5. Hidden occupational fatalities in the agricultural industry

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Agricultural work is accompanied with diverse hazards in the process of plowing, planting, growing, fertilizing, harvesting, packing, loading, repairing pens and gates, raising livestock, milking, breeding, birthing, tending sick or injured animals, mixing feed, feeding, moving animals, cleaning stalls and corrals, and so on (Cigularov et al., 2009). Many farm workers apply pesticides and fertilizers to crops, and operate and repair farm equipment. Most of the above activities are physically challenging. During planting and harvesting of crops, workers are in the fields for many hours and often work every day of the week. Those involved in livestock operations, particularly in dairy operations must also work long hours every day of the week tending to the cows.

Based on the United States Department of Agriculture (USDA, 2010), there were 2.2 million farms that had generated approximately $331 billion in 2009. Of these farms, more than 90 percent were owned by individuals or families. Most farms involve relatively few acres, with 54.4 percent operating 1–99 acres and 31 percent operating 100–499 acres. The critical contribution of the agricultural industry to the society, however, is accompanied by an unacceptable loss of workers' lives. Over the past two decades, this industry has been ranked as the most dangerous occupation (National Institute for Occupational Safety and Health [NIOSH], 2010) based on rates of fatal and non-fatal injuries. The fatality rate for farm workers is approximately six times higher than the average rate for all industries (22.5/100 000 vs. 3.8/100 000) (National Safety Council [NSC], 2001). According to the NSC, an average of 740 farm workers lose their lives each year and another 130 000 workers become temporarily or permanently disabled as a result of hazards on farms. These hazards include, but are not limited to, toxic chemical exposures, entrapment in confined spaces, electrocution, tractor overturns, technological changes in operating equipment, repetitive exposure to musculoskeletal strains and sprains, animal handling, etc.

SUICIDE IN THE AGRICULTURAL INDUSTRY

In this chapter, we attempt to continue raising awareness about a hidden occupational fatality, self-inflicted injury. Self-inflicted fatality, or suicide, is arguably viewed as a hidden occupational fatality because suicide is not defined as occupationally related unless the worker chose to end his or her life at their place of employment (Bureau of Labor Statistics [BLS], 2004a). In reality, approximately 75 percent of suicides occur in a house or apartment, followed by natural areas, streets or highways, or in motor vehicles (Colorado Department of Public Health and Environment, 2007). Thus, it is not surprising that few suicides at work are seen in the BLS Census of Fatal Occupational Injuries database. For instance, there were 242 occupational fatalities in the State of Colorado from 2004 to 2006. Among them, there are only 11 suicide cases that occurred at the workplace. It has long been suspected that suicidal tendencies may, to some degree, be affected by occupation (Blachly et al., 1963; Kposowa, 1999; Liu and Waterbor, 1994; van Wijngaarden, 2003).

High rates of suicide in the agricultural industry in different countries have been reported over many years, with farm workers often among the highest reported. Based on all suicide records in New Zealand between 2001 and 2005, Gallagher, Kliem, Beautrais and Stallones (2008) revealed that workers in farming, fisheries, or forestry had high suicide rates compared to workers in other occupations. Page and Fragar (2002) also reported higher suicide rates among male farm workers in Australia than rates in the male national population, and rates in the rural population. Recently we compared suicide rates among farm workers in Colorado, with Colorado population for two time periods: 1990–1999 (derived from Colorado death certificate files) and 2004–2006 (derived from Colorado Violent Death Reporting System). Part of our initial findings (Stallones et al., 2010) showed that the average annual suicide rate per 100 000 was 263.9 for male farm workers vs. 31.5 for the general male population, 56.1 for female farm workers vs. 8.1 for the general female population between 1990 and 1999; 226 among male farm workers vs. 67.3 among the general male population, and 37.4 among female farm workers vs. 18.5 among the general female population from 2004 to 2006.

