks for farmer, rancher, or migrant farm worker suicide, especially in relation to an increased number of farmer suicides in the United States after the economic farm crisis in the 1980's (Browning et al., 2008; Carson, Araquistain, Ide, Quoss, & Weigel, 1994; DeArmond, Stallones, Chen, & Sintek, 2006; McSparron, 2005; Hovey & Magana 2003; Rosmann & Delworth, 1990); in Great Britain after the "Mad Cow" and Foot-and-Mouth disease outbreaks (London Mirror, 1998; NHS Cumbria, 2010-2012); and in Australia due to an increased risk of suicide after a decade-long drought (Hanigan, et al, 2012).

In addition, homicide and suicide research has considered access to firearms as a risk factor for gun-related homicide and suicide, and suicide research has considered access to pesticides as a risk factor for poison-related suicides (Keifer & Firestone, 2007; Gunnell & Eddleston, 2003; Miller et al, 2002; Beseler C, et al. 2006; Beard et al., 2011, Skegg et al, 2010; Alston, 2012; Hawton, et al., 1998). Access to means is considered a critical risk factor by the National Strategy for Suicide Prevention: Goals and Objectives for Action (2001). Farmers have easy access to both guns and pesticides.

There has been little research to investigate occupational risk factors for farmers to homicide, and therefore there has been little comparison between farmer homicide and farmer suicide. There has been little investigation of regional variations in farmer or agricultural worker occupational homicide and suicide. The literature lacks comparison of farmers, a manager position, and agricultural workers, a laborer position, and other occupations. Farmers have access to guns, the most prominent means for both homicide and suicide, and this access deserves further investigation in the role guns play in purposeful harm to self or others for farmers.

The purpose of this paper was to review the occupational homicide and suicide statistics for farmers and agricultural workers and to identify victim characteristics and incident circumstances. This study had three aims:

Aim 1: Estimate rates of homicide and suicide in agriculture and compare these rates with other working populations. Working hypotheses: Rates of homicide are lower in agriculture than in other working populations, but rates of suicide are higher in agriculture compared with other working groups.

Aim 2: Examine the regional distribution of occupational homicide and suicide rates in the United States. Working hypothesis: Rates of suicide and homicide are higher in the Southern United States compared with other regions of the country.

Aim 3: Compare occupational homicide and suicide cases of farmers and agricultural workers by demographics, external cause, and nature of injury. Working hypothesis: Males are equally likely to be victims of both homicide and suicide, and use of firearms are the most likely cause of death in homicide and suicide.

CHAPTER II: LITERATURE REVIEW

The following literature review first presents information regarding farmers, agricultural production and suicide. Then, homicide as an occupational risk for farmers or agricultural workers is discussed.

Farmers and Agricultural Workers

Farms, farmers, and agricultural workers in the United States

In 2010, there were an estimated 2.2 million farms on 917 million acres of land for an average of 418 acres per farm (NASS). A farm is defined by Census of Agriculture as “any place from which \$1,000 or more of agricultural products were produced and sold, or normally would have been sold, during the year”. Government payments are included in sales. Ranches, institutional farms, experimental and research farms, and Indian Reservations are included as farms. Places with the entire acreage enrolled in the Conservation Reserve Program (CRP), Wetlands Reserve Program (WRP), or other government programs are counted as farms. Small farms (those with annual incomes less than \$250,000) comprised 91% of all farms (Hoppe, MacDonald, and Korb, 2010). The family farm accounts for 95% of the agricultural work culture in developed countries (Donham and Thelin, 2006).

While an estimated that 3 million people in the US were involved in agriculture (Waggoner, et al., 2010), less than one percent of the 313,000,000 people living in the United States claim farming as an occupation, and only 45% of farmers claimed farming as their principle occupation (EPA, 2013). One million farms had positive net cash income based solely on the farm operation, while 1.2 million farms depend on non-farm income to cover farm expenses (USDA, 2007). From 2002 to 2007, the number of farmers who worked off the farm increased from 55% to 65 percent. The BLS estimated 1,200,000 farmers, ranchers, and other

agricultural managers in 2010; and 758,000 agricultural workers jobs in 2010. This is at the same time unemployment in rural America has risen, while over 56% of non-metro counties have experienced population loss between 2000-2008 (USDA, Briefing on the status of rural America, 2012). According to the 2007 Census of Agriculture, 1.83 million farms have a white, male principal operator. The average age of principal operators increased from 53 (in 1992) to 57 years in 2007 (USDA).

Donham and Thelin (2006) clarified the differences between family farmers and corporate farming (pp.13-15): “Farm family members consider themselves to be owner-operators, managers, and self-employee, not farm workers. A farm worker, to them, is someone who is an employee, a person with less socioeconomic status...Corporate-style farms take on the general structure and work organization of an ordinary private industry or factor with emphasis on high productivity based on routine and tightly managed work processes where hired labor, not family labor, is essential. Labor and management are separated. Residence and the farm business are usually separated.”

For farming families, the farm is both work and home, an identity and way of life. Farm husbands’ primary responsibility is agricultural production, and farm wives’ sphere of responsibility includes the household, children, vegetable garden, errands, and administrative work (Elkind, Carlson, and Schnabel, 2005).

Family farmers enjoy being their own boss, cultivating the land, working together with family members, and contributing in a meaningful way to the world. However, these advantages are also potential stressors, including personal responsibility for the financial success or failure of the family business.

Farmer Stress

Farmers feel occupational stress for many reasons, including management of own company, self-reliance, personal illness, diseases in crop or livestock, long work days, few vacation days, caring for family members, relationships with family members and neighbors, work in a changing world, national and world politics, and weather (Elkhind and Cody-Salter, 2005; Walker and Walker, 1987; McLaren, and Challis, 2009; Merchant, et al 1989; Donham and Thelin, 2006; Rosenblatt and Anderson, 1981; Tevis, 1982). Picket et al. (1998) state that loneliness and isolation was a risk factor in suicide in the farm setting. Thu et al. (1997), found that farmers reporting high stress were almost 2x as likely to experience a serious injury in comparison to farmers experiencing low or moderate stress. The authors found high stress, high workloads, and limited social outlets were over 3x as likely to experience a farm injury versus other farmers. The authors found that while economic issues were not directly related to injuries, stress was created when the farmer or spouse worked off the farm.

Farmers' physical work environment includes heat, cold, noise, vibration, odors, particulate emissions, and environmental pollutants (Donham and Thelin, 2006).

Bultena, Lasley, and Guler (1986) found farm families experiencing chronic stress due to economic setbacks exhibited anger, depression, self-depreciation, identity loss, diminished self-sufficiency, suicide tendency, increased substance abuse, and increased interpersonal violence (Bultena, Lasley, and Gular, 1986).

Agricultural Health and Safety

“Agricultural health and safety...is a broad term that is used to describe a field of practice and associated endeavors aimed at reducing occupational injuries and illnesses in agricultural populations (Donham and Thelin, 2006, p. 3).” Farmers are healthier than the general

population, although they suffer a higher rate of unintentional fatal injuries from machines. (Blair, et al. 2005; Waggoner et al., 2010). Donham and Thelin summarized Bureau of Labor Statistics (BLS) and National Safety Council data when they stated that “Agriculture is one of the nation’s most dangerous industries” (pp. 304-305), ranging 22.3 to 28.6 deaths per 100,000 adult workers, with an annual average of 806 deaths (1992-2002) with 85% of those deaths in production agriculture.

Suicide and mental health of farmers is a national occupational health concern

The National Occupational Research Agenda (NORA, 2008), cited the stressful agricultural working conditions (e.g. economic forces, weather, and isolation) and its adverse effect on the psychological well-being of workers recommending further research to help farmers and agricultural workers to recognize stress and seek help before attempting suicide. The Food, Conservation, and Energy Act of 2008 (i.e., the Farm Bill) created the Farm and Ranch Stress Assistance Network which provides grant funding to state cooperative extension services and nonprofit organizations to initiate, expand, or sustain programs that provide professional agricultural behavioral health counseling and referral (Title 7, Agriculture, SS5936). The National Institutes for Occupational Safety and Health (NIOSH) nationally funds nine Centers of Excellence in Agricultural Disease and Injury Research, Education, and Prevention (Krueger, 2011) to study ways to protect and educate farmers from occupational risks.

The current Farm Bill includes crop insurance and supplemental payments intended to reduce financial risk, and loan rates and grants to promote farming as a profession. There are also provisions that fund disaster services, including psychological services during disasters administered through the Extension Disaster Education Network (EDEN). The Mental Health America (MHA) and National Alliance on Mental Illness (NAMI) provide mental health

resources, with partnerships across the nation. They also research, advocate and recommend policies. For example, according to NAMI (2011), 20 states decreased mental health funding from 2011 to 2012. The USDA provides loans and grants to develop essential community facility for public use in rural areas, including hospitals, fire safety, public safety, housing, and economic growth projects. For example, AgriWellness, Inc., and Iowa-based organization, coordinated the Sowing the Seeds of Hope activities across Iowa, Kansas, Minnesota, Nebraska, North Dakota, South Dakota, and Wisconsin and provided behavioral health services to stressed farmers, agriculture workers, their family members, and rural communities (Agriwellness website).

Suicide

Suicide is a national tragedy

“Suicide exacts an enormous toll from the American people. Our Nation loses 30,000 lives to this tragedy each year, another 650,000 receive emergency care after attempting to take their own lives” (Surgeon General’s preface to the National Strategy for Suicide Prevention, 2001, p. 1). Risk factors for suicide include economic and labor market conditions, poor access to quality public health services, isolation, availability of lethal method, being male, history of mental illness, chronic pain or illness, alcohol or drug abuse, and feeling loss of control over life (U.S. Department of Human Services, 2001; NHS Cumbria, 2010-2012).

According to the 2011 National Vital Statistics Report, suicide is the 10th leading cause of death in the United States, and homicide is the 15th (Kochanek, Jiaquan, Murphy, Minino, & Kung, 2011). Seventy-five percent of the 177,154 injury-related deaths in 2009 were caused by poisoning (23.5%), motor-vehicle traffic (19.5%), firearms (17.7%), and falls (14.4%). Of the 41,592 poisoning deaths, 15.4% were suicides. Of the 31,347 firearm deaths, 59.8% were suicides and 36.7% were homicides (pp. 10-11).

