DISSERTATION

# DEPRESSIVE SYMPTOMS, DRINKING PATTERNS AND FARM-WORK INJURY AMONG COLORADO FARM RESIDENTS

Submitted by

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WE HEREBY RECOMMEND THAT THE DISSERTATION PREPARED UNDER OUR SUPERVISION BY MARILYN GRACE PETERSEN LEFF ENTITLED DEPRESSIVE SYMPTOMS, DRINKING PATTERNS AND FARM-WORK INJURY AMONG COLORADO FARM RESIDENTS BE ACCEPTED AS FULFILLING IN PART REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY.

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## ABSTRACT OF DISSERTATION

## DRINKING PATTERNS, DEPRESSIVE SYMPTOMS, AND FARM-WORK INJURY AMONG COLORADO FARM RESIDENTS

**Introduction:** Farm-work injury is a major occupational health problem. The purposes of this study were to 1)describe farm residents who are heavy drinkers with high depressive symptoms and 2)assess the association between farm-work injury and depressive symptoms, farm-work injury and drinking pattern, and farm-work injury and the interaction of these two in cross-sectional and prospective analysis.

**Methods:** A population-based sample of farm residents within Colorado was followed for three years. Information on socio-demographic and health related variables were gathered including farm-work injuries, depressive symptoms, and alcohol use. Multinomial logistic regression was used to describe differences and similarities between farm residents with high depressive symptoms and heavy drinking, high depressive symptoms only, and heavy drinking only compared to those without either. Poisson regression with repeated measures was conducted to estimate the effect of depressive symptoms and alcohol use and the interaction between the two variables on farm-work injury.

**Results:** An association between smoking and co-occurring heavy drinking and high depressive symptoms was found (OR 3.69, 95% CI 1.0,13.1) that was not seen among those with heavy drinking only or high depressive symptoms only. Time spent in farm work was also associated with depressive symptoms and with co-occurring heavy alcohol use. In both the cross-sectional and prospective regression analyses, no association was found between drinking pattern and injury for men or for women. After adjusting for age

and smoking status, high depressive symptoms was associated with farm-work injuries among women (OR 3.6, 95% CI 1.8-6.9) in the cross-sectional analysis but not in the prospective analysis. No association between farm-work injuries and depressive symptoms was found for men. No interaction between drinking pattern and depressive symptoms in relation to injuries was seen in either men or women.

**Discussion/Conclusions:** The association between smoking and co-occurrence of heavy drinking and high depressive symptoms may provide useful information for smoking cessation efforts. Depressive symptoms were more likely a result of farm-work injury in women rather than a cause. Future studies are needed to understand the impact of farm-work injuries in the context of differences in the roles of men and women farmers

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# CHAPTER 1: INTRODUCTION

Farming is recognized as one of the most hazardous occupations in the United States(1). In 2006, the overall occupational injury incidence rate was 4.4 per 100 full-time equivalents (FTE) while the incidence of farm-work related injuries varied from 5.8 per 100 FTE among crop producing farms to 8.1 per 100 FTE for animal production farms(2). Authors have investigated individual characteristics and behaviors to understand which factors may be associated with increased incidence of injury. Depressive symptoms (3-5) and drinking patterns (6-9) have been shown to be associated with increased incidence of farm injuries. While both have been studied independently, to date no study has assessed the association between the co-occurrence of depressive symptoms and drinking patterns with farm injuries.

In general population studies, co-morbid alcohol use disorders and depressive disorders occur more often than would be expected by chance(10-18). The co-occurrence results in an increase in severity of symptoms of each disorder (19;20) and problems in social functioning (21) compared to those with only one disorder. Average daily alcohol intake during heaviest use of alcohol was found to be higher among those with both depression and alcohol use disorders combined compared to those with alcohol use disorders alone(22). Anxiety, depressive, and substance use disorders among employed workers resulted in a higher average number of work days lost and work activities curtailed when two or more of the disorders were present compared to those with only one of these disorders(23).

The co-occurrence of heavy drinking and high rates of depressive symptoms has been associated with increased mortality(24). Greenfield and colleagues (24) found a

four-fold increase in 11-year mortality among men who drank more than 6 drinks per day and had high rates of depressive symptoms compared to men who abstained from alcohol and had low rates of depressive symptoms. Compared to life-time abstainers, women in this study who were ex-drinkers and who consumed more than 8 drinks on at least one occasion had the highest 1-year mortality risk (RR=1.61). Women in this highest risk category with co-occurring high depressive symptoms were more than 4 times as likely to have died during the 11 year follow-up compared to women who abstained from alcohol and had low depressive symptoms(24). No work has been done to describe similarities and differences among those with co-occurring high depressive symptoms and heavy alcohol use compared to those with only one of these factors or neither.

While the association of high depressive symptoms and drinking patterns have been studied individually in relationship to farm-work injury, no work has assessed the association of the co-occurrence of heavy drinking and high depressive symptoms either on occupational injury in general or farm-work injury specifically. If health outcomes are more severe for those with concurrent high depressive symptoms and heavy drinking, then higher rates of injury among those with both would be expected.

The purpose of this dissertation is to explore associations between depressive symptoms, drinking patterns and farm-work injuries among farm residents in Colorado using data collected for the Colorado Farm Family Health and Hazard Surveillance (CFFHHS). The dissertation is structured to include one chapter which reviews literature relevant to the topic, three chapters written as publishable papers, and a summary chapter. The review of literature is covered in Chapter 2 and includes two topics:

1. *Depressive symptoms and alcohol use.* The first topic includes a review of measures used to estimate the prevalence of depressive disorders, depressive symptoms, alcohol use disorders, and drinking patterns. Next the epidemiology of co-morbidity of alcohol use disorders and major depressive disorders and the epidemiology of the co-occurrence of depressive symptoms and drinking patterns is explored. Finally, possible pathways in an association between depressive disorders and alcohol use disorders and depressive symptoms and drinking patterns are reviewed.

2. *Alcohol use, depressive symptoms, and injury.* This topic looks first at the possible reasons for an association between alcohol use and injury. The epidemiology of alcohol use with both general occupational injuries and specifically farm work injuries is reviewed. The same topics are then explored for depressive symptoms including possible pathways between depressive symptoms and injury and the epidemiology of depressive symptoms and both occupational injury and depressive symptoms and farm work injury.

The next three chapters (Chapters 3 through 5) are presented as publishable papers. Chapter 3 compares social and demographic characteristics of non-heavy drinkers without depressive symptoms with those of heavy drinkers without depressive symptoms, non-heavy drinkers with depressive symptoms, and heavy drinkers with depressive symptoms among farm residents in Colorado. Chapter 4 describes the association between farm work injuries, alcohol consumption and depressive symptoms among Colorado farm residents in a cross-sectional analysis. Chapter 5 evaluates whether pre-existing depressive symptoms and drinking pattern increase risk for farm-work injury in a prospective analysis. In both Chapters 4 and 5, the hypothesis that the presence of depressive symptoms moderates the effect of drinking pattern on farm work

injury is explored. Chapter 6 provides a summary of the findings presented in the dissertation.

## CHAPTER 2: LITERATURE REVIEW

### 1. DEPRESSIVE SYMPTOMS AND ALCOHOL USE

Depression and alcohol use disorders are two of the most common mental health disorders in the U.S.(15;16;25) with a high burden of disease world-wide attributed to both(26). Two different approaches have been taken to study these problems. One is the development of instruments based on the diagnostic criteria established by the American Psychiatric Association found in the Diagnostic and Statistical Manuals of Mental Disorders. These manuals, currently in the 4th revised edition, address specific criteria to be able to assign a psychiatric diagnosis(27). The other approach is by counting the number of depressive symptoms and frequency and quantity of alcohol usually consumed.

#### Definitions and Measures

*Diagnostic basis for depression based on DSM-IV.* Depression is defined by the expression of symptoms through behavior and feelings with an emphasis on mood. The disorder is based on the number, frequency and duration of symptoms, as well as the impact that these symptoms have on day-to-day functioning. Several distinct categories of depression are included under the heading of major depression: major depression: dysthymia: bipolar I: and bipolar II. While dejected mood and loss of interest or pleasure are defining characteristics of the disorder, other symptoms need to be present in order for a diagnosis of major depressive event (MDE). Symptoms cluster around expression of feelings of dejection, guilt, loss of self-esteem, and loss of interest and pleasure in those things that were interesting and pleasurable prior to the onset of depression, as well as thoughts of death. Somatic symptoms include changes in appetite and/or weight,

changes in sleep patterns, and a generalized fatigue. One symptom of depression is the inability to concentrate. The mood disturbance plus four other symptoms must be present for at least two weeks and interfere in the individual's social, occupational, or personal functioning for an MDE to be diagnosed. In addition, these cannot be due to bereavement or a physical health problem(27).

Dysthymia is another form of depression which has fewer symptoms than MDE and is a more long lasting disorder. The diagnosis is made when an individual experiences mood disturbance plus two symptoms and the symptoms last more than the two. The predominant characteristic of dysthymia is that depressed mood lasts two years or more. This disorder is thought to have less impact on day-to-day functioning. Criteria for all disorders reflect a consensus of current thinking and are used as guidelines in order to enhance diagnostic consistency among clinicians and researchers(27).

*Diagnostic basis for alcohol use disorders.* Alcohol abuse and alcohol dependence are the two disorders that comprise alcohol use disorders (AUD) as defined by the DSM-IV-TR (27) and are based on guidelines that have changed over time. Having a diagnosis of either disorder is a maladaptive pattern of alcohol use that leads to

> "significant impairment in functioning. One or more of the following must be present within a 12 month period: (1) recurrent use resulting in a failure to fulfill major obligations at work, school, or home; (2) recurrent use in situations which are physically hazardous (e.g., driving while intoxicated); (3) legal problems resulting from recurrent use; or (4) continued use despite significant social or interpersonal problems caused by the substance used." (28)

Alcohol dependence also includes the above symptoms of abuse but adds other criteria. These include having three or more of the following in a 12-month period of time:

1) "Tolerance, as defined by either of the following:
    a. Need for markedly increased amounts of the substance to achieve intoxication or desired effect
    b. Markedly diminished effect with continued use of the same amount of the substance
2) Withdrawal, as manifested by either of the following:
    a. The characteristic withdrawal syndrome for the substance
    b. The same (or closely related) substance is taken to relieve or avoid withdrawal symptoms
3) The substance is often taken in larger amounts or over a longer period than was intended
4) There is a persistent desire or unsuccessful efforts to cut down or control substance use
5) A great deal of time is spent in activities necessary to obtain the substance, use the substance, or recover from its effects
6) Important social, occupational, or recreational activities are given up or reduced because of substance use
7) The substance use is continued despite knowledge of having had a persistent or recurrent physical or psychological problem that is likely to have been caused or exacerbated by the substance." (28)

*Instruments used in estimating population prevalence of depressive and alcohol use disorders.* Several instruments have been developed to measure lifetime history and current prevalence of depressive disorders and AUD in population based surveys. Two recently developed instruments are the World Mental Health–Composite International Diagnostic Interview (WMH-CIDI) (29) and the Alcohol Use Disorder and Associated Disabilities Interview Schedule –DSM-IV Version (AUDADIS-IV)(30). These represent measures of psychiatric disorders which use structured interviews and are consistent with criteria established in the original version of the DSM-IV (31). These instruments have been used in studies whose goal was to estimate prevalence of psychiatric disorders in large population-based surveys using highly trained lay interviewers such as the National Comorbidity Study-Revised (NCS-R) study and the National Epidemiological Survey on Alcohol and Related Conditions (NESARC)(25;29;29;32). The WMH-CIDI's questions on alcohol abuse are screening criteria to determine whether respondents will be asked

questions regarding alcohol dependence. The AUDADIS-IV does not. Therefore, rates of alcohol dependence are found to be higher in the surveys using the AUDADIS-IV compared with those using the WMH-CIDI(33).

The questions in both of these ask whether the respondent had ever experienced the necessary criteria resulting in a lifetime prevalence of the disorder and whether the criteria were met in the last 12 months resulting in a current disorder. Co-morbidity then is assessed as lifetime or current. Distinctions are made as to which diagnosis occurred first. Lifetime co-morbidity can mean that one disorder followed another, not necessarily in the same 12 month time period. Concurrent co-morbidity indicates that both disorders occurred within the same 12 month period.