The high rate of suicide among farm workers sends an alarming signal for four main reasons. First, suicide rates among farm workers seem disproportionately high, compared to other occupations, considering farm workers represent less than 0.7 percent of employees in 2009 (BLS, 2004b). Second, it has been estimated that there are 25 suicide attempts for every suicide completion (American Association for Suicidology, 2006). In other words, high suicide rates for farm workers only reflect the tip of iceberg,

which suggests that mental health problems may be much more severe in the agricultural industry than has previously been acknowledged. Third, people who attempt suicide and survive often have disabling injuries such as brain damage, para- or quadriplegia, organ failure, depression, and other mental health problems. Finally, suicide affects the health and safety of families, job sites and the farming community. In the situation of farm workers the impact most likely falls on the surviving family members and in the case of a farm owner, the family may not be able to keep the farm operating with the loss of a key contributor to the farm work. In addition, farming communities can be small close-knit groups and a suicide death in the community may have a profound impact on the well-being of the overall community. Neighbors, friends and family as well as other farm workers may feel shock, anger, guilt and depression. The medical costs and lost wages associated with suicide as well as those who are affected would take a great toll on the industry (Centers for Disease Control and Prevention, 2008).

RISK FACTORS OF SUICIDE

Despite extensive research, there is no universally accepted theory to explain the occurrence of suicide. A number of risk factors have been reported as associated with increased risk of suicide in the general population and in the farm population, including age (increased rates with increased age), race (white and Asian populations), sex (males with higher rates except among Asian populations), family history of attempts, alcohol/substance abuse, maltreatment as a child, interpersonal loss or rejection, cultural and religious beliefs, mental disorders, physical illness, economic problems, lack of mental health services, and access to lethal means such as firearms or pesticides (Boxer et al., 1992; Charlton, 1995; Cubbin et al., 2002; Gregoire, 2002; Gunderson et al., 1990; Hawton et al., 1998; Kelly and Bunting, 1998; Thomas et al., 2003).

Although risk factors or plausible factors associated with suicide in general are documented in the suicide prevention literature, it is still not yet clear why farm workers report higher rates of depression and have such high suicide rates compared to other occupations (Grosch and Murphy, 1998). Based on the nature of the farm work, two unique yet critical factors, exposure to farm stressors (Fraser et al., 2005; Schenker, 1996) and organophosphate pesticides (Jaga and Dharmani, 2007; Stallones and Beseler, 2002), may account for higher depression (a potential trigger for suicide) in the agricultural industry. In the next two sections, we will first review a unique set of stressors farm workers face, and their potential

linkage with depression and suicide, followed by the focus on exposure to organophosphate pesticide at workplaces, and how the exposure may link to the high rate of suicide in the agricultural industry.

EXPOSURE TO FARM STRESSORS

Stressful experience resulting from job stressors (i.e. stressful events or incidents) is often unavoidable, and has become part of work life. Potential adverse impacts of job stressors include the decrease of cognitive function (Proctor et al., 1996) and the increase of mental and physical fatigue and depression (Suwazono, et al., 2007), which may likely lead to mental illness and suicide (e.g. Amagasa et al., 2005).

Compared to job stressors reported in general industries (e.g. time pressure, job insecurity, conflict between different work roles, situational constraints [Spector et al., 2000]), those experienced among farm workers are rather unique, and tend not to be captured by conventional job stress models (Cornish and Gerrard, 1995; Sonnentag and Frese, 2003). Specifically, underlying causes of job stressors (e.g. time pressure or job insecurity) in the agricultural industry tend to be affected by circumstances which are not necessarily directly related to the job per se, yet these conditions could have a profound impact on one's work and experience.