Browning, Westneat, et al, 2008, found that suicide rates of southern U.S. farmers aged 25-34 years, and over 75 years of age were significantly higher than the total white male population in the states studied, and a firearm was used 86% of the time. Hawton and Fagg et al, 1998, studied 702 suicide or undetermined cause deaths in the UK from 1981 to 1993 found that causes of death included firearms (40%), hanging (30%), carbon monoxide (16%), and poisoning (8%). Skegg, Firth et al (2010) examined occupational suicides between 1973 and 2004 in New Zealand and found that farmers, hunters, and cullers were more than twice as likely as all other occupations to use firearms.

Workplace suicide is a concern

In 2010, Bureau of Labor Statistics (BLS) reported 270 workplace suicides, the highest annual total ever reported since the collection of BLS data started in 1992, whereas workplace homicides were the lowest ever reported at 518. The all-workplace fatal injury rate was 3.6 per 100,000 full-time equivalent workers for 2010. Census of Fatal Occupational Injuries (CFOI) demographics of 251 workplace suicides in 2008 were 94% men, 36% were forty-five to fifty-four years of age, and 78% were white. Of the total suicides, 52% died of gunshot wounds, and 31% died of strangulation/suffocation.

The largest group of suicides by position were workers in management occupations (14%). Farmers are categorized as managers by the BLS occupational classification system. Kposowa (1999) found that industrial groups and the type of industry affected the risk of suicide, with miners having the highest risk for suicide. The author found that farmers, farm managers, and farm workers experienced the fewest suicides during 1979-1989 data, although the authors found that agriculture, forestry, and fisheries employees had a significantly high suicide risk. Kposowa found that only (non-agricultural) laborers and the unemployed had higher risks of

suicide than farmers or farm managers (Kposowa, p. 650). The authors found that the risk of suicide varies among industrial group and less remarkably among occupational groups.

Farmers have a higher suicide rate than other comparative groups.

Stallones (1990) found the highest suicide rates among Kentucky farmers, and then among Kentucky males, and then by U.S. males. Firearms were the most frequently used means for suicides by Kentucky farmers and Kentucky males. Booth et al., 2000, also recognized that farmer suicides are commonly gunshots. Alston (2012) identified that rural male suicide in Australia was higher than rural women, urban men, and urban women.

Farmers have increased risk for suicide when they are unable to continue farming.

Donham and Thelin (2006) summarized, “Studies (by Zwerling et al., 1995; Thomas et al., 2003) indicate that the suicide incidence is raised in groups of farmers who experience extensive economic problems, threats of losing their farms, or threats to their position as an independent entrepreneur” (p. 295). Stress during the growing season includes machinery breakdown, price uncertainties, machinery costs, interest rates, planting, weather; intergenerational stress (Rosenblatt and Anderson, 1981; Tevis, 1982).

Gunderson et al. (1993) identified that the suicide rates of farmers post-economic crises was four times that of other rural residents and suicide rates of male farmers was twice the rate of males in general. Daymond and Gunderson (1987) used data from 1980-1985 from Minnesota, North Dakota, South Dakota, Montana, and Wisconsin found farmer suicide rates were 58/100,000 farmers who were owner-operators versus hired workers at 3-5 per 100,000 or farm women 1-2/100,000. One Canadian study did not find a relationship between farmer suicide and economic stress. They identified a suicide rate for Ontario farmers of 7.2 per 100,000 (Pickett et al., 1993). The current U.S. agriculture economy has experienced increased livestock food costs,

reduced subsidies, and confusion regarding passing a new Farm Bill. The 2012 drought affected agriculture across the nation, and the economic impact could be a critical risk factor for suicide making an in-depth study on farmer suicide timely.

Is suicide linked to pesticide use?

Some have questioned whether or not there exists a link between pesticide use and suicide. Stallones (2006) found that males and females in occupations exposed to pesticides had higher rates of suicide than those not exposed, odds ratio of 1.14 for males and 1.98 for females. This finding builds on previous research by Stallones and Beseler (2002, 2008) that found farmers and their spouses who had suffered a pesticide-related illness were almost 6 times as likely to report depressive symptoms. However, Beard et al (2011) found no increased risk for suicide for moderate pesticide use. While this literature is evocative, this topic will not be addressed in this report.

Homicide

Homicide is defined as “the taking of another person’s life” (Weiner, Zahn, and Sagi, 1990, p. 43), and legally may be criminal with intent to kill (murder), criminal without intent to kill (manslaughter) or noncriminal. Homicide studies investigate “the victim-offender relationship and the circumstances of the event” (Flewelling and Williams, p. 99). Riedel & Zahn (1985) found acquaintance homicide was the most frequent, followed by stranger homicide, and then family homicide. Acquaintance homicide was found to be the most frequent in a Chicago study by Rosenfeld in 1997 and Zahn in Philadelphia (1997). Daly and Wilson, 1999, identified the gender differences in their previous studies (1988, 1990) that found “men kill unrelated men vastly more often than women kill unrelated women” (p. 67).

Nisbett (1993) found that the Southern U.S. is more violent than the rest of the country, and homicide rates for rural White, Southern males are higher than their Northern counterparts. Culturally, Southerners endorsed violence for protection and in response to insults more than Northerners, indicating a culture of honor that accepts violence in certain circumstances. Regional differences may provide insight regarding occupational homicide and suicide rates.

Homicide data

There are two national sources for homicide or suicide data. Mortality data are listed on death certificates by coroners or medical examiners who define homicide medically, and that data are then shared with the Vital Statistics Division of the National Center for Health Statistics. Police departments send homicide information to the Uniform Crime Reporting Program (Riedel, 1999). Police define homicide legally, either murder or manslaughter. Justifiable homicides are those by officers of the law or in self-defense. Vital Statistics data provide information for determining the incidence of homicide, numbers that include justifiable homicides, while the Uniform Crime Reports (UCR) provides information for determining the prevalence of murder victimization using numbers that do not include justifiable homicides. While homicides or suicides may be considered and documented as unintentional or death by natural causes, “vital statistics data is considered highly reliable from 1933 onward” (Zahn and McCall, 1999, p. 11).

Farmers’ risk for homicide and suicide.

Homicide is not defined as an occupational risk for farmers, although it does happen. One limitation is that farmer homicides may be business related, and thereby defined occupational, or it may occur as a home or family issue, and thereby is not defined as an occupational risk. CFOI recognizes a work relationship when the fatality occurred on the employer’s premises and the person was there to work, or off the employer’s premises and the person was there to work, or

the event or exposure was related to the person's work or status as an employee (CFOI definitions). Or, since only 45% of farmers identify as farmers on occupational information, perhaps homicide or suicide data is not connected to farming as the occupation.

One study of 139,662 current and former California members of the United Farm Workers of America found that homicide rates between 1973-2000 was higher for farm workers in comparison to the general California population (Mills et al, 2006). Further research regarding farm workers may elucidate the discrepancy between lower farmer homicide rates and higher farm worker homicide rates. A study of farm fatalities in youth populations identified that suicide accounted for 8% of deaths and homicide accounted for 6% (Goldcamp, Hendricks, & Myers, 2004). These numbers are higher for farm youth than for agriculture populations in total, lending support for further investigation into agriculture suicide and homicide. Once identified as an occupational risk, then interventions can be implemented to recognize and reduce risk (Messner and Rosenfeld, 1999). Daly and Wilson (1999) summarized the lofty goal of "any theory on the nature of human conflict ought to shed some light on who is likely to kill whom, when, why, and under what circumstances" (p. 61).

Why investigate homicide and suicide together?

Pokorny's 1965 article comparing homicide, aggravated assault, suicide, and attempted suicide found that suicides and attempted suicides occur typically at home, whereas homicides occur more typically away from home in public places. For many farmers, their home life is intermingled with their work life. Corzine, Huff-Corzine, and Whitt (1999) suggest that an integrated model of homicide and suicide better explains the lethal violence rate, whether the target is self or others. The integrated model uses the lethal violence rate (LVR) = suicide rate + homicide rate. There is support that homicide and suicide rates vary inversely (Whitt, Gordon,

and Hoffley, 1972; Hackney, 1969). However, by studying both, a more complete picture of intentional harm (to self or others) can provide a more clear understanding of occupational risk.

Farmers are working managers who often live and work in the same location, a unique occupational circumstance. They are at risk for injury, but also isolation and multiple stressors that can lead to depression, suicide, and homicide. Agricultural workers have been found to have higher homicide rates than general population homicide rates, and both homicide and suicide are in the top 10 causes of death for farm youth. Despite these statistics, a comprehensive review of agriculture occupational risk for suicide and homicide (i.e. farmers, ranchers, forestry and agricultural workers) has not been undertaken.

CHAPTER III: METHODOLOGY

Population and sample

The population under investigation is all agricultural workers, both farmers and agriculture laborers, and their risk for occupational suicide and homicide. Using 2010 data, BLS estimated there were 1.2 million farmers, ranchers, or other agricultural managers, and approximately 758,000 agricultural workers in the United States.

The sample includes all identified farmer and agriculture laborers occupational homicides and suicides recorded in the CFOI database for workers in the United States from 1992 to 2010.

Design

This study uses secondary data for hypothesis-testing. The Bureau of Labor Statistics Census of Fatal Occupational Injuries (CFOI) data is collected according to standardized procedures and provides a large sample size to draw from with over 18,000 occupational fatalities from 1992 to 2010. The data set includes the population of interest, including farmers, ranchers, and agricultural workers, as well as other occupations for comparison.

Data source

The researcher, as part of the University of Iowa research team, used CFOI data from the Bureau of Labor Statistics through the off-site data request application. The data encompassed 1992-2010 allowing for a 19-year window of occupation-related homicide and suicide incidents to achieve a sufficient sample size for various analytic procedures.

Data and instrumentation

The Bureau of Labor Statistics Census of Fatal Occupational Injuries (CFOI) program collects data annually for all groups of employees including private sector workers, government workers, self-employed, and family businesses. Data from all 50 states plus the District of

Columbia are provided through state and federal agencies that collect, code, and verify fatality data from workers' compensation reports, death certificates, accident reports, and media. In order to confirm the results, at least two data sources must be used to verify the occupational fatality. According to BLS "CFOI includes all fatal work injuries in its annual total, including fatal injuries that occur at small businesses or on family farms. Final decisions about whether a case is in scope for CFOI are made by BLS. Fatal work injuries resulting from a suicide or homicide are in scope for CFOI. Decisions about whether a fatal work incident is coded as a suicide or homicide are based on the information contained in the source documents collected for each individual case" (email correspondence with BLS CFOI staff, 5/30/13). "The CFOI has been endorsed by the National Safety Council and National Center for Health Statistics as the official count of work-related fatalities" (BLS, 2012, p. 16).

Work-related incidents.