*Symptoms of depression.* Another approach to the study of depression is the study of symptoms of depression. When studying depressive symptoms, studies use self-report questionnaires that ask respondents whether they have experienced symptoms of depressive disorders. These generally do not include questions about how the symptoms have interfered with functioning nor do they exclude symptoms in the presence of bereavement or physical illness. Many of these scales have values which are used to categorize high depressive symptoms. Examples of scales used to measure level of depressive symptoms include the Centers for Epidemiological Studies – Depression Scale (CES-D)(34), the Primary Care Evaluation of Mental Disorders (PRIME-MD) (35), subscales within general health questionnaires including the Short-Form 36 (36) and the General Health Questionnaire(37). Unlike the diagnostic measures, the measures of depressive symptoms are limited to a recent time period. For example, the CES-D uses the last week and the PRIME-MD uses the last 2 weeks. These instruments are designed

to be used in screening of patient populations, population surveys of health and in surveillance.

The measure of depressive symptoms used in this study was the CES-D; an instrument that has been widely used and has been shown to be valid for detecting symptoms of depression in different populations(34;38-42). The scale consists of 20 questions and obtains information about the frequency of symptoms within the past week. Scored range from 0 (never) to 3 (5-7 times in the past week) resulting in total scores ranging from 0 to 60. Four of the questions are worded in a positive manner and the scoring of those four questions are reversed. Because of high internal consistency in the scale, the answers are summed to give a score(34;43). A cut point of 16 or greater has been used as an indicator of high rate of depressive symptoms and represents the top 20% of scores in community-based surveys(38). See Appendix A for the instrument.

The questions on the CES-D include many of the same symptoms as found on the DSM-IV for MDE. However, no specific questions are included on diminished interest or pleasure in usual activities or on thoughts of death and/or suicide. The CES-D does not make exclusions for bereavement or physical health problems. Thus, the CES-D cannot be used for a diagnosis of MDE. The sensitivity of the CES-D in detecting current major depressive disorders in larger community U.S. samples compared to other diagnostic measures ranged from 98% (43) to 64.0% (44); specificity from 73% (43) to 94% (44). The positive predictive values ranged from 7% (40) to 33 % (44). Because of the limited ability of the CES-D to discriminate among psychiatric patients, Roberts and colleagues have suggested that the CES-D and other short measures of depressive symptoms are tools that measure a "state of demoralization" (p. 80) rather than any

depressive diagnosis(45). Radloff explained that the scale was intended to be used to assess the prevalence of depressive symptoms in populations with special emphasis on depressed mood(34).

Some authors have questioned whether the measurement of depressive symptoms, such as those used in the CES-D, is gender neutral. For instance, authors have noted that the item on crying is more consistently associated with depressed affect as measured by other items on the CES-D among women than men(46-49). Just as rates of depressive disorders are higher in women than men, rates of high depressive symptoms have also been consistently found in women than men(50-53). In their study of the CES-D instrument, Frerichs and colleagues also suggest that they found similar inconsistencies on the response of men and women to certain items on the CES-D(54). They did not elaborate on which items these were but did suggest that some of the differences in rates of high depressive symptoms may be due to gender bias in some of the items (54).

*Heavy drinking.* Rather than assessing alcohol use disorders, the quantity and frequency of alcohol consumption has been assessed in population surveys of health. While a quantitative measure of the amount of alcohol consumed is not included in the psychiatric diagnosis of either alcohol abuse or dependence, a linear relationship has been demonstrated between the number of drinks consumed per day and the likelihood of meeting the criteria for alcohol dependence(55). There are two measures of heavy alcohol use: binge drinking and heavy drinking.

Heavy drinking has not been defined consistently across studies. The National Household Survey on Drug Use and Health (NHSDUH) defines heavy drinking as 5 or

more episodes of drinking 5 drinks at one time for men and 4 for women within one month(56). The Centers for Disease Control and Prevention in both the National Health Interview Survey (NHIS) and the Behavioral Risk Factor Surveillance System (BRFSS) define drinking by average amount of alcohol consumed in a week. Heavy drinking is defined as more than 2 alcoholic beverages per day or more than 14 in a week for men and for women as more than 1 drink a day or more than 7 drinks in a week(57;58). This definition is based on U.S. Department of Agricultural dietary guidelines(59). Other authors have defined heavy drinking as a high level of alcohol consumed on a typical drinking occasion and the definition of high level varies(24;60;61). For example, in a longitudinal study of changes in drinking patterns over time, heavy drinking was defined as five or more drinks per drinking occasion for men and four drinks or more for women(62).

Binge drinking is currently defined as having 5 or more drinks on one occasion for men and 4 or more drinks on one occasion for women(56-58). As with scales measuring symptoms of depression, indices of heavy and binge drinking are used in general population surveys of health and are not intended to measure AUD.

The measurements of both binge and heavy drinking are limited to current drinking patterns and the time frame for "current" is not consistent across surveys. The NHIS uses the past year as the time frame for questions on both binge drinking and usual quantity and frequency of drinking(58). In the BRFSS (63)and the NSDUH (56), the time frame is the past 30 days. In a review of 12 studies of alcohol intake measures, the time frame used to report consumption of alcohol did not explain the variance in the mean level of alcohol among different populations in these studies(64).

The differences in amounts of alcohol used to classify binge and heavy drinking by sex is based upon what is known about differences in metabolism of alcohol in men and women. Physiological response to alcohol involves the drug's absorption, distribution, metabolism, and elimination(65). Alcohol dehydrogenase (ADH) and aldehyde dehydrogenase(ALDH) are major enzymes involved in the degradation of alcohol(65). The blood alcohol concentration (BAC) is higher for women than men after ingesting the same amount of alcohol(65;66). The bioavailability of alcohol is lower for men than women because men have higher AHD activity than women even after accounting for difference in body weight or lean body mass(67). This difference by sex seems to diminish around age 50 as ADH gastric activity declines with age and more strongly among men(66-68).

Another reason for the higher bioavailability of alcohol in women than men is related to differences in average body composition. The alcohol molecule is both fat and water soluble. However, the alcohol molecule is more soluble in water than in fat(65). The proportion of body weight that is water is lower in women than men(65;69). Women generally have lower skeletal muscle mass and a higher fat mass than men. Women will have a higher BAC consuming similar amounts of alcohol than men due to the fact that women have a "lower tissue mass ... within which ETOH can be diffused away from the bloodstream"(65).

Differences in the definition of binge drinking of 4 drinks for a woman versus 5 for a man were explored in a nationally representative sample survey of college students by Wechsler and colleagues(70). Women who typically drank 5 or more drinks were more likely to experience such drinking related problems as hangovers, missing a class,

falling behind, doing something to cause regret, and forgetting things than men who drank 5 or more drinks. When the definition of problem drinking was changed to typically 4 or more drinks for women, women were just as likely to experience these drinking problems as men who typically drank 5 or more drinks(70). However, no other studies have been done to verify this finding in other populations and may not be applicable to the general population.

The measures of heavy drinking in the present study combined both heavy drinking and binge drinking. Alcohol use questions in this study came from the latest alcohol consumption questions used on the BRFSS at the time of the CFFHHS(71). At that time, separate questions on binge drinking for men and women were not part of the survey, and binge drinking was defined as 5 or more drinks on one occasion in the past 30 days for both men and women. In addition to a question specifically asking how many times in the last 30 days the respondent had had five or more drinks on one occasion, regular alcohol use in the past 30 days was also ascertained. Heavy drinking was defined as greater than an average of 7 drinks per week for women and 14 for men. In this study, heavy drinking was defined as being a heavy drinker, a binge drinker, or both.

Epidemiology of co-occurrence of depression symptoms and drinking patterns

*Co-morbidity of depressive disorders and alcohol use disorders.* Twelve month prevalence rates for major depressive disorder based on the NESARC and the NCS-R, surveys of the U.S. non-institutionalized adult population, ranged from 5.3 to 6.6%(16;25); lifetime prevalence rates ranged from 13.2 to 16.6%(15;72). Rates for

alcohol use disorders in these same surveys ranged from 8.5(13) to 4.4% (16) for 12-month prevalence and 30.3(13) to 18.6%(15) for lifetime prevalence.

In general population studies, major depressive disorders and alcohol use disorders have been found to occur together more often than would be expected by chance(10-14;16;18;73). For example, results from the NESARC estimated that 14.1% of those having a major depressive disorder in the last 12 months also had an alcohol use disorder in the same time frame; higher than the 5.3% prevalence rate of the general population(13) Results from the NCS-R estimated that 24% of those with a lifetime major depressive disorder had also experienced at least one episode of a substance use disorder compared to 13.2% in the general population(72). The association between a current major depressive disorder and alcohol abuse has been consistently smaller than that of current major depressive disorder and alcohol dependence(12;13;16;25;74).

Women have higher rates of depression while men have higher rates of AUDs(12;13;15;16). Co-morbidity is categorized by three distinct types: primary depression (depressive disorder followed later in time by an alcohol use disorder), primary AUDs (alcohol use disorder followed later in time by a depressive disorder) and concurrent co-morbidity (two disorders occur within the same 12 month time frame). Males have higher rates of primary AUDs and females, primary depression(22). Males have higher rates of concurrent AUD and MDD than females(19;22). Results from the NLAES showed that the 3 co-morbid groups were younger than those with depressive disorder only or AUD only(19). In an analysis of NESARC data, the association between a current diagnosis of any of the major depressive disorders and a concurrent diagnosis of alcohol use disorder was significantly stronger among Blacks than among

Whites(75). In a study of patients seen for major depressive disorder, those with MDD and a substance abuse disorder were more likely to be younger, male, single or divorced, and not of Hispanic origin than those with major depression alone(76).

*Co-occurrence of depressive symptoms and heavy or binge drinking.* Few studies have measured the prevalence of co-occurring rates of high depressive symptoms and heavy and/or binge drinking. These community studies have focused on shorter time periods and provide a time-limited snapshot. Measures of depressive symptoms and alcohol use, as well as the populations studied, have varied among studies making comparisons difficult. Most studies have addressed the question of co-occurrence by asking whether one is a risk factor or associated with the other; the results have not been consistent across different populations. Using data from the Eastern Baltimore Health Survey, Dryman and Anthony found that moderate drinking and heavy drinking were associated with increased measure of psychiatric distress in women but not in men(77). Psychiatric distress was measured by scores on the General Health Questionnaire. In the 1991 NHIS, respondents were asked to report how often in the last two weeks they had experienced the following 5 negative moods: depression, loneliness, restlessness, boredom, and frequent feelings of upset. Approximately 7% of men who reported feeling depressed very often or often also drank heavily as defined as 3 drinks or more per day(78). When adjusted for age, race, education, income, marital status, and health status, heavy drinking was significantly higher in this group compared to those who rarely or ever felt depressed (AOR 1.5, 1.2-2.1). The proportion of heavy drinkers among women did not vary by frequency of depressive symptoms(78).

Binge drinking was associated with high depressive symptoms as measured by the PRIME-MD instrument among non-institutionalized adults in New Mexico(79). No increase in prevalence of high depressive symptoms based on the CES-D was found among rural West Virginia adults by drinking pattern defined as none, light, and heavy(80). No definition for these 3 levels of drinking was given by the authors.

Two cross-sectional population-based studies investigated the association of depressive symptoms and alcohol use by using the scores of the CES-D rather than using a cut point to designate high rates of depressive symptoms(81;82). Neff used linear regression analyses to estimate if the quantity (usual number of drinks) or frequency (how often drinking) were associated with CES-D scores using data from a national sample(82). Higher quantity was associated with higher scores; increasing number of drinking occasions or frequency was associated with decreasing CES-D scores(82). However, the correlations, even though statistically significant, were quite small in all results.

Using data from the Los Angeles Epidemiologic Catchment Area (LA-ECA) study, Golding, Burnam, and Wells investigated the association of alcohol use and depressive symptoms among Mexican-American and non-Hispanic whites(81). In a multivariable linear regression analysis, daily drinking was associated with higher CES-D scores in men but not in women when adjusting for race/ethnicity and other socio-demographic variables. Quantity of usual alcohol intake was not associated with increased CES-D scores in this model(81). However, the univariate results indicate that the mean CES-D scores do not increase or decrease by sex and ethnic group in a linear fashion in either quantity or frequency of drinking. For instance, CES-D scores were

lowest among weekly drinkers and highest in daily drinkers among Anglo men. Those with the least frequent drinking pattern, monthly and no drinking had mean CES-D scores between these two groups(81). This suggests that the linear model may not be the best choice to ascertain the relationship between frequency and quantity of drinking and depressive symptoms.

Increased levels of quantity of alcohol consumed on a usual drinking occasion were associated with increased symptoms of depression as measured by the Symptom Distress Checklist in a random survey of employed men and women(83). This association continued to be significant in a multivariable linear model after controlling for socio-demographic factors associated with depression in other studies and after investigating whether the relationship between depressive symptoms and quantity of alcohol was linear(83).