More often job stressors faced by farm workers are unpredictable and uncontrollable. For instance, workers need to harvest crops quickly due to sudden changes in climatic conditions, which cannot be easily controlled, prevented, or eliminated through job designs, engineering control, pre-task planning or active coping. Stressors such as financial crisis or farm foreclosures caused by socio-economic factors (e.g. low market price) tend to lead workers or owners to blame themselves and lose hope (Gerrard, 1995). In addition, the destocking or culling of livestock due to epidemics (e.g. Ovine Johne's disease in Australia or foot-and-mouth disease in Great Britain) not only causes financial loss, but also severely affects the psychological well-being of farmers and their families, who often experience a sense of failure, as well as feelings of guilt, shame, helplessness or anger (Hall et al., 2004)

Considering more than 90 percent of farms are relatively small, and owned by individuals or families, farm work has been traditionally interwoven with family life. Empirical findings have revealed that family problems are one of the most frequent stressors experienced by farmers (Booth and Lloyd, 2000). Yet, work–family initiatives proposed by work and family researchers (e.g. Kelly et al., 2008) such as work–life policies and benefits (e.g. family leaves, flexible work arrangements and depend-

ent care supports) and work redesign ('no work on weekends') may not be compatible with farmers' work and lifestyle. Furthermore, conventional social support systems such as emotional or problem-solving support provided by supervisors and co-workers (Chen et al., 1999) may not be applicable due to the unique organizational structures and mobile workforce in small and medium sized farms. In sum, the agricultural industry faces a unique set of stressors that are not typically encountered by other industries, yet prevention approaches and mental health services have not been adequately investigated, developed, and provided for this population (Gunderson, 1995; Hall et al., 2004).

EXPOSURES TO ORGANOPHOSPHATE PESTICIDES

Suicide using pesticides as the agent of harm has been a primary focus of many studies of suicide in various countries (e.g. Eddleston and Philips, 2004; London et al., 2005). Yet, the focus of our review is to what extent pesticide exposure at work may be responsible for suicidal behavior. It has been reported in several epidemiological studies over the past two decades that higher rates of suicide have appeared among farmers and others exposed to organophosphate pesticides at work (e.g. Gunderson et al., 1990; Hawton et al., 1998; Kposowa, 1999; Stallones, 1990, 2006). The possible link between organophosphate exposure and suicide is also recognized by physicians (Royal College of Physicians and Royal College of Psychiatrists, 1998).

Organophosphate pesticides were first introduced in the 1940s. Deaths from exposure to these compounds were reported as early as 1949 (West, 1968). In moderate exposure cases, the symptoms were followed by headache and insomnia with excessive dreaming and nightmares, and the symptoms in extreme exposures were followed by ataxia, tremor, drowsiness, difficulty concentrating, mental confusion, disorientation, and changes in speech characterized by slurring, difficulty in forming words and in self-expression and repetition (Durham et al., 1965; Grob et al., 1950). Apathy, anxiety, uneasiness, withdrawal and depression were also reported to occur (Dille and Smith, 1964; Gershon and Shaw, 1961).

Ahmed and Davies (1997) have proposed a long-term neuropsychiatric syndrome resulting from organophosphate exposure. The syndrome is called chronic organophosphate-induced neuropsychiatric disorder (COPIND) which is characterized by the following symptoms: one or more episodes of severe flu-like symptoms lasting more than three days following exposure (and sometimes hypersalivation, abdominal cramps and diarrhea); mood destabilization; suicidal thinking; cognitive

impairment; language disorder including word finding and expressive disorders; alcohol intolerance including marked increase in the inebriating effects of alcohol, severe hang-over and quasi-allergic effects; heightened sense of smell; handwriting deterioration; sensitivity to exposure to low concentrations of organophosphates; and decreased exercise tolerance reflected in initial normal muscle power but inability to maintain it and no evidence of generalized weakness.

While comparing exposed farmers to unexposed farmers, Levin et al. (1976) reported that the former tended to report high anxiety. Reidy et al. (1992) also found that twice poisoned migrant farm workers scored higher on anxiety and depression symptom checklists one to two years after the poisoning episode. Similar patterns were found from studies comparing exposed individuals or workers vs. controls (London et al., 1997; Rosenstock et al., 1991; Wesseling et al., 2010) in various countries (e.g. in South African fruit farms or among Costa Rican banana workers).