The BLS CFOI data provides data on homicides and suicides that have met the criteria of being a work-related incident. A work relationship is considered to exist when the event that resulted in the fatality occurred on the employer's premises and the person was there to work, or off the employer's premises and the person was there to work (BLS CFOI, 2013). "For a fatality to be included in CFOI, the decedent must have been self-employed, working for pay, or volunteering at the time of the event, engaged in a legal work activity, and present at the site of the incident as a job requirement...Fatalities that occur during a person's normal commute to or from work are excluded from CFOI counts" (BLS, 2012, p. 16).

In agriculture, this is often determined by location of the incident, for example in the field or in the home. Farmers often conduct business from their homes and with family members,

therefore allowing for suicide or homicide to be classified as personal versus occupational. If the act is categorized as not work-related, then it would not be included in the BLS CFOI data.

The denominator values for total population were taken from the historical data from the Current Population Survey (BLS). The denominator for the farmers and agricultural workers was taken from the historical data on Current Population Survey, available in annual numbers from 2003 through 2010. The denominator data for farmers and agricultural workers for 1992 to 2002 was estimated by averaging the first five years of data (2003-2008) in the CPS, a number ranging from 2,275,000 to 2,095,000. These numbers are similar to the 2007 USDA Census of Agriculture data estimating 2.2 million farming operations.

Occupation/Industry

From 1992 to 2002, CFOI used the U.S. Census Bureau Occupation Classification System to classify occupation. From 2003 to 2010, CFOI used the 2000 Standard Occupation Classification (SOC) system to classify occupation (BLS, 2012). The substantial differences between the two occupation classification schemes constitute a break in series, and users are advised against making comparisons between them” (BLS, 2012, p. 5). In order to analyze all 19 years of data, the differences were addressed in coding the occupation variable used for analysis as described in the following section.

Variables

The OIICS manual (2007) is the reference source for CFOI data collected between 1992 and 2010.

The variables used for analysis include:

- Year of death (1992-2010).

- Age Category (15 years and under; 16-19 years; 20-24 years; 25-34 years; 35-44 years; 45-54 years; 55-64 years; 65 years and older).
- Gender (Male or Female).
- Race or ethnic origin (White; Black/African American; American Indian or Alaskan Native, Asian, Native Hawaiian or Pacific Islander; Other or Person of Multiple Races).
- Occupation (Using U.S. Census Codes for 1992-2002 and SOC for 2003-2010, occupations were coded for farmers and farm managers, farm workers and direct supervisors, fishing, logging and mining, and all others; Farmers included codes 473, 474, 475, 476 and 11-9010, 11-9011, 11-9012, 45-1010, 45-1011, 45-1012; Agricultural workers included codes 477, 479, 483, 484, 485, 488, 489 and 45-2000 through 45-2099; Fishing occupations included codes 497, 498, 499 and 45-3000 through 45-3021; Forestry included codes 494, 495, 496 and 45-4000 through 4029).
- Employee status (Self-employed; work in family business; work for pay; active duty of the resident military and off-duty police).
- Worker activity at time of incident.
- Worker location.
- Geographic location based on the state and the Bureau of the Census regions (Northeast, Midwest, South, West; Northeast: Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont; Midwest: Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin; South: Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, and West Virginia;

West: Arizona, Colorado, Idaho, Montana, Nevada, Alaska, California, Hawaii, Oregon, Washington, New Mexico, Utah, and Wyoming).

- Employer establishment size (1-10 employees, 11-19; 20-49; 50-99; 100+ employees).
- Event or Exposure: the manner in which the injury or illness was produced or inflicted by the source of injury or illness as defined by the Occupational Injury and Illness Classification Manual (BLS, 2007) and looked at assaults and violent acts; assaults and violent acts by persons (cases in which the worker was injured or made ill by intentional assaults by a person other than the injured person or by violent); harmful actions of unknown intent by a person); hitting, kicking, beating; shooting; stabbing, or self-inflicted injury (cases both with and without intent being known).

Analysis

CFOI data text files were exported to SPSS 21 for analysis. Total fatality numbers for all occupations, for farmers and agricultural workers, forestry, and fishing were generated, with descriptive information provided for farmers and agricultural workers.

The first hypothesis, rates of homicide are lower in agriculture than in other working populations, but rates of suicide are higher in agriculture compared with other working groups, was analyzed by showing rates of homicide and suicide for total population and farmers and agricultural workers based on total worker denominator values from BLS data. Overall rates of homicide and suicide in comparison of total fatalities were generated based on total sample population, farmers, agricultural workers, fishing, and forestry populations. Then, the 19-year trend for homicide and suicide of farmers versus all occupations was calculated and compared with all occupations.

The second hypothesis, rates of suicide and homicide are higher in the Southern United States compared with other regions of the country, was analyzed by sorting all farmer and agricultural worker homicide and suicide numbers and comparing them by region using a Chi-square analysis. This approach addressed the question, “Are there more farmer and agricultural worker workplace homicides and suicides in the Southern United States?”

The third hypothesis, males are equally likely to be victims of both homicide and suicide, and use of firearms are the most likely cause of death in homicide and suicide, has two parts that were analyzed separately. First, the population rates of males to females in farming occupations were provided for comparison. Then, the total number male to female agricultural homicides and suicides were compared using a Chi-square analysis to determine whether male versus female farmers/agricultural workers are more likely to die from homicide or suicide. A multiple regression was then used to identify demographic variables that significantly contribute to whether or not a farmer/agricultural worker became the victim of homicide or suicide in the workplace.

CHAPTER IV: RESULTS

CFOI data from 1992 to 2010 was analyzed for the purpose of addressing questions about occupational homicide and suicide for farmers and agricultural worker populations.

Farmers, Agricultural Workers and Other Occupations

Table 1 provides summary statistics for total fatalities for all years (1992-2010). Farmers plus agricultural workers account for nine percent of the fatalities, while they make up less than two percent of the working population. Rates of homicide plus suicide for farmers and agricultural workers were compared to total occupation rates of homicide plus suicide for each year 1992-2010 in Table 2. “Total occupation” does include farmers and agricultural workers. Rate trends are provided in Figure 1 and show that the farmer and agricultural worker rates are higher than the rates for the total population. Further review found that homicide rates for farmers and agricultural workers are higher 4 of 19 years and lower 13 of 19 years when compared to the homicide rates for all occupations (see Table 3 and Figure 2). Suicide rates for farmers and agricultural workers are higher than suicide rates for total occupations for 18 years (see Table 4 and Figure 3).

Table 1. Occupational Fatalities, Homicides, and Suicides for Farmers, Agricultural Workers, Fishing, Forestry, and All Occupations from 1992 to 2010.

	Farmers N(%)	Agricultural Workers N(%)	Fishing N(%)	Forestry N(%)	Other N(%)	All Occupations N(%)
Fatalities 1992-2010	6664 (6%)	3372 (3%)	1498 (1%)	1778 (2%)	96,908 (88%)	110,220 (100%)
Homicides & Suicides 1992-2010	235 (1.3%)	166 (0.9%)	60 (0.3%)	17 (0.1%)	17,546 (97.3%)	18,024 (100%)
Homicides 1992-2010	75 (0.5%)	96 (0.7%)	27 (0.2%)	8 (0.1%)	13,643 (98.5%)	13,849 (100%)
Suicides 1992-2010	160 (3.8%)	70 (1.7%)	33 (0.8%)	9 (0.2%)	3903 (93.5%)	4175 (100%)

Fatal injury data and rates were generated/calculated by the author with restricted access to BLS CFOI microdata.

Table 2. Occupational Homicides and Suicide Rates for Farmers and Agricultural Workers and All Occupations from 1992-2010.

Year	Rates for Farmers/Ag Workers			Rates for All Occupations		
	N=	Population N=	Rate/100,000	N=	Population N=	Rate/100,000
1992	20	2,201,000	0.91	1251	118,492,000	1.06
1993	12	2,201,000	0.55	1294	120,259,000	1.08
1994	31	2,201,000	1.41	1293	123,060,000	1.05
1995	25	2,201,000	1.14	1246	124,900,000	1.00
1996	34	2,201,000	1.54	1131	126,708,000	0.89
1997	27	2,201,000	1.23	1077	129,558,000	0.83
1998	28	2,201,000	1.27	938	131,463,000	0.71
1999	28	2,201,000	1.27	870	133,488,000	0.65
2000	22	2,201,000	1.00	899	136,891,000	0.66
2001	20	2,201,000	0.91	873	136,933,000	0.64
2002	21	2,201,000	0.95	808	136,485,000	0.59
2003	24	2,275,000	1.05	854	137,736,000	0.62
2004	14	2,232,000	0.63	769	139,252,000	0.55
2005	N/A	2,197,000	N/A	750	141,730,000	0.53
2006	N/A	2,206,000	N/A	752	144,427,000	0.52
2007	19	2,095,000	0.91	828	146,047,000	0.57
2008	N/A	2,168,000	N/A	791	145,362,000	0.54
2009	18	2,018,000	0.89	806	139,877,000	0.58
2010	N/A	2,206,000	N/A	794	139,064,000	0.57

Fatal injury data and rates were generated/calculated by the author with restricted access to BLS CFOI microdata. N/A indicates either no data available, or data does not meet BLS publication criteria.