Alcohol use has not been found to be associated with high rates of depressive symptoms in farmers. Neither the use of alcohol as a dichotomous variable nor the usual number of alcoholic drinks consumed on a drinking day was associated with a score of 16 or more on the CES-D among two different samples of Colorado farm residents(84;85). Binge drinking was not related to the prevalence of high depressive symptoms in either Colorado or Iowa farmers(86;87).

The results of these studies do not show a consistent relationship between drinking pattern and depressive symptoms. One reason for this overall finding may be that the measures for alcohol use and depressive symptoms varied by study and were less specific than those used in the studies using instruments based on psychiatric diagnoses. Alcohol abuse is not as strongly linked with current depressive disorders as alcohol

dependence(12;13;16;25). Alcohol abuse is more prevalent than alcohol dependence(15;16;25). Heavy drinkers contain people with both alcohol abuse and alcohol dependence and others who would not meet those diagnostic criteria. Yet, it is still unclear how common the co-occurrence of heavy drinking and high depressive symptoms are in different populations, as well as how those with high depressive symptoms only and heavy alcohol use only differ from those with co-occurring high depressive symptoms and heavy alcohol use.

## Reasons behind co-morbidity and co-occurrence

Reasons for the co-occurrence of alcohol use and depressive disorders are not clear but appear to be a complex interplay of genetic, biological, cognitive, and psychosocial processes. Alcohol and depressive disorders may have shared precursors or one disorder may directly or indirectly influence the development of the other. However, pinpointing the etiological pathways is difficult. Both depressive disorders and alcohol use disorders comprise a heterogeneous, imprecise grouping and have many different etiologies and over-lapping causal pathways within each diagnosis(20;88;89). Without more precision within each diagnostic category, the likelihood of finding shared pathways is diminished.

*Shared biological pathways*. Several neurotransmitter systems are involved in both depressive disorders and alcohol use disorders. These include the Gamma-aminobutyrihc acid$_A$ ($GABA_A$) receptor system, the dopamine (DA) receptor systems, and the serotonin systems(5-HT)(90-92). Studies have assessed specific gene sites for evidence of shared transmission associated with these neurotransmitter systems. For instance, in a study of 104 alcohol dependent patients without depression and 38 controls, the small allele of the

serotonin transporter gene 5-HTTLPR was found to be significantly more prevalent in the cases than controls(93). An analysis of the Collaborative Study on the Genetics of Alcoholism (COGA) found that the short allele was associated with lifetime depression but not alcohol dependence, contradicting results of the former study(94). Another genetic pathway that has been investigated is the cholinergicmuscarinic 2 receptor (CHRM2) which is thought to influence memory and cognition. Studies have shown variation at this site is associated with development of alcohol dependence and mood disorders(95).

*Shared familial pathways.* One hypothesis is that common familial pathways underlie the two disorders. These include common genetic susceptibilities and common environmental precursors including family disruption, childhood abuse, and stress(88;96).

Family, twin, and adoption studies have shown a consistent familial transmission of both of these disorders when studied individually(97;98). If there are shared familial etiologies, relatives of persons with one disorder would be expected to have higher rates of either AUD only or MDE only or higher rates of co-morbid AUD and MDE than the general population. If there is no common etiology, one would not expect to find an increase of AUD only in relatives of those with depression only or depression only in those with AUD only. Taking into account the co-morbidity status of both the probands and the relatives in family studies is crucial.

Merikangas, Risch, and Weissman found limited shared transmissibility between alcoholism and depression when taking co-morbidity into account(99). The authors studied the transmissibility of three disorders, AUD, MDE, and anxiety disorders in

relatives of probands being treated for major depression and a community control group. The patients in the study were categorized in mutually exclusive diagnostic groups: MDD only, MDD+AUD, MDD+ anxiety, MDD+AUD+anxiety, and none of the three disorders. Transmissibility was assessed by evaluating how well the presence of each of the disorders in the relatives accounted for the variance in the existence of the disorders in the probands. While some shared transmissibility did occur with AUD and MDD, a large percentage of the variance in AUD could be accounted for by AUD in relatives. Shared familial factors were much stronger between depressive disorders and anxiety disorders than between depressive disorders and alcohol use disorders(99). Swendsen and Merikangas studied familial transmission patterns in a group of probands recruited through a clinic treating alcohol use and anxiety disorders and a control group found through random digit dialing in the same community(20). The presence of a depressive disorder in probands was not a risk factor for AUD in relatives after controlling for the presence of co-morbid alcohol dependence in the probands(20).

Two community family studies provide some evidence of limited co-transmission. Using data from the NLAES study, Grant and Pickering found that respondents with a lifetime diagnosis of major depression only were more likely to have first-degree relatives with an AUD than community members without a lifetime diagnosis of major depression(100). This risk was smaller than the increased odds of having a relative with AUD when the respondent had co-morbid MDD and AUD. Kendler, Davis, and Kessler analyzed data from a sub-sample of NCS which included diagnostic information on parents of respondents(96). The authors first assessed the association between five specific disorders in the respondent and their parents. Each disorder in the respondent

was associated with an increased prevalence of the same disorder in the parents of the respondent compared to parents of respondents without the disorder(96). However, when including the presence of co-morbidities, this association, while still significant, between MDE and AUD, was reduced. This finding suggests that other disorders may contribute in some limited way to the transmission of these two disorders in families. Further analysis showed that the association between MDE and generalized anxiety disorders was stronger within families than that between MDE and AUD while AUD was more highly associated with anti-social personality disorders and other substance use disorders(96). In summary, the family studies suggest that similar familial precursors would account only for a small portion, if any, of the co-occurrence of MDD and AUD.

Twin studies have also been used to evaluate whether shared genetic effects could account for the higher than expected co-occurrence of MDD and AUD. In general authors have found little support for shared genetic effects. Data from the Vietnam Era Twin Registry, a registry of male twin pairs who served in the military in the Vietnam era, were used to investigate the shared genetic effects of major depression and alcohol dependence(101). The authors performed genetic analyses of twin pair data using a normal liability threshold model to separate the total diagnostic variance for MDD and AUD into genetic, shared environmental and non-shared environmental components. Non-shared environmental components included education, household income, and combat experience. Initially, shared genetic effects for MDD and AUD were significant. However, after controlling for the presence of anti-social personality disorder, these shared genetic effects were no longer statistically significant while the genetic effects specific for each disorder remained significant(101). Two different studies, one using a

population-based registry of twins (102) and the other using data from the NCS study (96) suggest that shared genetic factors predispose individuals to more than one disorder and these disorders can be grouped. One broad category sharing genetic risks was anxiety and depression, and this category did not include substance abuse disorders. Substance abuse disorders were more likely to be associated with anti-social personality disorders and anxiety disorders rather than depression(96;102). Other twin studies have also found strong within disorder familial associations in both MDD and AUD but not cross-disorder familial associations when taking into account co-morbidities(103;104).

In summary, while there is strong evidence for the independent familial transmission of both AUD and MDD, there is no strong evidence to date that a family history of MDD alone increases the risk of AUD alone. This may change as the understanding of genetic precursors, specifically of alcohol dependence and major depressive disorders are understood and how environmental conditions interact with these precursors resulting in these disorders.

*Direct pathways of alcohol use on depressive symptoms and depressive symptoms on alcohol use.* Another reason for the high co-occurrence of AUD and MDD is that each has been thought to be a result, either directly or indirectly, of the other. Alcohol is a stimulant as blood alcohol level rises but results in depressive mood as blood alcohol level falls. Protracted, heavy drinking can result in depression. The patterns of depressive symptoms found in those with an alcohol induced depression do not appear to differ from those with an independent depression(105). A direct way in which depression may influence the development of an alcohol use disorder is that heavy drinking may be used as a way to self-medicate symptoms of depression(20;88;103).

*Indirect effects of alcohol use and depressive symptoms.* Alcohol use can indirectly result in depression. The consequences of the heavy use or misuse of alcohol can lead to psychosocial problems, including relationship, job, and other role problems. Depression may be a result of the stress experienced from the problems attributed to heavy drinking. In the same manner, one theory of alcohol use is as a tension reliever. Stress is a major factor influencing drug-seeking behavior, including alcohol(90). Alcohol may be used in an attempt to relieve tension related to similar psychosocial problems, (e.g., relationship problems, work-related problems, etc.) that may be the result of depression. The use of alcohol for tension relief is not straightforward. Studies have shown that drinking to reduce tension is modified by such factors as young age (106), a pre-existing belief that alcohol will reduce tension(106;107), and passive coping style(108;109). Nolen-Hoeksema and Harrell found that among those with a passive coping style, men were more likely to use alcohol to relieve tension than women(109).

*Alcohol use and depressive symptoms as predictors of each other in prospective studies.* Several studies have tested whether increased alcohol use results in an increase of depressive symptoms and whether high depressive symptoms predict an increase in alcohol use. The results are inconsistent, but most studies found that, adjusting for alcohol use at baseline, a high level of depressive symptoms at baseline was associated with increased alcohol use at follow-up. This finding was more pronounced in women than men (110-112), a finding consistent with earlier findings that primary depression is found at higher rates among women than men(22). A review of 8 longitudinal studies varying in follow-up from 2 to 10 years found that a depression score representing the number of depressive symptoms at baseline was a positive significant predictor of the

quantity of usual alcohol consumption at follow-up for women but not for men(111). In a population-based cohort, women with a baseline score of 18 or more on a modified CES–D Scale were more likely to have a diagnosis of alcohol dependence and/or heavy weekly drinking at 3 or 4 years of follow-up compared to those without such a score(112). This association was not seen in men and was not seen for women at 7 years of follow-up.

Two studies used data from the community Epidemiologic Catchment Area (ECA) to investigate the impact of baseline depressive symptoms on alcohol use one year later. In a study limited to respondents without a history of alcohol dependence, Gilman and Abraham reported that the odds of alcohol dependence at follow-up increased with increasing number of depressive symptoms at baseline for women but not men(110). Dixit and Crum limited their study to women who were at risk for incident heavy drinking, i.e., those who were not heavy drinkers at baseline and/or had no history of an alcohol use disorder at baseline(113). Women in this study who had a history of a lifetime depressive disorder at baseline were more likely to be heavy drinkers one year later. In addition, as the number of lifetime depressive symptoms increased, the odds of being a heavy drinker one year later also increased(113). Both of these studies suggest that depressive symptoms and disorders pose a risk of heavy drinking for women.

Other authors have investigated the impact of depressive symptoms on drinking patterns among sub-groups of drinkers to assess the effect of past and present depressive disorders on the drinking pattern. In an analysis of the Canadian National Population Health Survey limited to women who reported binge drinking less than once a month, those with a major depressive disorder were more likely to report binge drinking once a

month or more at one year follow-up than women without a major depressive disorder at baseline(114). No difference in drinking patterns at follow-up by depressive status at baseline was found among men(114). A longitudinal study of women drinkers separated out the respondents into problem drinkers and non-problem drinkers at baseline(115). Among problem drinkers, having a lifetime history of depressive disorder and a depressive episode during the follow-up period were both independently predictive of continued problem drinking at 5 years of follow-up. Among non-problem drinkers, only a depressive episode during the 5 year interval was independently associated with problem drinking at follow-up(115). This suggests that, if the co-morbidity exists at baseline (lifetime history of depressive disorders and problem drinking), then problem drinking is less likely to abate over time than among those without co-morbidity.

One study reported increased drinking associated with a lifetime diagnosis of depression in men but not in women at one year of follow-up. Crum, Brown, Ling and Eaton limited their study to women and men who would be considered to be lifetime problem drinkers, that is, persons who had at least one alcohol reported problem occurring in their lifetime(116). Both women and men problem drinkers who had had a depressive episode since the baseline interview were more likely to go from less than daily drinking to daily drinking compared to those who had no depressive episode in the prior year(116). In addition, men with a lifetime diagnosis of depression at baseline were also more likely to increase the frequency of their drinking compared to men without such a history. This was not true for women(116).

Some of these same authors have used the same data to investigate the impact of alcohol use on the development of depressive symptoms. Unlike the impact of

depressive symptoms on alcohol use, the impact of alcohol use on the development of depressive symptoms seems to be similar by sex. In their review of longitudinal studies, Hartka and colleagues reported that usual quantity of alcohol consumed at Time 1 was independently associated with depression status at Time 2 after controlling for depression status and age at Time 1(111). An increase in alcohol quantity from baseline predicted an increase in depressive symptoms(111). Limiting their analysis to respondents without a history of major depression, Gilman and Abraham reported that the odds of a major depressive disorder at follow-up increased with increasing number of alcoholic symptoms at baseline for both men and women(110). One study did not find that alcohol problems predicted increased depressive symptoms in either men or women(112). In a three-wave panel study of a random sample of adults from Erie County, New York, Moscato and colleagues did not find that a high rate of depressive symptoms as measured by the CES-D in a 3 year, 4 year, or 7 year interval, was associated with alcohol use problems at baseline after adjusting for depressive symptoms at baseline(112). The differing results from this study and the previous study may be due to several differences in study design: population studied, sample size, instruments used, and adjustment variables. One difference may be that the study by Gilman and Abraham (110) had a 1 year follow-up compared to the longer follow-up period in the latter study. It may be that increased alcohol use only predicts increased depressive symptoms over a shorter period of time and may be related to alcohol-induced depressive episodes.