Unfortunately, the adverse effects of organophosphate pesticides do not just affect farm workers. For instance, Kamel and Hoppin (2004) reported neurological symptoms associated with pesticide exposure among pesticide applicators from Iowa and North Carolina recruited between 1993 and 1997. High frequency and low frequency use of organophosphate pesticides was compared and high frequency use was significantly associated with a wide range of symptoms including: fatigue, tension, insomnia, depression, difficulty concentrating, loss of appetite, and difficulty speaking among white male applicators. In the same cohort (Beseler et al., 2006), female spouses of pesticide applicators were diagnosed with depression more often in the presence of a history of a pesticide poisoning than spouses whose partner had not been poisoned (odds ratio 3.26, 95% CI 1.72, 6.19), after controlling for state of residence, age, race, off-farm work, alcohol consumption, cigarette smoking, physician visits and solvent exposure. Among the pesticide applicators, the odds ratio of diagnosed depression comparing those with a history of poisoning to those with no history, after controlling for the variables listed above, was 2.57 with 95% CI range from 1.74 to 3.79 (Beseler et al., 2008).

ADDRESSING THE HIDDEN OCCUPATIONAL FATALITIES

The goal of this chapter is to raise awareness about the hidden occupational fatality, suicide, in the agricultural industry, and to review two contributing factors of depression and suicide among farm workers. In the remaining section, we attempt to propose a few suggestions for future

research and practice to address this occupational safety and health challenge.

Foremost, the definition of occupational self-inflicted fatality currently employed by government agencies (e.g. NIOSH, OSHA and the Bureau of Labor Statistics) and society is too limited to guide the development of a valid occupational surveillance tool as well as prevention strategies. This work-oriented definition (i.e. workers die by suicide at work) ignores the fact that boundaries between work and life are intertwined, particularly in the agricultural industry.

Our findings and other research (Gallagher et al., 2008; Stallones et al., 2010) have shown farmers have higher suicide rates than other occupational groups. Similarly, farming populations have long been reported to have higher rates of depression than other occupational groups (Gregoire, 2002; Linn and Husaini, 1987; Scarth et al., 2000; Stallones et al., 1995; Thomas et al., 2003). However, it has been consistently shown that farmers are reluctant to seek medical care for mental health and stress-related problems (e.g. Judd et al., 2006). More often they rely on their families and friends, prayer and non-professional help as preferred alternate ways to deal with mental health problems (Kirkwood and Peck, 1997). In addition, the culture in the farming communities emphasizes staying positive and strong in the face of challenges, and it is not acceptable for farm workers and their families to be negative or to complain. The need to combat the above barriers cannot be unstated. Research and practice need to utilize innovative approaches to build the capacity of culturally competent suicide intervention and prevention services in rural farming communities, to improve the ability and skills of farm workers and/or their families to respond to suicide risk in neighbors and family members, and strengthen mental health infrastructures. Prevention initiatives to address the above issues have been studied by our research team for different populations (see Chen et al., 2009; Stallones and Moore, 2010)

Third, people who are depressed tend to seek medical attention for physical issues more often than those who are not depressed (Cockerham et al. 1988; Rowen et al., 2002). Depression can manifest in a number of somatic symptoms which may lead people to seek medical care for those symptoms rather than for their mental health problems (Meyer et al., 2000; Stoudemire et al., 1985). Increasing the awareness of medical care providers of the likelihood that mental health problems may be manifested through somatic symptoms may ultimately increase treatment options for depressed agricultural workers and reduce the risk of severe adverse outcomes such as suicide.

It has been postulated that the likelihood that someone will engage in suicidal behavior in the presence of stressors may be lowered or raised

(Kamali et al., 2001), depending on other risk factors (e.g. genetic predisposition, personality traits, biochemical factors in a person's metabolism, the emotional state of hopelessness, or the presence or absence of ongoing support systems). The role of the such risk factors have not been incorporated in studies of mental health among agricultural workers in a systematic way, and would be of help in assessing potential prevention strategies. The integration of studies on depression, stressors and environmental exposures may provide a better understanding of the complex nature of gene and environmental interactions in agricultural workers.

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