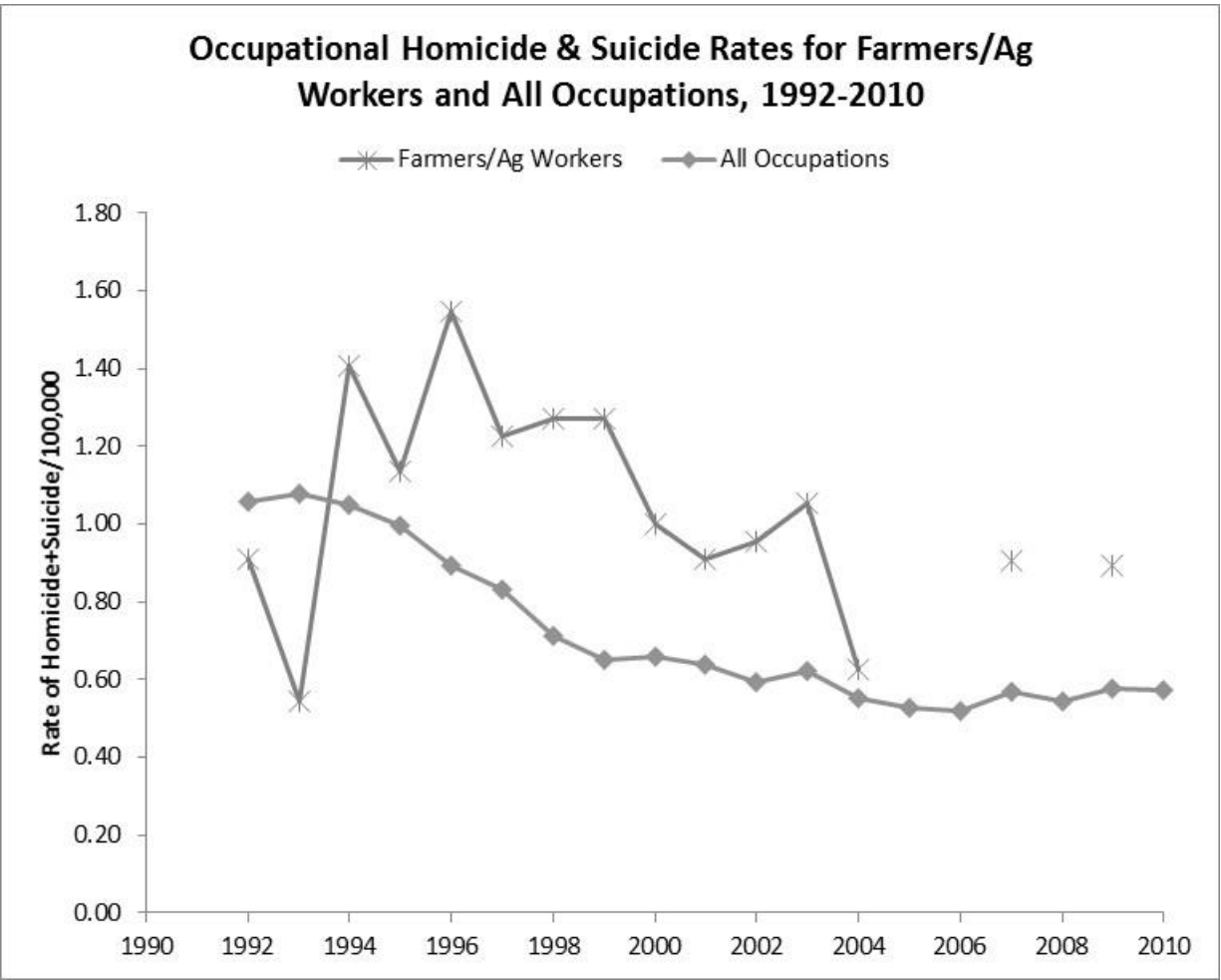


Figure 1. Occupational Homicide & Suicide Rates for Farmers and Agriculture Workers Compared to All Occupations from 1992 through 2010. Fatal injury data and rates were generated/calculated by the author with restricted access to BLS CFOI microdata. Missing years indicates either no data available, or data does not meet BLS publication criteria.

Table 3. Occupational Homicides Rates/100,000 for Farmers and Agricultural Workers and All Occupations from 1992-2010.

Year	Farmers/Ag Workers			All Occupations		
	N=	Population N=	Rate/100,000	N=	Population N=	Rate/100,000
1992	10	2,201,000	0.45	1046	118,492,000	0.88
1993	6	2,201,000	0.27	1072	120,259,000	0.89
1994	14	2,201,000	0.64	1079	123,060,000	0.88
1995	16	2,201,000	0.73	1025	124,900,000	0.82
1996	13	2,201,000	0.59	927	126,708,000	0.73
1997	7	2,201,000	0.32	861	129,558,000	0.66
1998	17	2,201,000	0.77	717	131,463,000	0.55
1999	12	2,201,000	0.55	652	133,488,000	0.49
2000	8	2,201,000	0.36	678	136,891,000	0.50
2001	5	2,201,000	0.23	643	136,933,000	0.47
2002	9	2,201,000	0.41	609	136,485,000	0.45
2003	12	2,275,000	0.53	636	137,736,000	0.46
2004	6	2,232,000	0.27	563	139,252,000	0.40
2005	N/A	2,197,000	N/A	570	141,730,000	0.40
2006	N/A	2,206,000	N/A	544	144,427,000	0.38
2007	5	2,095,000	0.24	632	146,047,000	0.43
2008	14	2,168,000	0.65	773	145,362,000	0.53
2009	6	2,018,000	0.30	788	139,877,000	0.56
2010	6	2,206,000	0.27	782	139,064,000	0.56

Fatal injury data and rates were generated/calculated by the author with restricted access to BLS CFOI microdata.

N/A indicates either no data available, or data does not meet BLS publication criteria.

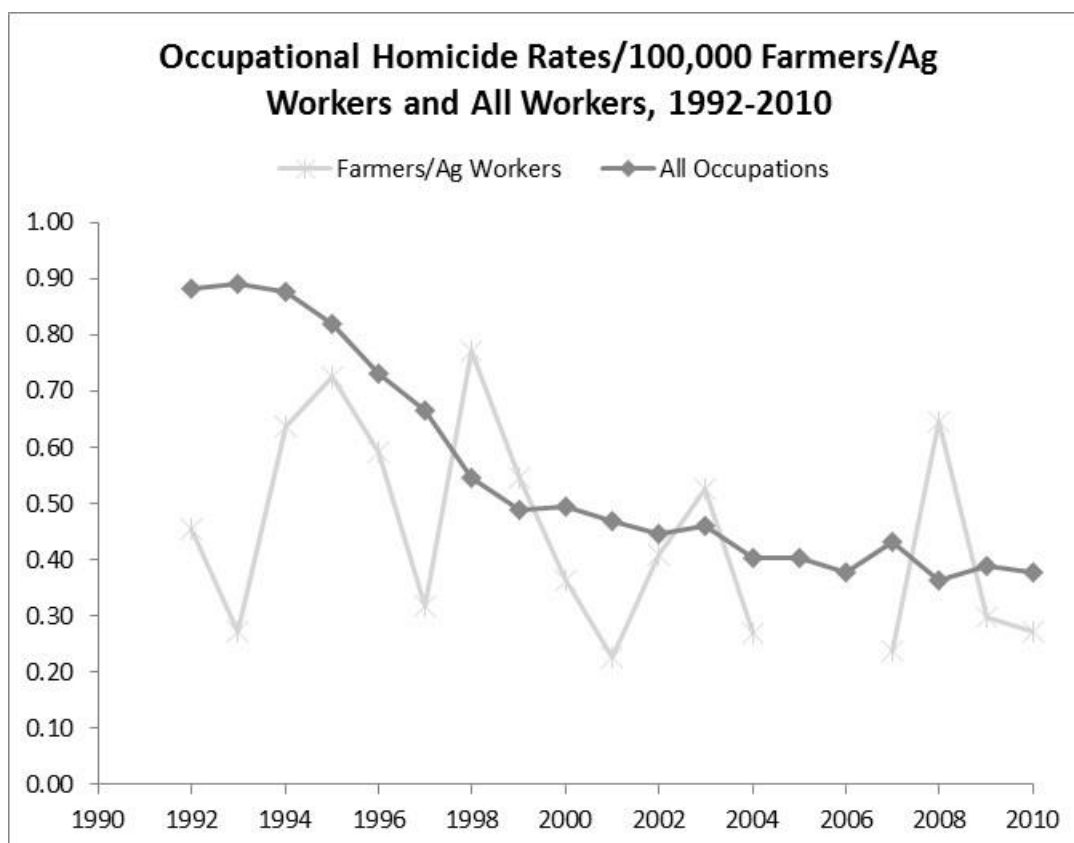


Figure 2. Occupational Homicide Rates per 100,000 Farmers and Agriculture Workers Compared to Occupational Homicide Rates per 100,000 Workers in All Occupations from 1992 through 2010. 2005 and 2006 data is either not available or does not meet BLS publication criteria. Fatal injury data and rates were generated/calculated by the author with restricted access to BLS CFOI microdata.

Table 4. Occupational Suicide Rates/100,000 for Farmers and Agricultural Workers and All Occupations from 1992-2010.

Year	Farmers/Ag Workers			All Occupations		
	N=	Population	N= Rate/100,000	N=	Population	N= Rate/100,000
1992	10	2,201,000	0.45	205	118,492,000	0.17
1993	6	2,201,000	0.27	222	120,259,000	0.18
1994	17	2,201,000	0.77	214	123,060,000	0.17
1995	9	2,201,000	0.41	221	124,900,000	0.18
1996	21	2,201,000	0.95	204	126,708,000	0.16
1997	20	2,201,000	0.91	216	129,558,000	0.17
1998	11	2,201,000	0.50	221	131,463,000	0.17
1999	16	2,201,000	0.73	218	133,488,000	0.16
2000	14	2,201,000	0.64	221	136,891,000	0.16
2001	15	2,201,000	0.68	230	136,933,000	0.17
2002	12	2,201,000	0.55	199	136,485,000	0.15
2003	12	2,275,000	0.53	218	137,736,000	0.16
2004	8	2,232,000	0.36	206	139,252,000	0.15
2005	10	2,197,000	0.46	180	141,730,000	0.13
2006	13	2,206,000	0.59	208	144,427,000	0.14
2007	14	2,095,000	0.67	196	146,047,000	0.13
2008	N/A	2,168,000	N/A	263	145,362,000	0.18
2009	12	2,018,000	0.59	263	139,877,000	0.19
2010	N/A	2,206,000	N/A	270	139,064,000	0.19

Fatal injury data and rates were generated/calculated by the author with restricted access to BLS CFOI microdata.

N/A indicates either no data available, or data does not meet BLS publication criteria.