In summary, the etiology of co-morbid disorders still is unclear due in part to the heterogeneous nature of both depression and alcohol use disorders. Several pathways have been suggested. To date, the evidence for shared precursors for both alcohol use

problems and depressive disorders through familial transmission is weak. Rather stronger evidence exists for the direct and indirect impact of depressive symptoms and disorders and problem alcohol use on each other.

## 2. ALCOHOL USE, DEPRESSIVE SYMPTOMS, AND OCCUPATIONAL INJURIES

While no work to date has been done on the effects of the co-occurrence of heavy drinking and high depressive symptoms with injury, several studies have investigated the relationships between alcohol use and occupational injury(60;117-123) and between depressive symptoms and occupational injury(124-126).

### Alcohol Use and Injury

*Suggested pathways in the relationship between drinking patterns and injury.* It has long been recognized that the acute effects of alcohol, including both cognitive and physical impairment (e.g., poor coordination, faulty judgment, decreased reaction time, etc.) increase the risk of all different kinds of injuries(127). However, the relationship between usual drinking pattern and injury is less clear. Heavy drinking and alcohol use disorders could be considered a proxy for the possibility of on-the-job drinking leading to impairment from acute alcohol effects. In a study of hourly workers at a large manufacturing plant, the number of heavy drinking episodes in the past year was correlated with the number of problems experienced at work in a univariate analysis(117). Job related problems included the number of accidents at work, as well as such problems as conflicts with supervisors, absences, sleeping on the job, and problems with job tasks and co-workers. When adjusting for drinking on the job, heavy drinking was no longer associated with on-the-job problems, suggesting that the relationship between heavy drinking and work problems was mediated by drinking on the job(117).

One theory for the relationship between usual drinking pattern and injury suggests that heavy drinking may have effects beyond the acute phase of impairment. Symptoms of alcohol hangover are one mechanism. A hangover is defined by a "constellation of unpleasant physical and mental symptoms that occur after a bout of heavy alcohol drinking" (128) and include symptoms that could possibly increase the risk of injury, such as fatigue, headache, decreased sleep, decreased attention, lengthened reaction time and lack of concentration. Laboratory studies have shown decreased performance on flight simulators among pilots a day after intoxication (129;130) and similar hangover effects among drivers using driving simulators(131). No association has been reported between coming to work with a hangover at least once in the past year and an on-the-job injury during the same time period(117;118). One study involved employed persons in four New England states in a random digit-dial telephone survey(118). A second study was conducted among a random ample of hourly employees of a large manufacturing plant(117). These studies do not provide direct evidence on the relationship between hangovers and injuries because the temporal sequence between the presence of a hangover and the occurrence of the injury was not ascertained.

Another mechanism that could explain an association between heavy drinking and injury is that this relationship is due to the effects of risk taking behaviors. Heavy drinkers may also be more likely to take more risks, and risk taking behavior has been associated with the occurrence of injury(132). Authors have acknowledged this potential confounding by adjusting for behaviors that could be explained as risk-taking. Some have used smoking behavior as a proxy for risk-taking behaviors. Based on data from the 1988 National Health Interview Survey (NHIS), the odds of occupational injury among

heavy drinkers decreased when smoking was taken into account; however, heavy drinking continued to increase the odds of occupational injury even after adjusting for smoking(60). In a study of older workers, adjusting for smoking had little effect on the association between heavy drinking and occupational injury(123) Other studies have measured risk-taking behavior in other ways. In a case-control study of hourly transportation workers, the relationship between baseline substance use problems and later occupational injury was diminished in the presence of documented problem behaviors at work(121). The results suggested that workers who had substance use problems were not necessarily impaired by alcohol at the time of injury but had a propensity for other behaviors that put them at risk for on-the-job injuries(121). In a study of employees of a large manufacturing plant, Ames, Grube, and Moore found that heavy drinkers, defined as those who consumed 10 or more drinks at least one time in the past year, had more work-related problems compared to non-heavy drinkers(117).

In the 1995 National Alcohol Survey, scales were included which measured both risk-taking impulsivity and sensation seeking. In an univariate analysis of this cross-sectional study, Cherpital found that the quantity and frequency of usual alcohol intake, frequency of drunkness in the past year, and simultaneous use of alcohol and drugs in the past year were associated with the occurrence of a medically treated injury in the same time period(132). However, when sensation-seeking and risk-taking scales were included in the analysis, only the simultaneous use of alcohol and drugs continued to be associated with the occurrence of injuries(132).

A third suggested pathway is that overuse of alcohol leads to a higher rate of disability and that disability increases the risk of injury. In a cross-sectional analysis of

the Health and Retirement Study, Zwerling and colleagues reported that heavy drinking and a history of alcohol-related problems were both associated with impaired hearing and a general measure of disability(123). This finding may be limited to older age groups in which the chronic use of alcohol could lead to disability.

*Drinking patterns and occupational injury* Several population-based studies have evaluated the association between drinking patterns and occupational injury. While using a variety of definitions for usual drinking patterns, several analyses of national cross-sectional surveys have found an association between drinking patterns and on-the-job injury after adjustment for other risk factors, including sociodemographic variables (age, gender, marital status, education) and occupational factors (e.g., occupation, physical demands of the job, work-shift). In a survey of residents of four New England states, workers who usually drank 5 or more drinks per day were more likely to report having an accident at work than abstainers (26% vs 8%)(118). Cross-sectional analyses of the Health and Retirement study found that workers aged 51-61 years who drank 5 or more drinks per day in the last year were more than 4 times as likely to report an on-the-job injury in that same time period then those who typically drank 1 to 2 drinks per day(123). Those who abstained from drinking also had an increased odds of injury (1.64, 95 % CI 1.03-2.61) compared to those who had 1-2 drinks per day(123). In the 1988 National Health Interview Survey (NHIS), among adults who had worked in the past year, the frequency of heavy drinking, defined as the number of days the respondent had 5 or more drinks on one occasion in the past year was associated with increased odds of on-the-job injury(60). Compared to those who did not drink heavily in the past 12 months, the odds ratio for on-the-job injury during the same time period increased from 1.07 (95% CI

1.03-1.11) for those who drank heavily only 1 time in the past year to 1.59 ( 95% CI 1.24-2.04) who drank heavily 52 or more times during that time period(60). Analysis of the NHIS did not include a category of abstainers; when the analysis was limited to only those who drank, the fit of the model improved suggesting that including non-drinkers and moderate drinkers in one category may not provide the best explanation of the relationship between drinking pattern and on-the-job injury(60).

A prospective study of San Francisco transit operators found those reporting drinking 10 or more drinks per week at baseline were more likely to have a workers' compensation claim within a 5 year follow-up period(120). Abstainers had higher injury rates than those who drank 1 to 9 drinks a week, but this difference was not statistically significant(120).

A survey of 16 different worksites in the United States studied the relationship between alcohol consumption and work performance(119). One measure was on-the-job injury, defined as a positive response to the question of having been hurt on the job in the past 12 months. In an univariate analysis, Mangione and colleagues reported that abstainers and heavy drinkers, defined as those who drank 60 or more drinks in the past month, and were binge drinkers (5 or more drinks at one time for men, 4 for women) in the past month, were the most likely to respond positively to this question(119).

In a prospective analysis of the National Longitudinal Survey of Youth, Veazie and Smith defined heavy drinking at baseline as having 6 or more drinks at one time in the past 30 days(122). In evaluating the increased risk of heavy drinking for work-related injury, this study focused on current drinkers only, those who had at least one drink in the 30 days prior to the baseline interview. Those who were heavy drinkers at baseline were

more likely to have an injury on the job within the past six months at the follow-up interview 2 years later (1.6, 95% CI 1.0, 2.8) after adjustment for socio-demographic and occupational variables compared to drinkers who were not heavy drinkers(122). No association was found between being a current drinker at baseline (yes or no) in the follow-up period(122).

Ames, Grube, and Moore surveyed a random sample of hourly employees in a large unionized heavy machinery manufacturing plant about the number of work-related problems including on-the-job injury(117). Respondents were asked how often they had an accident at work in the past year. The authors found no correlation between the number of heavy drinking episodes, defined as the number of times the respondent drank 10 or more drinks at one time, and the number of accidents at work(117).

*Drinking patterns and farm-related injuries.* Heavy alcohol use has not shown a consistent relationship with farm-work injuries. Dawson (1994) analyzed data from the 1988 National Health Interview Survey (NHIS) to estimate occupational injury by drinking pattern(60). Among respondents in the farming/forestry/fishing/ occupational group, the highest rate of occupational injury occurred among those who drank 5 or more drinks at a time at least once a week or more in the past year(60). Those who never drank 5 or more drinks in a setting during the past year had the lowest rate of work-related injury(60). In a survey of principal farm operators in Alabama, Zhou and Roseman (1994) found higher levels of alcohol use resulted in increasing odds of farm-work injury(9). This same trend was found among white male principal operators in selected counties in Alabama and Mississippi(6). However, the trend of higher alcohol use associated with farm-work injury was not seen among African-American principal farm

operators or African-American farm workers(6). Among the latter, those who reported drinking moderate amounts of alcohol (1 to 99 ml per week) were more likely to report having a farm-work injury (OR 4.75 95% CI 1.67-13.5) compared to those who did not drink alcohol(6).

Several studies have found an increased estimate of association between drinking pattern and injury, but these estimates have not been statistically significant. For instance, in a follow-up study of the sample of farmers reported by Lyman and colleagues, baseline alcohol consumption was not associated with farm-work injury in the total sample(133) When stratified by race and farm ownership, African-American farm owners who consumed 100 ml or more of alcohol per week had a two fold increase of injury compared to African-American farm owners who did not drink although this estimate was not statistically significant(133). In a case-control study of Ohio principal operators of cash grain farms, those who consumed more than 104 drinks in a year had a higher odds of reporting a farm-work injury than those who drank less than that, but the difference was not statistically significant(134). Similarly, among older male farmers in Colorado, the odds of farm-work related injury increased as the number of drinks per month increased, but the differences were not statistically significant(135). Zwerling and colleagues found an increased odds of injury among a national sample of older farm workers with a history of alcohol problems compared to those without such a history; this estimate, which was not statistically significant, was based on a total sample of 237 and only 3 work-related injuries(3).

Other studies, such as the cross-sectional study of African-American farm workers (6), have reported alcohol use levels to be associated with farm-work injuries but

not at the highest levels of use. In a prospective study of migrant farm workers in northern California, workers who drank 1 to 4 drinks per week had the highest risk of injury (18.5/100 FTE) while those who drank 10 or more had a slightly lower risk (7.8/100 FTE) than those who abstained from alcohol (8.4/100 FTE)(7). Among principal farm operators in Colorado, the combination of 3 or more drinking days per week and drinking 1 to 2 drinks on a drinking day resulted in a 60% increase in the risk of having a farm-work injury in this prospective study when compared to those who did not drink alcohol at all(8). However, the highest level of drinking (3 or more drinking days per week with 3 or more drinks per drinking day) was not associated with farm-work injuries (OR 1.08, 95% CI 0.49-2.38)(8). In a case-control study of injuries occurring to farmers in Ontario, Canada, the highest injury rates occurred in the group who never drank alcohol but this finding was not statistically significant(136). In that study, the alcohol measure was limited to only the frequency of drinking and did not include quantity consumed on a drinking day(136).

No association between alcohol use and farm-work injury has been reported in several studies among Iowa farmers(4;137-140). In a nested case-control study of principal farm operators in Iowa, no association was found between having 2 or more drinks per day and general farm injury(140), falls (139),animal-related injuries (137) or low back pain injury (138). Park and colleagues (2001) found that binge drinking at baseline was not associated with farm-work injuries up to a year later(4).

## Depressive Symptoms and Injury

*Suggested pathways for an association between depressive symptoms and injury.*

Depressive symptoms have been linked both as sequelae and precursors for injury.

Several studies have found events including motor-vehicle crashes(141), falls among the elderly(142) and occupational cumulative trauma(143) led to the development of depressive symptoms. Symptoms of depression, such as lack of sleep, feelings of fatigue, inability to concentrate and memory problems may also increase the risk of injury.

Limited research has been conducted investigating the association of pre-existing depressive symptoms and injuries. In a hospital-based case-control study, patients seen in the emergency department for intentional and unintentional trauma had higher rates of depression compared to patients who were admitted to the hospital for elective surgery unrelated to past trauma(144). The authors stated that they asked the patients to respond to the depression interview based on symptoms prior to the hospital visit(144). In a population-based survey of residents in one rural county in Iowa, respondents were followed up to eight years and asked every 3 months about whether they had had an injury(145). A short form of the CES-D was used to measure depressive symptoms at baseline(145). Depressive symptoms at baseline increased the risk of injury by 41% after adjustment for antidepressant medication use, sex, income, prior injury, and sleeping fewer then 7 hours a night(145). In another prospective study, older women with high depressive symptoms at baseline were more likely to experience non-vertebral fractures due to falls than women without high depressive symptoms(146). Respondents were followed an average of six years. This association was found after adjusting for bone-density, neuromuscular functioning, history of falls and medications(146).

Another pathway between depressive symptoms and injury could be in the association between disability and injury. Disabilities, such as blindness, hearing impairment, upper extremity impairment, and arthritis, have been found to be associated

with occupational injury(147). High depressive symptoms have been found in populations with disabilities including adults with chronic pain related to joints and the musculoskeletal system (148;149) and older adults with functional limitations due to poor health(150-152). Additionally, disability resulting from chronic alcohol use could lead to depression and also to injury.

*Depressive symptoms and occupational injury.* Cross-sectional and prospective analyses of the Health and Retirement Study were completed to assess risk factors for occupational injuries. Among this nationally representative sample of workers aged 51-61 years at baseline, respondents in the highest 30% of CES-D scores were more likely to report an injury at work in the past year in multivariate cross-sectional analyses (1.47, 95% CI 1.17,1.65)(126) and in multivariate analysis after 2 years of follow-up (1.37 95% CI 1.05, 1.77)(125). Using a convenience sample of workers reporting to two different occupational health clinics in one town, Peele and Tollerud found that persons with a work-related injury in the last 72 hours scored higher on a depression screen than workers seen in the clinic for other medical problems(124). The authors acknowledged the possibility that the depressive symptoms could have resulted from the injury but suggested that the screening tool used measured pre-existing depressive symptoms(124).

*Depressive symptoms and farm-work injuries* Several studies have focused on building models describing factors associated with farm-work and have included depressive symptoms in their models(3;4;137-140). An association between high levels of depressive symptoms using the CES-D has been found in a national sample of older agricultural workers (3), Colorado female farm residents(5), and Iowa male farmers(4). High depressive symptoms were associated with a three to close to a five fold increased

odds of farm work injuries compared to those with low depressive symptoms(3-5). In other studies of Iowa farmers, high depressive symptoms were not associated with general agricultural injuries (140), animal-related agricultural injuries (137) and farm-work related falls (139) but were associated with low back injuries(138).

## Summary

While several studies have shown an association between higher levels of alcohol use and occupational injury, this association has not been confirmed among farming populations. Both general population studies and farm-work specific studies point out that if a relationship does exist, it is not linear. Those who abstain from alcohol have higher risks than those who drink moderately in some general occupational studies (119;123) and in farm studies (136); other farm-work studies reported an increased risk of injury associated with moderate alcohol use (6-8). Other studies have combined non-drinkers and moderate drinkers as the reference category in evaluating associations between drinking patterns and occupational injury(60;117). Combining these categories may hinder uncovering true associations of different levels of drinking and occupational injury. The differences in definitions of drinking patterns across studies hinder the ability to make direct comparison. Standardized measurement of drinking is needed across occupational studies in order to facilitate understanding of the relationship between work-related injuries and alcohol consumption patterns.

A number of studies have addressed the relationship between farm injuries and depressive symptoms but results have been inconsistent. Only one of these studies was done prospectively and found that a score of 16 or more on the CES-D was a risk factor for future farm work injury among male farmers(4). Research is needed to confirm that

depressive symptoms precede farm work injury in other populations. No studies in the farm population have addressed the co-occurrence of alcohol use and depressive symptoms on farm-work injuries. Research is needed to determine if the effect estimate of depressive symptoms on farm-work injury is the same at different levels of drinking patterns.

Missing from the studies on drinking patterns and depressive symptoms in the farming population is the time at risk for occupational injury. One factor found to be consistently associated with farm-work injuries is the hours spent farming (140;153-157) Stallones and colleagues reported that farm residents not involved in the operation of the farm reported higher levels of depressive symptoms than those involved in farm work(84). No information is available regarding the association between depressive symptoms and number of hours worked on the farm. No information on whether the use of alcohol also varies with the number of hours worked on farming is available. Since disability and alcohol use have been associated among older workers (123), those with disabilities who also use alcohol heavily may not be working as many hours and thus have less at-risk time for work-related injury. The increased risk of injury for both non-drinkers and moderate drinkers may be moderated by the time spent at work. If alcohol use and/or depressive symptoms are inversely associated with the number of hours spent on farm work, then not adjusting for the farm-work time may mask an association between alcohol use and farm-work injury and depressive symptoms and farm-work injury.

## Chapter 3: A Comparison of Farm Residents with Co-occurring Heavy Drinking and High Depressive Symptoms, Heavy Drinking Only, High Depressive Symptoms Only, and Those with Neither.

### Introduction

One in five U.S. adults is estimated to have experienced a mental health disorder within the past year(16). Two of the most common mental health disorders are depressive disorders and alcohol use disorders(15;16). A high burden of disease world-wide has been attributed to both(26). These two disorders occur together more often than would be expected by chance alone(10-14;16-18). An increase in severity of symptoms of each disorder (19;20), an increase in problems in social functioning (21) and an increase in work-loss days (23) has been found among those with both disorders compared to those with only one disorder. The co-occurrence of heavy drinking and high rates of depressive symptoms has been associated with increased mortality (24) compared to those with heavy drinking only. No information is available on the prevalence of co-morbidity by occupation.

While no information is available to estimate the prevalence of co-morbidity by occupation, some studies compared the prevalence of depressive disorders and alcohol use disorders by occupation Studies show a small but consistent increase in depression among farmers. The 12-month prevalence of major depression among the occupational group of farming, forestry, and fisheries in the Epidemiologic Catchment Area (ECA) survey was estimated at 4.3% compared to 3.5% for all employed persons(158). Using data from this same survey, Eaton and colleagues found the 12 month prevalence to be 5% in this occupational category compared to 4% among all respondents who had ever

held a full-time job(159). A study of male, cash grain farmers in Ohio found the age-adjusted mean scores on the Centers for Epidemiology Scale –Depression (CES-D) to be significantly higher compared to working men of the same age from a representative sample of the U.S.(160). Recent studies found that the prevalence of high depressive symptoms among farm residents ranged from 6.1% in one Colorado agricultural region (85) to 12.1% of Iowa principal farm operators(87).

Results of studies comparing alcohol use disorders among different occupations suggest that farmers have slightly higher rates of such disorders compared to other occupations. Two probability samples of U.S. residents have shown rates of alcohol use disorders among the occupational group farming, forestry, and fishing to be higher than some other occupational categories(158;161). Roberts and Lee found that the prevalence of alcohol use disorders among this occupational group was 40% higher than the prevalence rate for all occupations over 6 months and 50% higher for lifetime prevalence(158). Estimates of 12-month alcohol dependence among working men and women from the 1988 National Health Interview Survey were 13.8% of farm men compared to 13.2% for men of all occupations and 7.5% for farm women compared to 5.9%(161). Farming, forestry and fishing workers were one of two occupational groups in California with excessive alcohol-related mortality compared to all occupational groups(162). These findings are in contrast to results of studies investigating drinking patterns among farmers. Results from the 1988 National Health Interview Survey found men and women farmers to have a similar daily average intake of alcohol compared to all employed men and women(161). A higher percentage of farmers have been reported to be non-drinkers compared to other occupations(83;161). In a study of Iowa residents, the

odds of binge drinking was reported to be lowest among farmers compared to 5 other occupational groups after adjusting for age and sex(163).

No information is available to estimate the prevalence of co-occurring heavy drinking and high depressive symptoms by occupation. In addition, little information is available to understand how those with the co-occurrence of heavy drinking and high depressive symptoms differ from those with only one of these or neither of these. National samples have suggested that men were more likely than women to have co-occurring alcohol use disorders and depressive disorders(19;22); in addition, those with co-occurring disorders were younger than those with only one disorder(19). Patients with major depressive disorders and a co-occurring substance abuse disorder have been found more likely to be young, male, divorced or single, and non-Hispanic than those with major depression but without a co-occurring substance abuse disorder(76). Work is needed via community based samples to understand how prevalent the co-occurrence of heavy drinking and depressive symptoms is in different occupational groups. Additionally, community based studies are needed to understand how those with both heavy drinking and high depressive symptoms differ from those with only one of these problems or neither of these problems.

The purposes of this study were to 1)estimate the prevalence of co-occurring heavy drinking and high depressive symptoms among principal farm operators and their spouses and 2)compare farm residents without heavy drinking patterns and high depressive symptoms to those with co-occurring heavy drinking and high depressive symptoms, high depressive symptoms only, and heavy drinking only.

## Methods

The target population of this study was principal farm owners and their spouses living in Colorado. Data are from the statewide 1993 Colorado Farm Family Health and Hazard Surveillance (CFFHHS).

*Selection of Study Subjects* The sampling methodology has been described elsewhere in detail(8;84;86). Briefly, a complete list of addresses with farm trucks registered was obtained from the Colorado Division of Motor Vehicles' 1991 public use tape. The list was stripped of duplicate addresses and the non-duplicated list was sorted into the 6 mutually-exclusive crop reporting districts used by the Colorado Agricultural Statistics Service(164). A random sample of addresses was drawn proportional to the distribution of farms by crop districts.

Reverse telephone directories and operator assistance were used to find telephone numbers. Approximately 25 percent of the original sample could not be linked to a working telephone number. Telephone interviews were conducted after screening questions were asked to determine if the address was a farm and, if so, whether the principal operator lived on the farm. In order to be eligible for inclusion, the farm had to gross at least $1,000 from the sale of agricultural products in a typical year. Separate interviews were conducted with the principal farm operator and the spouse. The response rate for those addresses for which telephone numbers were available was 62%. Table 3-1 provides the number of farms originally targeted for the sample by each agricultural region and the number of farms participating in the study.

Interviews took approximately 30 minutes to complete and were conducted between January and May of 1993. All data were collected by the Survey Research Unit,

Colorado Department of Public Health and Environment. The study was reviewed and approved by the Colorado State University Human Research Committee.

*Questionnaire* Questions were included on general health, specific health problems, farm characteristics, demographics, hours spent farming, farm work and farm hazards, pesticide exposure, prior pesticide poisoning, injuries, behavioral risk factors, safety knowledge, medical care, insurance status, depressive symptoms, alcohol consumption, social support, and stressful life events. The questions were developed in conjunction with staff from the National Institute of Occupational Safety and Health (NIOSH) based on instruments that have been developed and used in other national and international surveys (e.g., the Behavioral Risk Factor Surveillance System, the National Health Interview Survey, the United States Department of Agriculture Census of Agriculture).

The outcomes of interest in this analysis were depressive symptoms and heavy drinking patterns. Drinking patterns and high depressive symptoms had four mutually exclusive levels: heavy drinking with high depressive symptoms, heavy drinking only, high depressive symptoms only, and neither heavy drinking nor high depressive symptoms. The measure of depressive symptoms used in this study was the CES-D, an instrument that has been widely used and has been shown to be a reliable and valid instrument in detecting symptoms of depression(34;38-40;42). The scale consists of 20 questions and asks how often the respondent experienced each symptom within the past week. Responses range from 0 (never) to 3 (5-7 times in the past week) resulting in possible scores of 0 to 60. A cut-point of 16 or greater has been used as an indicator of high depressive symptoms in studies of farm residents (4;5;84;86;165) and was used as such in this study.

Heavy drinking included both binge drinking and a measure of the quantity and frequency of usual drinking within the past month. Questions were those used on the 1992 Behavioral Risk Factor Surveillance System(71). Respondents were classified as a binge drinker if they answered that they had 5 or more alcoholic drinks on one or more occasions in the past month. To measure drinking pattern, the number of alcoholic beverages usually consumed on a drinking occasion and the frequency of drinking occasions were obtained. Participants were asked to respond based on their alcoholic consumption in the past month. Heavy drinking was defined as an average of 15 or more drinks per week for males and 8 or more drinks per week for females(57;58). Respondents who were either binge or heavy drinkers were classified as heavy drinkers.