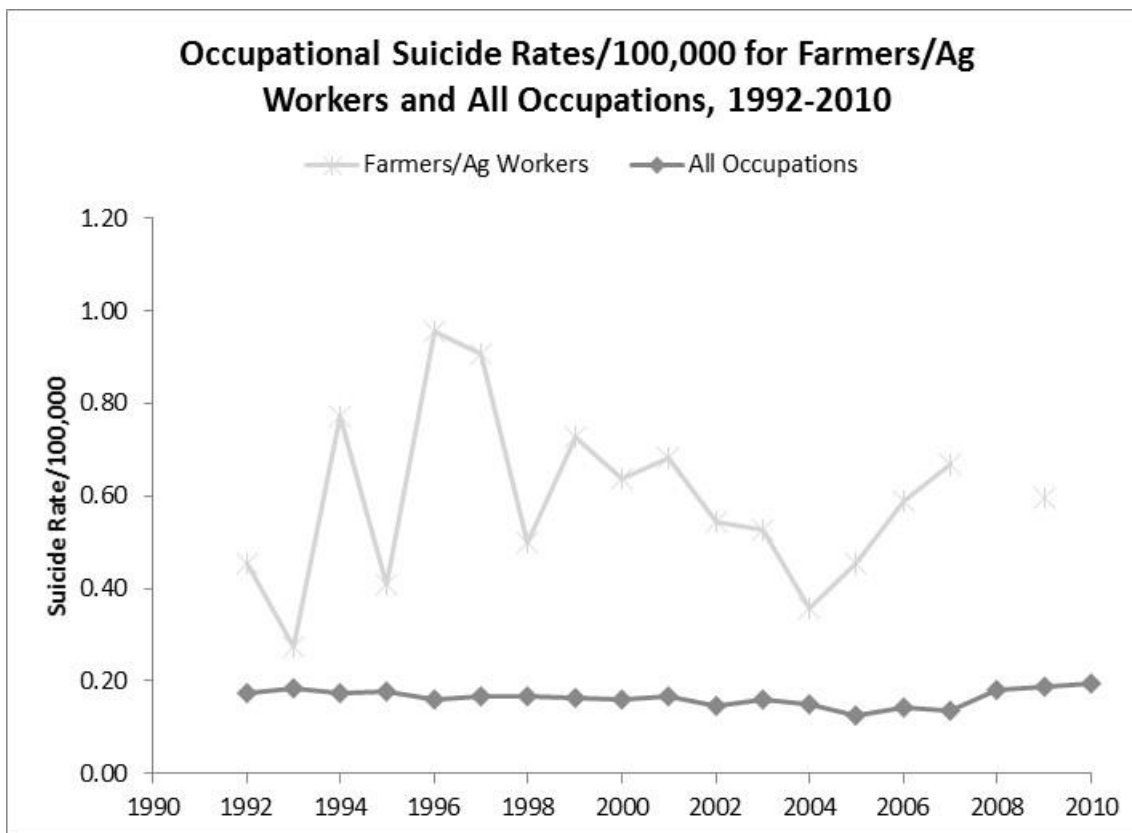


Figure 3. Occupational Suicide Rates per 100,000 Farmers and Agriculture Workers Compared to Occupational Suicide Rates per 100,000 Workers in All Occupations from 1992 through 2010. 2008 and 2010 data is either not available or does not meet BLS publication criteria. Fatal injury data and rates were generated/calculated by the author with restricted access to BLS CFOI microdata.

Farmer and Agricultural Worker Homicide and Suicide by Region

Occupational homicide and suicide for farmers and agricultural workers were compared by region. The differences are provided in Table 5 and illustrated in Figure 4 and show that farmers and agricultural workers are more likely to be victims of occupational homicide in the South (44.4%), followed closely by the West (39.8%). In comparison, farmers and agricultural workers are more likely to be victims of occupational suicide in the West (43.0%) and Midwest (37.4%). Occupational homicide and suicide for farmers and agricultural workers in the northeast

account for the smallest percent. The regional differences were significant using the Pearson Chi-square (value=61.724, df=3, p-value<0.001).

Table 5. Farmer and Agricultural Worker Occupational Homicide and Suicide by Region, 1992-2010

	Northeast N(%)	Midwest N(%)	South N(%)	West N(%)	Total N(%)
Farmer/Ag Worker Homicide	8 (4.7%)	19 (11.1%)	76 (44.4%)	68 (39.8%)	171 (100%)
Farmer/Ag Worker Suicide	14 (6.1%)	86 (37.4%)	31 (13.5%)	99 (43.0%)	230 (100%)

Fatal injury data and rates were generated/calculated by the author with restricted access to BLS CFOI microdata.

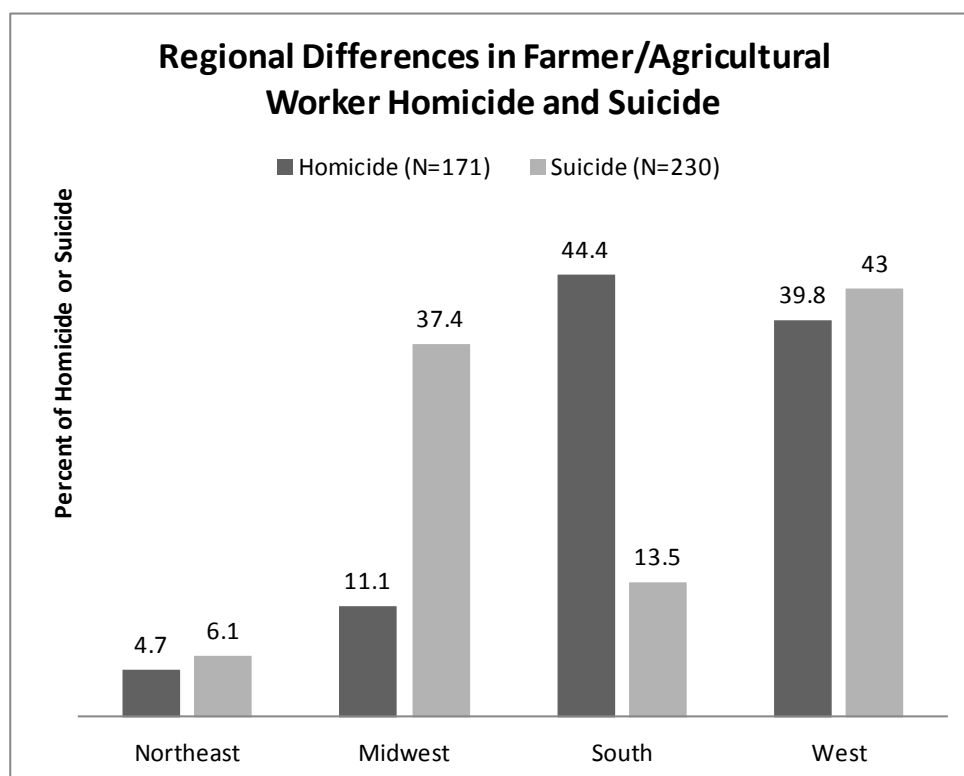


Figure 4. Regional Differences in Farmer and Agriculture Worker Homicide and Suicide Percentages. Fatal injury data and rates were generated/calculated by the author with restricted access to BLS CFOI microdata.

**Demographics and Worker Characteristics of Farmers
and Agricultural Workers Who Died of
Occupational Homicide or Suicide, 1992-2010.**

Demographics and worker characteristics of farmers and agricultural workers who were victims of occupational homicide or suicide are provided in Table 6. Based on this data, a typical victim of homicide was white, male, over 25 years of age, worked for pay for an employer that had less than 10 employees, and was located on the farm. A typical victim of suicide was white, male, over the age of 35, self-employed with less than 10 employees, and was located in a farm building (not a silo). Worker activity was reported for 235 cases (166 cases had missing data). Of the 235 cases, 8.8% (n=15) were when the farmer or agricultural worker was caring for animals. Month of death was investigated, but was not found to significantly influence the outcome of homicide or suicide.

Binary logistic regression outcome modeling provided a probability of suicide versus homicide for gender (females=0, males=1), race (white=1, not white=0), age categories (34 years and younger, 35-54 years, 55-64 years, and 65 years and older), employee status (self-employed=1, not self-employed=0), and establishment size (1-10 employees, 10 employees or more). The age categories and establishment size categories were determined after a review of frequencies, and then each category was coded into a dichotomous variable. Gender, race, employee status, and establishment size were all found to significantly predict the likelihood of suicide for the sample population (see Table 7). Compared with females, males have 6.1 times increased odds for suicide over homicide. Compared with non-Whites, Whites have 4.7 times the odds of suicide over homicide. Self-employed farmers and agricultural workers have a 2.3 times the odds of suicide over homicide in comparison to those who worked for pay. A smaller

Table 6. Demographics and Worker Characteristics of Farmer/Ag Workers Who Were Victims of Homicide and Suicide, 1992-2010.

	Homicide	Suicide	Chi-square	df	P-value
Total	171 (100%)	230 (100%)			
Gender			12.01	1	0.001
Male to Female	381 males:20 females				
Age			26.757	8	0.001
19 years or under	7 (4.1%)	6 (2.6%)			
20-24 yrs	13 (7.6%)	8 (3.5%)			
25-34 yrs	38 (22.2%)	28 (12.2%)			
35-44 yrs	37 (21.6%)	50 (21.7%)			
45-54 yrs	19 (11.1%)	58 (25.2%)			
55-64 yrs	25 (14.6%)	33 (14.3%)			
65+ yrs	29 (17%)	47 (20.4%)			
Race			29.924	4	<0.001
White	142 (83%)	224 (97.4%)			
Other (Black/African American, American Indian/Alaskan Native/Native, Hawaiian/Pacific Islander, Multiple Races)	26 (15.2%)	5 (2.2%)			
Employee Status			45.111	4	<0.001
Self-Employed	66 (38.6%)	150 (65.2%)			
Work in Family Business	7 (4.1%)	22 (9.6%)			
Work for Pay	97 (56.7%)	57 (24.8%)			
Worker Location			95.045	31	<0.000
Farm	18 (10.5%)	12 (5.2%)			
Farm house	13 (7.6%)	25 (10.9%)			
Farm, unspecified	24 (14.0%)	56 (24.3%)			
Farm building, not silo	16(9.4%)	76 (33.0%)			
Farm land or Commercial store	54 (31.6%)	30 (13.0%)			
Employer Size			30.783	5	<0.001
1-10 employees	65 (38%)	148 (64.3%)			
11-19 employees	10 (2.5%)	9 (2.2%)			
20-99 employees	13 (3.2%)	5 (1.2%)			
100 or more	10 (2.5%)	5 (1.2%)			
missing	73 (18.2%)	63 (15.7%)			

Fatal injury data and rates were generated/calculated by the author with restricted access to BLS CFOI microdata.

Table 7. Predictors for Occupational Homicide and Suicide for Farmers/Ag Workers

Variables	Odds Ratio	CI	
		Lower	Upper
Male compared to female	6.112	1.857	20.114
White compared to Not White	4.657	1.789	12.122
Self-Employed compared to Not	2.269	1.354	3.803
Establishment Size 1-10 employees to 11+ employees*	1.906	1.207	3.010
Age 35-54 years compared to 34 years or younger*	1.669	0.932	2.989

*Dummy variables were created for establishment size and age categories.

Fatal injury data and rates were generated/calculated by the author with restricted access to BLS CFOI microdata.

establishment size had 1.9 times the odds of suicide over homicide. The age category of 35 to 54 years showed a 1.7 times increased odds ratio of suicide when compared to less than 35 years of age.