Independent variables found to be associated with depressive symptoms and alcohol consumption in other studies were tested for their association with each outcome. The independent variables included age, marital status, self-reported general health status, limits in regular activity due to health problems, history of acute pesticide poisoning, negative life events, social support, smoking status, time spent on farm work, and season of interview.

To measure health status, respondents were asked to rate their present health as excellent, very good, good, fair, or poor. Disability was defined as any limitation in regular activity due to health problems. Respondents were asked if, during the past 12 months, they had to cut down or stop any activity they used to do because of ill health. Pesticide poisoning was determined by asking respondents if they had ever become ill from any exposure to pesticides.

Respondents were asked if the following 10 different negative life events had happened to them in the past year: 1)losing something of sentimental value; 2) having a close friend die; 3) having been divorced or separated; 4) having trouble with in-laws; 5) the death of a spouse; 6) the death of another family member; 7) a substantial decrease in income; 8) going deeply into debt; 9) legal problems; and 10) having been assaulted. The measure of negative life events was the total of the number of events experienced. Social support was assessed as the number of persons (relatives or non-relatives) that respondents felt very close to, that is, people they felt at ease with, could talk to about personal problems, and could get real help from in times of trouble.

Smoking was classified as current smoker or non-smoker. Respondents were asked if they had ever smoked 100 cigarettes in their life. Those who answered yes were asked a follow-up question to determine if they were smokers at the time of interview.

Farm-work time represented the total number of hours worked on farm-tasks and converted to full time equivalents (FTE). Respondents were asked the number of hours that they spent at particular farm tasks each season (fall, winter, spring, summer). The average number of hours per day, the average number of days per week, and the average number of weeks per season were recorded for the following farm work: animal handling, handling of farmstead materials, crop production, farm maintenance, farm related transport, and other farm related job tasks. The total number of hours for each season and each task was summed to get the total number of hours spent in the past year. The full time equivalent status of each respondent was measured using the actual number of farm-work hours spent in the last 12 months divided by 2000 hours, the number of

hours equal to one FTE in one year(2). Time at farm work was divided into 3 categories, less than half-time FTE, from half-time FTE to less than 1 FTE, and 1 or more FTE.

*Statistical Analysis* To assess the association between the independent variables of interest and the outcomes, multinomial logistic regression was performed using SUDAAN, Release 9.0.1 (166), to account for the complex sampling design of the CFFHHS. Univariate multinomial logistic regression was first done to assess which independent variables were associated with the outcomes of interest. Any variable with a probability of less than 0.20 for its association with any of the 3 levels of the outcome variable was retained for possible inclusion in the multivariable model.

Multivariable multinomial logistic regression, using a forward step-wise procedure, was performed to determine which variables were independently associated with depressive symptoms status and heavy drinking status. Adjusted odds ratios for all the variables studied were developed by controlling for all variables found to be independently associated at $p<0.05$ in the multinomial model.

All independent variables were also tested as potential confounders. Confounding was defined as a variable whose addition to the model changed the odds ratio of one of the other model variables by 10 percent or more. To test how effectively the final logistic model described depressive symptom and heavy drinking status in this sample, each of the independent variables with a $p>.05$ was added into the model one at a time. The likelihood ratio test based on the chi-square distribution was used to assess whether the addition of any of these increased the goodness-of-fit of the model.

## Results

A total of 467 men and 405 women were interviewed from 485 farms. Thirty-two women were principal farm operators. Close to 2% of both men and women had missing data on either the drinking variable or the CES-D score. The results of this study are based on the 457 men and 398 women for whom these two dependent variables were available. Table 3-2 provides the demographic characteristics of the sample. The mean age for the farm residents was 47 years. Male farmers ranged in age from 21 to 74; females from 21 to 77. Ninety-five percent of farm residents were of white, non-Hispanic descent. Given that the sample included principal farm operators and their spouses, it is not surprising that over 90% of both men and women were married at the time of the interview. Farming and farm administration was the primary occupation for the men while over 40% of women reported a primary occupation other than farming; 36% of women reported homemaking as their primary occupation. Close to 60% of women and 43% of men reported that they had paid employment off the farm. The mean number of farm-work hours was over 1300 hours per year more for men than for women farm residents.

Two percent of men and 1.3% of women were heavy drinkers who also had a score of 16 or more on the CES-D. Results of the univariate multinomial logistic regression are provided in Table 3-3. Men were 40% less likely to report high rates of depressive symptoms without heavy drinking than women but were over 2 times more likely to report heavy drinking without high depressive symptoms. Men were close to 60% more likely to report both heavy drinking and depressive symptoms compared to women, but this difference was not statistically significant.

All three outcomes were found most common in the youngest age group (20-29). Those in the middle years (30-49) were close to 4 times more likely to be heavy drinkers than the older group of farm residents. Respondents in these age groups also were more likely to have high depressive symptoms than their older counterparts. Increases in the odds ratio for depressive symptoms only among those 30-49 ranged from 2.0 to 1.6 although these odds ratios were not statistically significant.

Marital status was associated with all three outcomes. Compared to married respondents, those not currently married were more likely to have high depressive symptoms only (OR 2.9 95% CI 1.3, 6.2); heavy drinking only (OR 2.5 95% CI 1.1,5.5); and concurrence of high depressive symptoms and heavy drinking (OR 5.0 95% CI 1.3,19.5) compared to married respondents.

Variables related to health varied by outcome. Poor or fair health status was associated with depressive symptoms only but not heavy drinking only. Those with poor or fair health were also more likely to report having depressive symptoms with heavy drinking, but the difference was not statistically significant. Having limited activity due to poor health was associated with depressive symptoms only (OR 3.0 95% CI, 1.3, 6.9). A history of acute pesticide poisoning was associated with depressive symptoms only but not the other two outcomes. Current smokers were close to four times more likely to have concurrent depressive symptoms and heavy drinking compared to current non-smokers. Smoking status was not associated with either high depressive symptoms only or heavy drinking only.

Those with 1 negative life event were over 3 times more likely to report depressive symptoms only (OR 3.3 95% CI 1.0-10.2) compared to those with no negative

events in the past 12 months. Those with 2 or more such events were over 10 times more likely to have depressive symptoms only (OR 10.8 95% CI 3.9, 30.1). No association was seen between the number of negative life events and the other two outcomes. The number of close family and friends was not associated with any of the three outcomes in the univariate analysis.

Season when the interview was completed was not associated with any of the outcomes. Time spent in farm-work was associated with depressive symptoms only and concurrent depressive symptoms and heavy drinking. Those who worked between 1/2 and less than 1 FTE in farm work during the year were less likely to report depressive symptoms only (OR 0.3, 95% CI (0.1, 1.0) but were more likely to report depressive symptoms with heavy drinking (OR 3.3, 95% CI 1.0, 11.0) than those who worked a full time equivalent or more.

The multivariable model included the following variables: sex, age, marital status, health status, number of negative events, number of close family/friends, smoking status, history of acute pesticide poisoning, and farm-work time as percent of full time equivalent. The adjusted odds ratios (AOR) for each of these factors and 95% confidence intervals (CIs) adjusted for the other factors are presented in Table 3-4. In the multivariable model, sex continued to be associated with depressive symptoms only and heavy drinking only but not concurrent depressive symptoms with heavy drinking. Males were 2.6 times more likely to report heavy drinking only and 50% less likely to report depressive symptoms only than female farm residents. Younger age was also highly associated with all 3 outcomes. Those 20-29 were 7.5 times more likely to report depressive symptoms only than those 65 and older, 9.8 times more likely to report

concurrent heavy drinking and depressive symptoms, and were 18 times more likely to report heavy drinking only. The pattern of association differed by age among the 3 outcomes in the years between the youngest and oldest age groups. A major reduction in the odds ratio from that in the youngest age group (20-29) to age 30-39 and older appeared for all outcomes. Those aged 30 through 64 were 2.4 to 2.9 times more likely to report depressive symptoms only than those 65 and older while those in this same age group were close to 4 to 5 times more likely to report heavy drinking only. No association was found for the middle year age groups and concurrent depressive symptoms and heavy drinking.

In the multivariable model, those not married were over 3 times more likely to report depressive symptoms only compared to married persons. The adjusted odds ratios comparing unmarried to married farm residents were similar to those with depressive symptoms only for both heavy drinkers only and concurrent depressive symptoms with heavy drinking but these were not statistically significant.

Fair or poor health status was associated with high rates of depressive symptoms only (AOR 4.2 95% CI 1.9, 9.6) and high rates of depressive symptoms with heavy drinking (AOR 5.9 CI 1.6, 22.2). Health status showed no association with heavy drinking.

Both the number of negative life events and the number of close family and friends were associated with depressive symptoms only in the multivariate model. Those with 1 negative event in the past year were over 3 times more likely and those with 2 or more were over 10 times more likely to report depressive symptoms only compared to those who had no negative events in the past year. This same pattern was not seen in

those who had both high depressive symptoms and heavy drinking nor in heavy drinkers only. An increase in one close friend or relative was associated with a 6 percent decrease in the estimated odds of reporting depressive symptoms only (AOR – 0.94 95% CI 0.89, 1.00). A similar odds ratio was found for the association between concurrent depressive symptoms and heavy drinking, but this was not statistically significant. The number of close family and friends was not associated with heavy drinking only.

Smoking was associated with concurrent depressive symptoms and heavy drinking. Those who were current smokers were approximately 4 times more likely to report both depressive symptoms and heavy drinking than those who did not smoke. No association between a history of acute pesticide poisoning and heavy drinking only or concurrent depressive symptoms and heavy drinking was found. Those who had an acute pesticide poisoning were 70% more likely to report depressive symptoms only; however, this was not statistically significant. Because the inclusion of pesticide poisoning in the multivariable model increased the goodness of fit of the model based on the likelihood ratio chi-square statistic, pesticide poisoning was retained in the model.

The association between the full time equivalency of farm work showed the same pattern in the multivariable model as found in the univariate analysis. No association was found between working less than one-half FTE on the farm in the past year and depressive symptoms only, heavy drinking only, and concurrent depressive symptoms and heavy drinking. Those who spent the equivalent of one-half to less than one FTE on farm-work were 74% less likely to report depressive symptoms only than those who worked the equivalent of one FTE or more. In contrast, those who spent this much time

in farm-work were 3.5 times more likely to report concurrent depressive symptoms and heavy drinking.

## Discussion

Results from this study found that 1.6% of the farm residents in this study had both high rates of depressive symptoms and heavy drinking. It is difficult to compare these findings with other populations. First, few studies report the prevalence of the co-occurrence of these two and second, when they are reported different measures of the outcomes have been used. A total of 7.9% of male and 11.4% of female farm residents in this study reported high depressive symptoms, with and without heavy alcohol use. Approximately 25% of males with depressive symptoms and 11% of women with depressive symptoms also reported heavy drinking. Results from the 1991 National Health Interview Survey (NHIS) found that 7% of men and 2.5% of women who report feeling depressed often or very often reported drinking heavily, defined as drinking 3 or more drinks a day for men and 2 or more per day for women(78). The higher rates of heavy drinking among farm residents with depressive symptoms may be due to the different measures used in the two studies. Binge drinking was included in the definition of heavy drinking in the current study which not the NHIS study. The definition of depressive symptoms also differed by study. Alternatively, a higher proportion of farm residents with depressive symptoms may also drink heavily. A study of non-institutionalized adults in New Mexico found that 25% of binge drinkers reported high rates of depressive symptoms compared to 15% of non-binge drinkers(79). By combining both heavy drinkers only and heavy drinkers with concurrent high depressive symptoms, a total of 10.5% of farm residents were heavy drinkers and of the heavy

drinkers 15% had high depressive symptoms. Again, the measures of both heavy drinking and depressive symptoms among farm residents differed from the study of New Mexico residents, thereby making direct comparisons difficult. In the study of co-occurrence of depressive symptoms and drinking patterns, consistent measures are needed to accurately compare prevalence across populations.

The higher prevalence of all three outcomes with young age compared to those with neither high depressive symptoms nor heavy drinking is consistent with findings from community surveys in which young age has been associated with high depressive symptoms (24;148;167;168) and heavy drinking (58;78;169;170). The results by sex are also consistent with community surveys. Males have higher rates of heavy alcohol use compared to females; and females have higher rates of high depressive symptoms than males(58;78;169;170). Other studies have suggested that males are more likely to have co-occurring negative mood and heavy drinking (78) and concurrent alcohol use disorders and depressive disorders(19;22). We found a higher rate of concurrent heavy drinking and high depressive symptoms among men than among women, but this difference was not statistically significant perhaps due to the small numbers of respondents in this category.

The findings showed a strong relationship between high depressive symptoms with and without heavy alcohol use and self-reported health status. An association between high depressive symptoms and poor self-reported health is consistent with other studies of farm residents(84-87). Some studies have suggested that heavy alcohol is associated with poor self-reported health in different populations(171-174). Non-drinkers have been reported to have higher rates of poor self-reported health than moderate

drinkers(171;173-176). In this analysis, both moderate and non-drinkers were combined into the non-heavy drinking category. Combining non-drinkers and moderate drinkers may have contributed to the null finding of no difference in health status for heavy drinkers only compared to non-heavy drinkers without depressive symptoms. However, the results do suggest that future studies should take into account the presence of depressive symptoms when studying associations between drinking pattern and health status.

The number of negative events in the past year was associated with high depressive symptoms only. In a review of studies on alcohol use and life events, Veenstra and colleagues reported that some studies, but not the majority of those reviewed, showed an association between heavy drinking and the number of negative life events(177). Rather, increased alcohol consumption was associated with specific negative life events while decreased consumption was associated with other specific events(177). Our findings of no association between the number of negative life events are consistent with this conclusion and suggest that future work on differences among those with high depressive symptoms only, heavy drinking only, and both high depressive symptoms and heavy drinking should focus on differences in specific negative life events.

Differences in the association between farm-work time and the three different outcomes are interesting. Those who worked half time or more but less than full time were over 3 times more likely to report high depressive symptoms with heavy drinking while those who worked full-time or more on the farm were more likely to have depressive symptoms only. This suggests that those who are working the longest hours

on the farm also have the highest rates of depression independent of sex. The reasons that those who put in less than full-time have high rates of depressive symptoms with concurrent heavy drinking are worth pursuing in other studies

Smoking rates have been reported to be higher in those with major depressive disorders (178), depressive symptoms (179;180), alcohol use disorders (178;181;182), and heavy drinkers(62;123;179;181;182). Smoking cessation rates have also been shown to be lower for those with high depressive symptoms (183), depressive disorders (178) and alcohol use disorders(178). This study found that concurrent heavy drinking and high depressive symptoms was associated with being a current smoker. Being a smoker was not associated with depressive symptoms only or with heavy drinking only. An earlier study did show that the association with smoking increased as the number of psychiatric diagnoses increased(178). Farm residents in this study had both a higher prevalence of non-drinkers (48.3% vs. 37.3%) and lower prevalence of smoking (14.5% vs. 23.9%) compared to the Colorado population at the time of the study(184). Falk and colleagues point out that the association between alcohol use and tobacco is partly a function of the ready availability and high rates of use of both substances in the population(182). Scarth and colleagues found no association between smoking and high rates of depressive symptoms in male principal farm operators in Colorado and Iowa(86;87).

Another explanation for the association of smoking with co-ocurring high depressive symptoms and heavy drinking may be that those with both may have the highest rates of anxiety. Other studies have shown relationships between anxiety and smoking (185), anxiety and alcohol use disorders (12) and anxiety and depressive

disorders (12;16) Results from a population-based survey in Norway investigating the effect of anxiety and depressive disorders in the association between smoking found that the association between depression and smoking was reduced significantly when taking co-morbid anxiety into account(185). While the study of farm residents did not assess anxiety, it may be that those with both high depressive symptoms and heavy drinking are those with the highest rates of anxiety which may account for the observed association.

The limitations of this study included the small number of respondents with co-occurring heavy drinking and depressive symptoms, which did not allow for reliable estimates of descriptive characteristics of this group. Additionally, it is known that survey respondents under-report alcohol use(64;186). If heavy drinking was underreported, our results could be biased toward the null, resulting in not being able to capture true differences among the different groups.

In summary, differences and similarities were described among those with heavy drinking only, depressive symptoms only, and co-occurring depressive symptoms and heavy drinking compared to those with neither high depressive symptoms nor heavy drinking in this farm resident population. No causal direction between associations found could be determined in this cross-sectional study. Attention needs to be paid to whether the higher rates of smoking among those with both are found in other populations. These findings suggest that a target group for smoking cessation efforts may be those who are heavy drinkers with high depressive symptoms.

TABLES: CHAPTER 3

Table 3-1: Target number of farms and actual number of farms participating by agricultural region: Colorado Farm Family Health and Hazard Surveillance (CFFHHS), 1993.

| District | Farm Households in which a Principal Operator Resides | Target Number of Farms | Number of Farms Participating |
|---|---|---|---|
| 1 | 5,578 | 170 | 159 |
| 2 | 4,713 | 117 | 112 |
| 3 | 2,709 | 68 | 67 |
| 4 | 1,567 | 33 | 33 |
| 5 | 4,176 | 90 | 77 |
| 6 | 1,131 | 28 | 28 |
| Total | 19,874 | 500 | 485 |

Table 3-2: Descriptive characteristics of principal farm operators and spouses: Colorado Farm Family Health and Hazard Surveillance, 1993

| | Males n=457 | Females n=398 | Total n=855 |
|---|---|---|---|
| Age- Mean (SE) | 48.3 (0.60) | 45.6 (0.60) | 47.1 (0.56) |
| Race/Ethnicity | | | |
| White, non-Hispanic | 96.5% | 94.5% | 95.5% |
| Hispanic, all races | 2.4% | 4.5% | 3.4% |
| Other non-Hispanic | 1.1% | 1.0% | 1.1% |
| Education | | | |
| Less than high school | 8.5% | 5.5% | 7.1% |
| High school graduate | 39.0% | 36.8% | 37.9% |
| Beyond high school without a degree | 29.1% | 30.5% | 29.7% |
| College graduate | 23.4% | 27.2% | 25.2% |
| Marital Status | | | |
| Married/unmarried couple | 90.8% | 96.2% | 93.3% |
| Divorced/separated | 2.6% | 0.5% | 1.6% |
| Widowed | 0.9% | 2.3% | 1.5% |
| Single, never married | 5.7% | 1.0% | 3.5% |
| Primary Occupation | | | |
| Farming, Ranching/Farm | 73.3% | 21.1% | 49.0% |
| Administration | 0.2% | 36.4% | 17.1% |
| Homemaking | 26.5% | 40.2% | 33.9% |
| Other occupation | | | |
| Paid employment outside of the farm | 43.3% | 59.8% | 51.0% |
| Number of farm work hours – Mean (SD) | 2834.2 (75.1) | 1498.2 (87.1) | 2212.3 (59.8) |
| Depressive Symptoms, Heavy Drinking | 80.3% | 83.1% | 81.6% |
| Neither | 5.9% | 10.1% | 7.8% |
| Depressive symptoms only | 11.8% | 5.5% | 8.9% |
| Heavy drinking only | 2.0% | 1.3% | 1.6% |
| Depressive symptoms + heavy drinking | | | |

Table 3-3: Univariate odds ratios and 95% confidence intervals for high rate of depressive symptoms only, heavy drinking only, and high rate of depressive symptoms and heavy drinking among Colorado Farm residents compared to those with neither high rates of depressive symptoms nor heavy drinking.

| Factor | Depressive Symptoms Only (n=67) | Heavy Drinking Only (n=76) | Depressive Symptoms + Heavy Drinking (n=14) |
|---|---|---|---|
| | Crude OR (95% CI) | Crude OR (95% CI) | Crude OR (95% CI) |
| Gender | | | |
| Female | Referent | Referent | Referent |
| Male | 0.6 (0.4, 1.0) | 2.2 (1.4, 3.6) | 1.6 (0.6, 4.5) |
| Age | | | |
| 65+ | Referent | Referent | Referent |
| 20-29 | 5.2 (1.9, 14.1) | 16.1 (4.1, 64.4) | 6.9 (0.7, 68.4) |
| 30-39 | 2.0 (0.9, 4.7) | 4.5 (1.2, 16.8) | 1.8 (0.2, 16.7) |
| 40-49 | 1.6 (0.7, 3.7) | 4.4 (1.2, 15.9) | 0.4 (0.0, 15.9) |
| 50-64 | 1.7 (0.7, 4.2) | 3.2 (0.8, 12.3) | 1.8 (0.2, 16.6) |
| Marital Status | | | |
| Married | Referent | Referent | Referent |
| Not Married | 2.9 (1.3, 6.2) | 2.5 (1.1, 5.5) | 5.0 (1.3, 19.5) |
| Health Status | | | |
| Excellent/Very Good/Good | Referent | Referent | Referent |
| Fair/Poor | 1.8 (1.0, 3.4) | 0.5 (0.2, 1.1) | 1.7 (0.5, 5.8) |
| Limited Activity | | | |
| No | Referent | Referent | Referent |
| Yes | 3.0 (1.3, 6.9)h | 0.6 (0.2, 1.6) | 1.7 (0.3, 8.4) |

Table 3-3 (continued)

| | | | |
|---|---|---|---|
| Number of Life Stressors | Referent | Referent | Referent |
| 0 | 3.3 (1.0, 10.2) | 0.6 (0.3, 1.1) | 0.3 (0.0, 1.4) |
| 1 | 10.8 (3.9, 30.1) | 0.7 (0.4, 1.2) | 1.9 (0.6, 6.5) |
| 2 | | | |
| Current Smoker | | | |
| No | Referent | Referent | Referent |
| Yes | 0.8 (0.3, 1.7) | 1.1 (0.6, 2.3) | 3.7 (1.3,10.3) |
| History of Acute Pesticide Poisoning | Referent | Referent | Referent |
| No | 2.7 (1.2,6.0) | 0.7 (0.2, 2.3) | 1.3 (0.2, 10.4) |
| Yes | | | |
| Season of Interview | | | |
| Spring | Referent | Referent | Referent |
| Winter | 1.1 (0.7, 1.9) | 1.1 (0.7, 1.9) | 0.7 (0.2, 1.9) |
| % of Farm-Work FTE* | | | |
| 1 or more FTE | Referent | Referent | Referent |
| <.5 FTE | 0.9 (0.5, 1.5) | 0.7 (0.4, 1.1) | 0.6 (0.1, 2.6) |
| .5-.99 FTE | 0.3 (0.1, 1.0) | 0.9 (0.5, 1.9) | 3.28 (1.0, 11.0) |

*Full Time Equivalent defined as 2000 work hours in one year

Table 3-4: Multivariable odds ratios and 95% confidence intervals for high rate of depressive symptoms only, heavy drinking only and high rate of depressive symptoms and heavy drinking among Colorado Farm residents compared to those with neither high rates of depressive symptoms nor heavy drinking.

| Factor | Depressive Symptoms Only (n=67) | Heavy Drinking Only (n=76) | Depressive Symptoms + Heavy Drinking (n=14) |
|---|---|---|---|
| | AOR (95% CI) | AOR (95% CI) | AOR (95% CI) |
| Sex | | | |
| Female | Referent | Referent | Referent |
| Male | 0.5 (0.3,0.9) | 2.7 (1.5,4.67) | 1.4 (0.4, 4.5) |
| Age | | | |
| 65+ | Referent | Referent | Referent |
| 20-29 | 7.5 (2.6, 21.9) | 18.1 (4.0, 81.8) | 9.8 (0.9, 106.8) |
| 30-39 | 2.9 (1.2, 7.0) | 5.5 (1.4, 21.9) | 2.6 (0.3 , 27.5) |
| 40-49 | 2.4 (1.0, 6.0) | 4.7 (1.2, 18.7) | 0.5 (0.0, 10.3) |
| 50-65 | 2.5 (0.9, 6.6) | 3.6 (0.9, 14.8) | 2.5 (0.3, 24.6) |
| Marital Status | | | |
| Married | Referent | Referent | Referent |
| Not Married | 3.0 (1.4, 6.8) | 2.3 (0.9, 5.7) | 3.3 (0.8, 13.5) |
| Health Status | | | |
| Excellent/Very Good/Good | Referent | Referent | Referent |
| Fair/Poor | 4.2 (1.9, 9.6) | 0.9 (0.3, 2.8) | 5.9 (1.6, 22.2) |

Table 3-4 (continued)

| | | | |
|---|---|---|---|
| Number of Life Stressors | | | |
| 0 | Referent | Referent | Referent |
| 1 | 3.4 (1.0, 11.1) | 0.7 (0.4, 1.3) | 0.3 (0.1, 1.2) |
| 2 | 10.8 (3.7, 31.6) | 0.8 (0.4, 1.4) | 2.2 (0.5, 8.9) |
| Number of Close Family/Friends | 0.9(0.9, 1.0) | 1.0 (0.9, 1.1) | 0.9 (0.8, 1.0) |
| Current Smoker | | | |
| No | Referent | Referent | Referent |
| Yes | 0.6 (0.3, 1.4) | 0.9 (0.4, 2.0) | 3.7 (1.0, 13.1) |
| History of Acute Pesticide Poisoning | | | |
| No | Referent | Referent | Referent |
| Yes | 1.7 (0.7, 4.0) | 0.7 (0.2, 2.6) | 0.8 (0.1, 5.4) |
| % of Farm-Work FTE* | | | |
| 1 or more FTE | Referent | Referent | Referent |
| <.5 FTE | 0.6 (0.4, 1.2) | 1.2 (0.7, 2.0) | 0.7 (0.2, 2.6) |
| .5-.99 FTE | 0.3 (0.1, 0.8) | 1.1 (0.6, 2.4) | 3.5 (1.0, 12.6) |

*Full Time Equivalent defined as 2000 work hours in one year

## CHAPTER 4: DEPRESSIVE SYMPTOMS, DRINKING PATTERNS AND FARM-WORK INJURIES: A CROSS-SECTIONAL ANALYSIS

### Introduction

Work related injury rates are high among farmers and farm workers(2). In a review of morbidity and mortality among agricultural workers, Rautiainen and Reynolds concluded that more surveillance of non-fatal agricultural injuries is needed to help guide intervention and prevention efforts(187). Two individual factors that have been studied in relation to agricultural injury are high depressive symptoms and drinking patterns. High depressive symptoms and alcohol use have not been consistently associated with farm-work injury, but no research has been conducted to understand if the presence of both may modify the association or lack of association seen with farm-work injury and these two individual factors.