Gender and Method of Occupation Homicide or Suicide for Farmers and Agricultural Workers

Farmer and agricultural worker occupational homicide and suicide data (n=401) was compared by gender with all occupational homicide and suicides and the national distribution of male to female farmers (see Table 8). The statistics reflect a higher number of male and lower number of female fatalities from homicide and suicide in the agricultural occupation versus the total occupation fatalities from homicide and suicide, and a difference in male to female homicides and suicides when compared to national proportions of male to female farm ownership. The difference between male and female farmer and agricultural workers homicide and suicide victims is statistically significant (Chi-square=12.01, df=1, p-value=0.001) and is illustrated in Figure 5.

Table 8. Occupational Homicide and Suicide for Farmers and Agricultural Workers by Gender, 1992-2010, Compared to Current Gender Distribution of Farm Ownership.

	Male	Female	Total
Total occ. homicides and suicides, 1992-2010	15145 (84%)	2879 (16%)	18024
Farmer/Ag Worker homicides and suicides, 1992-2010	381 (95%)	20 (5%)	401
Gender Distribution of Farm Ownership			
U.S. Census of Agriculture (2007)	1,898,583 (86.1%)	306,209 (13.9%)	

Fatal injury data and rates were generated/calculated by the author with restricted access to BLS CFOI microdata.



Figure 5. Gender Distribution of Farmers and Agriculture Workers Who Died From Occupational Homicide and Occupational Suicide Compared to U.S. Farmer Owners Gender Distribution. Fatal injury data and rates were generated/calculated by the author with restricted access to BLS CFOI microdata.

Gender and Homicide by Firearm

Males and females were compared using a Chi-square analysis to determine whether or not there were significant differences based on whether the victim was shot or not. There was no significant difference (Pearson Chi-square=0.056, df=1, p-value= .812) because both males and females suffered from firearm homicide at approximately 80 percent of the time (see Table 9).

Table 9. Death by Shooting for Occupational Homicide and for Farmers and Agricultural Workers by Gender, 1992-2010

	Non-Firearm Homicide	Firearm Homicide
Male	~20 %	~80%
Female	~20 %	~80%

Fatal injury data and rates were generated/calculated by the author with restricted access to BLS CFOI microdata.

Farmer and Agricultural Worker Homicide

Farmers and agricultural workers were victims of occupational homicide through shooting; hitting, kicking, and beating; stabbing; and other assault. There were a total of 171 homicides over the 19 year period, with shooting victims the most prevalent (n=135), followed by hitting, kicking, and beating (n=16), stabbing (n=13), and then an unspecified assault or violent act (n=7). The standardized comparison is shown in Figure 6 below.

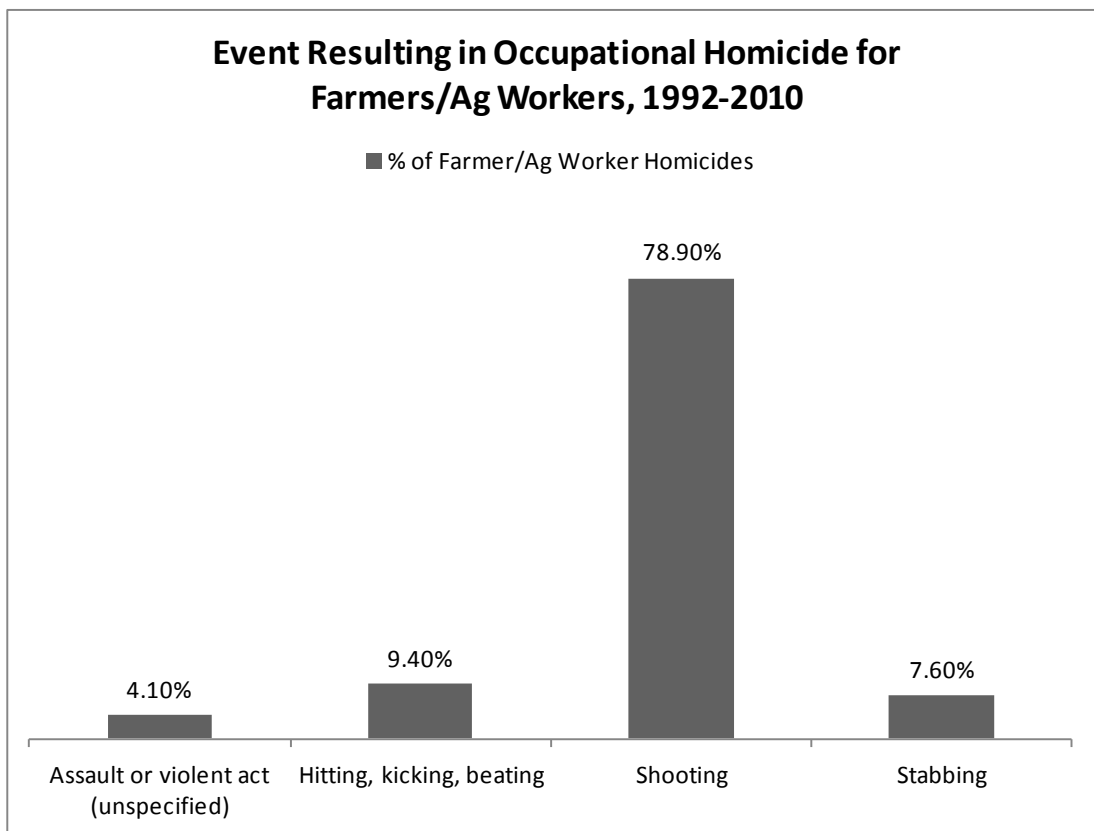


Figure 6. Event Resulting in Occupational Homicide for Farmer and Agriculture Workers from 1992 through 2010. Fatal injury data and rates were generated/calculated by the author with restricted access to BLS CFOI microdata.

CHAPTER V: DISCUSSION

This study reviewed occupational homicide and suicide for farmers and agriculture workers using 19 years of fatality data for the purposes of (1) estimating rates of homicide and suicide for farmers and agriculture workers and compare those rates with other worker populations; (2) examining regional distributions of those homicides and suicides; and (3) comparing demographics of those cases of homicide to cases of suicide.

This study confirmed other published data regarding farmers and agriculture workers that homicide rates are generally lower, while suicide rates are consistently higher for farmers and agriculture workers when compared with total occupations. Homicide patterns for total populations reflect a slow decline, while farmer and agriculture worker homicide patterns spike every few years. Further research may find homicide rates correlate with important agriculture events, such as drought, floods, or economic downturns. Suicide patterns are more interesting because they never drop below total occupation suicides. Could these suicides be a reflection of some agricultural constants, or do they reflect a greater societal issue felt by many and acted upon successfully by farmers?

This study attempted to define a total production agriculture working population by combining farmers and agriculture workers. This was a challenge for a few reasons. First, farmers are considered managers, and categorized as a different occupation than agriculture workers. Combining parts of different occupation categories meant that reference populations were not necessarily similar. For example, reference data from BLS included farmers and farm workers, but did not specify what occupation codes were used in their estimates. NASS data included only farm operators. Additionally, total population data was complicated by the suggestion that only 45% of farmers identified themselves occupationally as “farmers” (EPA,

2013; USDA, 2007). It was assumed that since 65% of farmers work off the farm for financial reasons, they self-reported as their off-farm work identity. Ultimately, total farmer and agriculture worker numbers were taken from the BLS website using available CPS data which was available from 2003 to 2010, and using five years of data (2003 to 2010), an estimate was made and used for the years 1992 to 2002. While the total population numbers seemed to reflect other estimated numbers for farmers and agriculture workers, a more in-depth review of numbers regarding farmer and agriculture workers from 1992 to 2002 may provide a more accurate estimate that may alter the rates used by this study.

This study found significant regional variations in that numbers of farmer and agriculture homicide and suicide. The South (44.4%) and West (39.8%) accounted for just over 84% of the occupational homicides, while the Midwest and Northeast accounted for 16 percent. Eighty percent of farmer and agriculture worker suicide occurred in the West (43%) and Midwest (37.4%). The Western region had high numbers of both homicide and suicide. The South had high numbers of homicide, but low numbers of suicide. The Midwest had high numbers of suicide, but low numbers of homicide. The Northeast had low occupational homicide and suicide numbers for farmers and agriculture workers. Prior research suggested that homicide and suicide rates vary inversely. This was found in two regions (South and Midwest), but not found in the West and Northeast (Whitt, Gordon, and Hoffley, 1972; Hackney, 1969). By looking at both homicide and suicide, a more complete picture of intentional harm (to self or others) has been provided.

These regional differences are evocative, and future research may further define these variations. For example, does the Southern culture that is more tolerant of violence influence homicide rates? Does the West share that culture? Or, is there a regional difference due to the

agriculture worker in comparison to the farmer position? What are the underlying differences in the homicide versus the suicide cases? Perhaps the low numbers of cases play a part in these differences. Additional comparisons with other occupations may provide insight to regional culture or highlight if this pattern is specific to production agriculture.

Regional rates were not calculated due to the difficulty in identifying like total farmer and agriculture worker populations, and the difficulty in finding similar regional data. The data may exist at the state level, and future research could investigate each state's farmer and agriculture worker populations and tally regional data.

Finally, as expected, males were equally likely to be victims of both homicide and suicide, and firearms were the most likely cause of death for both men and women victims accounting for 80% of homicides for both genders. Based on this data, a typical victim of homicide was white, male, over 25 years of age, worked for pay for an employer that had less than 10 employees, and was located on the farm. A typical victim of suicide was white, male, over the age of 35, self-employed with less than 10 employees, and was located in a farm building (not a silo). These demographics indicate a couple of important points. First, the race and gender aspect mirror national data. However, the age distribution is young in comparison to the past U.S. Census on Agriculture publications that have found the average age of farmers to be over 50 years of age. Also, the number of homicides among agriculture workers, prior research, and the regional variation of homicide, may have indicated more representation of a non-white population. That does not appear to be the case. The white majority in both occupational homicide and suicide may reflect the national distribution of farming, or ownership, but this variable deserves further investigation.

Homicide victims (61%) worked for pay, whereas 65% of the suicide victims were self-employed. This difference suggests that suicide was triggered by some type of owner-operator stress. Who are the agriculture workers who are victims of occupational homicide, and what is the relationship to their attacker? Further research may provide information needed in order to better develop appropriate intervention and prevention policy and programming. Finally, if data on worker activity were available in the data set, it may provide additional insight, although it is not expected that others would be present during suicide.

The regression analysis provides insight into suicide versus homicide victimization for farmers and agriculture workers. When compared to victims of homicide, victims of occupational suicide are more likely to be male (6 times), white (almost 5 times), self-employed (2 times), work in a small establishment (almost 2 times), and aged between 35 to 54 years of age (1.7 times). Males traditionally take on the role of “family provider” and if they are struggling to maintain that provider role, or experiencing the stress prior research has connected with production agriculture, then intentional, and successful self-harm appears to be one route more likely chosen by males. To clarify the statistics, recall that only 45% of farmers self-identify occupationally as farmer, so this group that has identified occupationally as farmer in the BLS data may very well not work in any other off-farm position. That would indicate that the income from farming is the farmer’s only income. This also makes sense when seeing that those who are self-employed, and those who work in small establishments, like those who are self-employed and have few employees, feel more of a burden in the farm and its operations. Since we know that the physical work environment is stressful and physically demanding, and the pressures on farmers can result in depression, and lack of access to or seeking of health care services results in substance abuse, interpersonal violence, anger, and hopelessness. The

consistently high suicide rates found in this study seem logical because farmers and agriculture workers experience the risk factors for suicide: economic and labor market conditions, poor access to quality public health services, isolation, availability of lethal method, being male, history of mental illness, chronic pain or illness, alcohol or drug abuse, and feeling loss of control over life (U.S. Department of Human Services, 2001). The results of this study builds on prior research and supports policy that provides increased access to mental health services for farmers and agriculture workers.

This study found a significantly higher number of male, and lower number of female, fatalities from homicide and suicide in the agricultural occupations versus the total occupation fatalities from homicide and suicide, and a difference in male to female homicides and suicides when compared to national proportions of male to female in farm ownership.

Firearms have been found to be the primary method for homicide and suicide in the past. The variables investigated in this study specified cause of death for homicides, but not for suicides. Men and women were found to be a victim of homicide from firearms 80% of the time. Another variable may provide cause of death for this population, and future research may consider cause of death for occupational suicide in farmer and agriculture populations. This study suggests that access to firearms lends itself to using firearms for homicide for both men and women. The use of firearms, approximately 80% of the time, is more than two times higher than prior published research from National Vital Statistics (2011). Prior research into suicide has shown that firearms are used more frequently in suicide, and future research could elucidate the use of firearms by farmers and agriculture workers in suicide (Browning et al., 2008; CFOI, 2008; National Vital Statistics, 2011; and Stallones, 1990).

Future Research

Future research in farmer and agriculture worker homicide and suicide incidents may investigate the changed and changing demographics of that workforce, such as the increasing numbers of female farmers and increasing farm size. In addition, defining and quantifying the unmet mental health needs of those working, and living, in agricultural settings would be a worthy endeavor. Farmer suicide has been linked to economic crises. While this study did not compare trends with economic crises, the opportunity exists for future comparisons using the established data file. Qualitative data may be pursued to better understand circumstances surrounding occupational homicide and suicide and to gain insight into moments when intervention could have taken place in order to save lives.

Limitations

In addition to limitations addressed in the Discussion, the following limitations apply to this study. First, the CFOI data does not provide non-fatal data, and was not compared to non-fatal injuries during this study, and these results, therefore, lack any insight into attempted homicides or attempted suicides. Next, trends are valuable, but do not take into account technological, economical, and social change through two decades. For example, issues that influenced homicide and suicide rates may or may not affect later years. Finally, the occupational coding differences between 1992-2002 and 2003-2010 are considered significant enough by BLS that it does not recommend comparing the two groups. This study tried to attempt to address this caveat by converting the codes in the two data sets (1992-2002 and 2003-2010) and consolidating them in order to review 19 years of data.

CONCLUSIONS

This study provided verification for existing research on farmer and agriculture worker homicide and suicide. The author found higher suicide rates and lower homicide rates when compared to all workers; regional variations in occupational homicide and suicide incidents for farmers and agriculture workers; males are more likely victims of homicide and suicide; and firearms are the most common method for homicide.

An important contribution of this study is the 19-year trend of occupational homicide and suicide rates for farmers and agriculture workers. The extended view provides insight into spikes and lows in homicide and suicide incidents. In addition, although farmer and agricultural suicide has been of interest since the economic crises in the 1980's, homicide of the same population has not been studied with the same interest leaving open the opportunity to study both homicide and suicide of farmer and agricultural workers. This study has highlighted interesting differences between homicide and suicide incidents for the targeted population.

Homicide and suicide are concerns for public health professionals, and professionals in agricultural health and safety, because they devastate families (emotionally and financially) when they occur, and they are preventable. Suicide has been shown to be related to stress and depression, and this study supports prior recommendations for improved access to health care and public health messages to increase the likelihood for farmers and agriculture workers to pursue mental health services. Finally, access to firearms provides farmers and agriculture workers with effective lethal means for homicide and suicide. Access to mental health services and messages encouraging use of available mental health care services may also reduce homicide.

REFERENCES

- Alston, M. 2012. "Rural male suicide in Australia." *Soc Sci Med* 74(4): 515-522.
- Agriwellness, Inc. "History." Accessed July 31, 2013.
<http://www.agriwellness.org/AWHistory.htm>.
- Beard, J.D., Umbach, D.M., Hoppin, J.A., Richards, M., Alavanja, M.C., Blair, A., Sandler, D.P., Kamel, F. 2011. "Suicide and Pesticide Use among Pesticide Applicators and Their Spouses in the Agricultural Health Study." *Environmental Health Perspectives* 119(11):1610-5.
- Beseler C, Stallones, L., Hoppin, J.A., Alavanja, M.C., Blair, A., Keefe, T., and Kamel, F. 2006. "Depression and Pesticide Exposures in Female Spouses of Licensed Pesticide Applicators in the Agricultural Health Study Cohort." *J Occ Env Med* 48(10): 1005-1013.
- Beseler, C.L, and Stallones, L. 2008, Oct. "A cohort study of pesticide poisoning and depression in Colorado farm residents." *Ann Epidemiology* 18(10):768-74.
- Blair, A., Sandler, D.P., Tarone, R., Lubin, J., Thomas, K., Hoppin, J.A., Samanic, C., Coble, J., Kamel, F., Knott, C., Dosemeci, M., Zahm, S.H., Lynch, C.F., Rothman, N., and Alavanja, M.C.R. 2005. "Mortality among participants in the Agricultural Health Study." *Annals of Epidemiology* 15(4):279-285.
- Bureau of Labor Statistics 2010. *Revisions to the 2010 Census of Fatal Occupational Injuries (CFOI) Counts*. Accessed December 18, 2012.
http://www.bls.gov/iif/oshwc/cfoi/cfoi_revised10.pdf.
- Bureau of Labor Statistics. 2012, September 5. BLS Handbook of Methods, Chapter 9. *Occupational Safety and Health Statistics*. Accessed on June 6, 2013.
<http://www.bls.gov/opub/hom/homch9.htm>.
- Bureau of Labor Statistics. 2007. *Occupational Injury and Illness Manual*. Accessed May 28, 2013. <http://www.bls.gov/iif/oshoiics.htm>.
- Bureau of Labor Statistics. 2010. *National Employment Matrix for Occupation*. Accessed July 10, 2013. <http://data.bls.gov/oep/nioem>.
- Bureau of Labor Statistics. (2010). Table A-6 Fatal Occupational Injuries Resulting from Transportation Incidents and Homicides by Occupation (Retrieved on July 10, 2013 from <http://www.bls.gov/iif/oshwc/cfoi/cftb0255.pdf>).
- Bureau of Labor Statistics. 2012. *Census of Fatal Occupational Injuries CFOI Research File User Reference*.

- Bureau of Labor Statistics 2013. *Census of Fatal Occupational Injuries, 1992-2002*. Accessed on March 9, 2013. <ftp://ftp.bls.gov/pub/time.series/cf/cf.txt>.
- Bureau of Labor Statistics 2013. *Census of Fatal Occupational Injuries, 1992-2002*. Accessed on October 9, 2012. <http://www.bls.gov/iif/oshwc/cfoi/osar0010.pdf>.
- Bureau of Labor Statistics 2013. *Quick Facts: Agricultural Workers*. Accessed June 7, 2013. <http://www.bls.gov/ooh/farming-fishing-and-forestry/agricultural-workers.htm>.
- Bureau of Labor Statistics. 2013. *Quick Facts: Farmers, Ranchers, and Other Agricultural Managers*. Accessed on June 7, 2013. <http://www.bls.gov/ooh/management/farmers-ranchers-and-other-agricultural-managers.htm>.
- Booth, N., Briscoe, M., and Powell, R. 2000. "Suicide in the Farming Community: Methods Used and Contact with Health Services." *Occup Environ Med* 57(9): 642-644.
- Booth, N.J. and K. Lloyed. 2000. "Stress in Farmers." *Int J Soc Psychiatry* 46(1): 67-73.
- Browning, S. R., S. C. Westneat, et al. 2008. "Suicides among Farmers in Three Southeastern States, 1990-1998." *J Agric Saf Health* 14(4): 461-472.
- Bultena, G., Lasley, P., and Guler, J. (1986). "The Farm Crisis: Patterns and Impacts of Financial Distress Among Iowa Farm Families." *Rural Sociology* 51:436-448.
- Carnegie, T.A.M. and Elkind, P.D. Eds. 2005. *Stress and Strain: An Anthology of Social Research on Farm Safety*. Eastern Washington University.
- Chapman and Schuler. 1990. In *Stress and Strain: An Anthology of Social Research on Farm Safety*, edited by T. Carnegie and P. Elkind, 2005. Eastern Washington University.
- Corzine, J., Huff-Corzine, L., and Whitt, H.P. 1999. Cultural and Subcultural Theories of Homicide. In *Homicide Studies: A Sourcebook of Social Research*, edited by M. D. Smith and M. Zahn, 1999. Thousand Oaks, CA: Sage.
- Daymond, J. and Gunderson, P. 1987. *An Analysis of Suicides Among Those Who Reside on Farms in Five North Central States, 1980-1985*. Minneapolis, MN: Center for Health Statistics, Minnesota State Department of Health.
- Donhman, K.J. and Thelin, A. 2006. *Agricultural Medicine: Occupational and Environmental Health for the Health Professions*. Ames, Iowa: Blackwell.
- Elbert, S. 1988. "Women and Farming: Changing Structure, Changing Roles." In *Women and Farming*, edited by W. Haneg and J. Knowles. 1988, 245-265. Westview Press.

- Elkind, P.D, Carlson, J.E. and Schnabel, B. In *Stress and Strain: An Anthology of Social Research on Farm Safety* edited by T. Carnegie and P. Elkhind, 2005. Eastern Washington University.
- Elkind, P.D. and Cody-Salter, H. 1994. "Farm Stressors: The Hazards of Agrarian Life." *Ann Agric Environ Med* 1:23-27.
- Environmental Protection Agency (EPA). *Ag 101*. Accessed June 7, 2013. <http://www.epa.gov/agriculture/ag101/demographics.html>.
- Extension Disaster Education Network (EDEN). Accessed July 31, 2013. <http://eden.lsu.edu/Pages/default.aspx>.
- Flewelling, R.L. and Williams, K.R. In *Homicide: A Sourcebook of Social Research* edited by M. Smith and M. Zahn, 1999. Sage: Thousand Oaks.
- Goldcamp, E.M., Hendricks, K.J., and Myers, J.R. 2004. "Farm Fatalities to Youth 1995-2000: A Comparison by Age Groups." *J Saf Research* 35(2):151-157.
- Gunderson, P., Donner, D., Nashold, R., Salkowicz, L., Sperry, S., & Wittman, B. 1993. "The Epidemiology of Suicide Among Farm Residents or Workers in Five North-Central States, 1980-1988." *American Journal of Preventative Medicine* 9:26-32.
- Gunnell, D. and Eddleston, M. 2003. *Int. J. Epidemiol* 32(6): 902-909.
- Hanigan, I.C., Butler, C.D., Kokic, P.N. and Hutchinson, M.F. 2012. "Suicide and drought in New South Wales, Australia, 1970-2007." *Proceedings of the National Academy of Sciences of the United States of America*. Accessed October 10, 2012. <http://www.pnas.org/content/109/35/13950>
- Hawton, K. Simkin, S., Malmberg, A., Fagg, J. and Harriss, L. 1998. "Methods Used for Suicide by Farmers in England and Wales: The Contribution of Availability and its Relevance to Prevention." *Journal of Psychiatry* 173: 320-324.
- Hoppe, R., MacDonald, J., and Korb, P. 2010, February. "Small Farms in the United States: Persistence Under Pressure." *Economic Information Bulletin*, EIB-63.
- Keifer MC, and Firestone J. 2007. "Neurotoxicity of Pesticides." *J Agromedicine* 12(1):17-25.
- Kochanek, K.D., Jiaquan, X., Murphy, S.L, Minino, A.M., and Kung, H. 2011, Dec. 29. "Deaths: Final Data for 2009." *National Vital Statistics Reports*, 60:3. Accessed December 18, 2012. <http://www.cdc.gov/nchs/fastats/lcod.htm/>.
- Kposowa, A. J. 1999. "Suicide Mortality in the United States: Differentials by Industrial and Occupational Groups." *Am J Ind Med* 36(6): 645-652.

- Krueger, J. 2011, October. "Public Health and the Farm Bill Issue Brief: How the Farm Bill Affects Public Health." *The Network for Public Health Law*. Accessed July 31, 2013. http://www.networkforphl.org/_asset/76kz89/.
- Langan, P. and Innes, C. 1990. The risk of violent crime. In *Violence: Patterns, Causes, Public Policy* edited by N. Weiner, M. Zahn, and R Sagi. New York: Harcourt Brace Jovanovich.
- London Mirror. 1998. "Desperate farmers driven to suicide in Mad Cow crisis." Accessed March 9, 2013. <http://www.thefreelibrary.com/DESPERATE+FARMERS+DRIVEN+TO+SUICIDE+IN+MAD+COW+CRISIS%3B+Two+die+every...-a060661730>.
- McLaren, S. and C. Challis 2009. "Resilience Among Men Farmers: The Protective Roles of Social Support and Sense of Belonging in the Depression-Suicidal Ideation Relation." *Death Studies*. 33(3): 262-276.
- Mental Health America (MHA). Accessed July 31, 2013. <http://www.mentalhealthamerica.net>.
- Merchant, J.A., Kross, B.C., Donham, K.J., Pratt, D.S. 1989. *Agriculture at Risk: A Report to the Nation*. Iowa City: Institute of Agricultural Medicine and Occupational Health, University of Iowa.
- Messner, S.F. and Rosenfeld, R. "Studying and Preventing Homicide: Issues and Challenges." In *Homicide: A sourcebook of Social Research* edited by M. Smith and M. Zahn, 1999. Sage: Thousand Oaks
- Miller, M., Azrael, D., Hemenway, D. 2002. "Household firearm ownership and suicide rates in the United States." *Epidemiology* 13:517-524.
- Mills, P. K., J. J. Beaumont, et al. 2006. "Proportionate mortality among current and former members of the United Farm Workers of America, AFL-CIO, in California 1973-2000." *J Agromedicine* 11(1): 39-48.
- National Agriculture Survey Statistics. 2012, February. *Farms, Land in Farms, and Livestock Operations, 2011 Summary*.
- Occupational Safety and Health Administration. Accessed June 17, 2013. http://www.osha.gov/pls/imis/sic_manual.html.
- National Alliance on Mental Illness. 2011, November. *State Mental Health Cuts*. Accessed July 31, 2013. <http://www.nami.org/ContentManagement/ContentDisplay.cfm?ContentFileID=147763>.

- National Occupational Research Agenda (NORA). Accessed October 1, 2012 from <http://www.cdc.gov/niosh/nora/comment/agendas/AgForFish/pdfs/AgForFishDec2008.pdf>.
- National Research Council. 2007. Accessed March 9, 2013. http://dels.nas.edu/resources/static-assets/materials-based-on-reports/reports-in-brief/niosh_aff.pdf.
- NHS Cumbria. *A Suicide Prevention Strategy for Cumbria, 2010-2012*. Accessed March 8, 2013. from <http://www.cumbriaobservatory.org.uk/elibrary/Content/Internet/536/671/4674/5359/5360/4101911752.pdf>.
- Nisbett, R.E. 1993, "Violence and U.S. regional culture." *American Psychologist*, 48(4): 441-449.
- Pickett, W., J. R. Davidson, et al. 1993. "Suicides on Ontario farms." *Can J Public Health* 84(4): 226-230.
- Pickett, W. King, W.D., Lees, R.E.M., Bienefeld M., Morrison H.I., Brison, R.J. 1998. "Suicide Mortality and Pesticide Use among Canadian Farmers." *American Journal of Industrial Medicine*, 34:364-372.
- Pokorny, A. "Human Violence: A Comparison of Homicide, Aggravated Assault, Suicide, and Attempted Suicide." In *Homicide: A sourcebook of Social Research* edited by M. Smith and M. Zahn, 1999. Sage: Thousand Oaks.
- Riedel, M. and Zahn, M. 1985. In *Homicide: A sourcebook of Social Research* edited by M. Smith and M. Zahn, 1999. Sage: Thousand Oaks
- Riedel, M. In *Homicide: A sourcebook of Social Research* edited by M. Smith and M. Zahn, 1999. Sage: Thousand Oaks
- Rosenblatt, P. C. 1990. *Farming Is in Our Blood: Farm Families in Economic Crisis*. Ames: Iowa State University Press.
- Rosenblatt, R. and Anderson, E. 1981. "Interactions in Farm Families: Tensions and Stress." In *The Family in Rural Society* edited by R. Coward and W. Smith. R., 168-180. Boulder, CO: Westview Press.
- Rosmann, M.R. 2008. "Behavioral Health Care of the Agricultural Population: A Brief History." *Journal of Rural Mental Health* 32(1), 39-48.
- Singh and Siapush. 2002. "The Increasing Rural-Urban Gradients in US Suicide Mortality 1970-1997." *American Journal of Public Health* (92)7:1161-1167.

- Skegg, K., H. Firth, et al. 2010. "Suicide by Occupation: Does Access to Means Increase the Risk?" *Aust N Z J Psychiatry* 44(5): 429-434.
- Smith, M.D., and Zahn, M.A. (Eds). 1999. *Homicide: A sourcebook of Social Research*. M. Sage: Thousand Oaks.
- Stallones, L. 1990. "Suicide mortality among Kentucky farmers, 1979-1985." *Suicide Life Threat Behav* 20(2): 156-163.
- Stallones, L. 2006. "Suicide and potential occupational exposure to pesticides, Colorado 1990-1999." *J. Agromedicine* 11(3-44): 107-12.
- Stallones, L. and Beseler, C. 2002, Aug. "Pesticide poisoning and depressive symptoms among farm residents." *Ann. Epidemiology* 12(6): 389-94.
- Tevis, C. 1982, February. A farm stress survey. *Successful Farming* pp. 27-42.
- Thu, K., Lasley, P., Whitten, P., Lewis, M., Donham, K., Zwerling, C., Scarth, R. (1997). "Stress as a risk factor for agricultural injuries: Comparative data from the Iowa Farm Family Health and Hazard Survey (1994) and the Iowa Farm and Rural Life Poll (1989)." *Agricultural Health and Safety: Recent Advances*. The Haworth Press. Pp. 181-191.
- United States Department of Agriculture. 2007. *Agricultural Census*. Accessed June 7, 2013. http://www.agcensus.usda.gov/Publications/2007/Online_Highlights/Fact_Sheets/Demographics/demographics.pdf.
- United States Department of Agriculture. (2012). *Briefing on the Status of Rural America*. Accessed July 31, 2013. http://www.usda.gov/documents/Briefing_on_the_Status_of_Rural_America_Low_Res_Cover_update_map.pdf.
- U.S. Department of Health and Human Services, Public Health Service. (2001). *National Strategy for Suicide Prevention: Goals and Objectives for Action* (DHHS Publication No. SMA 01-3517). Rockville, MD. Accessed October 16, 2012. <http://www.mentalhealth.samhsa.gov/suicideprevention/strategy.asp>.
- United States Code 7, *Farm and Ranch Stress Assistance Network*.
- Villarejo, D. 2003. "The Health of US Hired Farmworkers." *Annual Review of Public Health* 24:175-93.
- Waggoner JK, Kullman GJ, Henneberger PK, Umbach DM, Blair A, Alavanja MC, Kamel F, Lynch CF, Knott C, London SJ, Hines CJ, Thomas KW, Sandler DP, Lubin JH, Beane Freeman LE, Hoppin JA. 2011. Epub 11/17/2010. "Mortality in the Agricultural Health Study, 1993-2007." *American Journal of Epidemiology*. 173(1):71-83.

Walker, L.S., & Walker, J.L. 1987. "Stressors and Symptoms Predictive of Distress in Farmers." *Family Relations* 36:374-378.

Zahn, M.A. and McCall, P.L. 1999. "Trends and Patterns of Homicide in the 20th Century United States." In *Homicide: A sourcebook of Social Research* edited by M. Smith and M. Zahn, 9-23. Sage: Thousand Oaks.

Zwerling, Cl, L.F. Burmeister, et al. 1995. "Injury Mortality Among Iowa Farmers, 1980-1988: Comparison of PMR and SMR approaches." *Am J Epidemiol* 141(9): 878-882.