Depressive disorders are frequently found among those with alcohol use disorders(10-14;16-18). When the two occur together, the severity of symptoms of each disorder is worse compared to those with only one of the disorders(19;20). Other problems that have been noted with co-morbid disorders include an increase in problems in social functioning (21) and an increase in time away from work due to emotional problems(23). High depressive symptoms have also been shown to modify the effect of drinking patterns on all cause mortality. Greenfield, Rehm, and Rodgers found that pattern of alcohol use was associated with mortality in an 11 year follow-up period(24). Drinking pattern with the highest rate of all-cause mortality varied by sex. The effect of drinking pattern on all cause mortality changed in the presence of high depressive symptoms. The drinking pattern continued to predict mortality but only among those with high depressive symptoms(24).

No consistent association between high depressive symptoms and farm-work injury and alcohol use and farm-work injury has been found. High depressive symptoms have been shown to be associated with farm-work injury in a national sample of older agricultural workers(3), Colorado female farm residents(5), Iowa male farmers(4), and Iowa farmers with low-back injuries(138). Other studies of Iowa farmers have not found an association between high depressive symptoms and general agricultural injuries(140), animal-related agricultural injuries(137) and farm-work related falls(139).

Drinking patterns have also not shown a consistent association with farm-work injury. Based on data from the 1988 National Health Interview Survey(NHIS), Dawson investigated the number of occupational injuries by the usual number of times the respondent had consumed 5 or more drinks, i.e., the number of binge drinking episodes(60). Respondents in the farming, forestry, and fishing occupational group, who had a least one binge drinking episode on average every week over the past year, were over two times more likely to report an occupational injury during that time period than those who did not binge drink(60). Studies have shown that higher levels of alcohol use are associated with farm-work injury among principal farm operators in Alabama (9) and Caucasian principal operators in Alabama and Mississippi (6); others found moderate alcohol intake associated with farm-work injury among Hispanic farm workers in California (7), African-American farm workers in Alabama (6) and farm residents in Colorado(8); and others found no association between drinking pattern and farm-work injury among either Mississippi and Alabama farmers (133) or Iowa farmers(4;137-140). Two studies found increasing odds of farm-work injury with increasing levels of usual

alcohol use among both Ohio cash grain farmers(134) and older Colorado farmers(135). However, these estimates were not statistically significant.

Several factors may have influenced the inconsistency in findings between farm-work injury and depression and alcohol use. The differences among studies may be due to the differences in populations or the differences in the measures of depressive symptoms and alcohol use across studies. Time spent in farm work has been consistently associated with farm-work injuries(140;153-157). In a study of Colorado farm residents, those most likely to report high depressive symptoms were residents not involved in the operation of the farm compared to those involved in the farming operations(84). No study has investigated whether time spent farming varies by drinking pattern. If the levels of alcohol use and/or high depressive symptoms are inversely associated with the number of hours spent on farm work, then not adjusting for the farm-work time may obscure an association between alcohol use and farm-work injury and depressive symptoms and farm-work injury.

Studies that have investigated depressive symptoms and farm-work injuries and those that have investigated alcohol use and farm-work injuries have used different variables to adjust for time spent farming. However, the measures of time spent farming were not consistent among the studies. Several authors used dichotomous variables for time spent farming( e.g., worked 50 or more hours per week on the farm)(140) and dichotomous variables describing hours worked at various farm tasks (4) as possible risk factors for work injury. In research on alcohol use and farm-work injury, two studies used time spent in actual farm-work as the denominator (7;133), and another used time of observation to injury (8); but none of these studies investigated concurrent depressive

symptoms and alcohol use. Using the number of injuries per time worked (that is, the actual time at-risk for farm-work injuries,) appears to be the best way to sort out whether associations between alcohol use, depression, and the interaction of the two with agricultural injuries. The purpose of this study is to describe the relationships between farm work injuries, alcohol consumption, and depressive symptoms using the farm-work injury rate with time spent at farm work as the denominator.

## Methods

Principal farm owners and their spouses living on farms in Colorado were the target population for this study. Data are from the Colorado Farm Family Health and Hazard Surveillance (CFFHHS), a 3 year cohort study conducted between 1993 and 1995.

*Selection of Study Subjects* The sampling methodology has been described elsewhere in detail(5;8). Briefly, a complete list of addresses with registered farm trucks was obtained from the 1991 public use tape of the Colorado Division of Motor Vehicles Duplicate addresses were stripped from the file and the non-duplicated list was sorted into 6 mutually-exclusive crop reporting districts used by the Colorado Agricultural Statistics Service (164) based on county of registration. Telephone numbers were linked to addresses using reverse telephone directories and operator assistance. Working telephone numbers were found for 75 percent of the addresses. Addresses were randomly sampled proportional to the distribution of farms in the six crop reporting districts.

Screening questions were first asked to determine if the address was a farm and, if so, whether the principal operator lived on the farm. In order to be eligible for the study, the address had to be a farm with at least $1,000 gross from the sale of agricultural

products in a typical year. Separate interviews were conducted with the principal farm operator and the spouse. At the end of each interview, respondents were asked for permission to be called for follow-up interviews in the following year. The initial response rate for those farms for which telephone numbers were available was 62%; 88% of the original cohort participated in year 2; 75% in year 3.

Interviews took approximately 30 minutes to complete. Surveys were conducted between December and May of the first year of study and between March and May of the second and third years in order to reach farmers during seasons when work was relatively slow. Data were collected by the Survey Research Unit, Colorado Department of Public Health and Environment. The study was reviewed and approved by the Colorado State University's Human Research Committee.

*Questionnaire* Questions in the survey included general health, specific health problems, injuries in the last 12 months, farm characteristics, demographics, hours spent farming, farm work and farm hazards, pesticide exposure, prior pesticide poisoning, injuries, behavioral risk factors, safety knowledge, medical care, insurance status, depressive symptoms, alcohol consumption, social support, and stressful life events. The questions were developed in conjunction with staff from the National Institute of Occupational Safety and Health (NIOSH) drawing from instruments that had been developed and used in other surveillance systems (e.g., the Behavioral Risk Factor Surveillance System, the National Health Interview Survey, and the United States Department of Agriculture Census of Agriculture). Race, ethnicity, sex, and education status were asked only in the first year of the study. All other questions used in this study were asked of each

respondent at the baseline interview and at follow-up in the second and the third years of the study.

Farm-work injuries were defined as an injury that occurred during the process of farm-work that required the respondent to seek medical care, other than first aid; resulted in a loss of consciousness; resulted in curtailing work activities; or resulted in having to transfer to another job. Respondents were asked at the time of the first interview how many such injuries they had incurred during the past 12 months. At the second and third follow-up interviews, respondents were asked how many injuries they had had since the date of the last interview.

The measure of depressive symptoms was the Center for Epidemiological Studies – Depression Scale (CES-D), which has been widely used and has been shown to be a valid instrument in detecting symptoms of depression(34;38-40;42). The scale consists of 20 questions and asks how often the respondent experienced each symptom within the past week. Responses are coded from 0 (never) to 3 (5-7 times in the past week) resulting in scores ranging from 0 to 60. Four questions reflect positive affect and are reverse coded. A cut-point of 16 or greater has been used as an indicator of high depressive symptoms and was used in this study(4;5;84;86;165).

Drinking pattern was defined within the past month as no alcohol consumption, moderate, or heavy drinking. Heavy drinking was defined for this study as including both binge drinking and a measure of quantity and frequency of usual drinking. Respondents were considered to be a binge drinker if they answered that they had 5 or more alcoholic drinks on one or more occasions in the past 30 days. Heavy drinking was defined as an average of 15 or more drinks per week for males and 8 or more drinks per week for

females(57;58). The average number of drinks per week was calculated based on questions of frequency of drinking and usual number of alcoholic beverages consumed on each drinking occasion during the past 30 days. Respondents who were either binge or heavy drinkers or both were classified as heavy drinkers. Those who said that they had no alcoholic drinks in the past month were considered non-drinkers while those who had at least one alcoholic beverage in the past month and were not heavy drinkers were considered moderate drinkers.

Time at risk for farm injury was the number of hours spent in farm-related tasks during the past year. At each interview, respondents were asked the number of hours that they spent at specific farm tasks each season (fall, winter, spring, summer). The average number of hours per day, the average number of days per week, and the average number of weeks per season were recorded for the following farm tasks: animal handling, handling of farmstead materials, crop production, farm maintenance, farm related transport, and other farm related job tasks. Time-at-risk for injury was defined as the number of hours for all farm-related work during the past year. To estimate injury rates, time of farm work was converted to the percent of a full-time equivalent (FTE). Two thousand hours in one calendar year is considered the equivalent of one FTE(2). The total number of farm work hours divided by 2000 was computed to represent the FTE status for each respondent.

*Statistical Analysis* SAS version 9.1 (188) was used for all analyses. Univariate analyses were done to assess which sub-groups were more likely to be lost to follow-up. In order to account for the complex survey design, the SurveyFreq procedure in SAS was used in

the univariate analyses. The Rao Scott chi-square test was used to test for significant differences in the characteristics of the sample between years.

The analysis was limited to only those who had done farm work in each year. To assess the relationship between depressive symptoms, drinking patterns, and farm work injuries, Poisson regression using generalized estimating equations (GEE) with repeated measures were done using Proc Genmod in SAS(188). The data were structured so that one observation represented the data for one respondent for one year. At the time of each interview during the 3 year period of the study, respondents were asked the questions in the CES-D instrument, their current alcohol consumption, and the number of farm-work injuries in the past 12 months. Individual respondents had up to three different observations during the 3 year period. The GEE procedure takes into account the non-independence of observations (189-191). The Genmod procedure was used to implement GEE with empirically calculated standard errors using the Huber-White sandwich correction(189). An exchangeable working correlation structure was used in determining GEE estimates; GEE parameter estimates and standard error estimates obtained in this fashion are fairly robust to incorrect specification of the correlation structure(189). All equations were tested for over and under-dispersion using the log likelihood chi-square statistic and the Lagrange multiplier test for dispersion. When dispersion did occur the scale parameter was estimated by the square root of Pearson's chi-square divided by the degrees of freedom resulting in a scaled Pearson's chi-square equal to 1.

While the GEE methods are robust for missing data, these methods assume that data are missing completely at random and that there is no association between

completion of follow-up interviews and the dependent and independent variables of interest. To assess whether the results were consistent with these assumptions, analyses were done including only those respondents who had three observations over the three year time period. The results between the total sample and this sub-group were compared.

Three separate analyses were done: 1)the association between depressive symptoms and farm-work injuries; 2) the association between drinking pattern and farm-work injuries; and 3) the model with both depressive symptoms and drinking pattern which includes both confounding variables and the addition of an interaction term of depressive symptoms and drinking patterns in relation to farm-work injuries. Effects of the interaction term were measured in the adjusted models by likelihood ratio tests and by the statistical significance of the interaction term. To control for farm-work time in the GEE analysis, the logarithm of the number of hours of farm-work time was used as the offset variable.

To assess whether recall bias in estimating farm-work time over the four different seasons influenced the results of the analysis, an upper limit of possible hours worked was set which amounted to 16 hours of work each day during the 13 weeks of each season. If respondents reported more hours than that, their work-time for the year was set at the possible upper limit. Additionally, analyses were repeated excluding these outliers. This was done when estimating injury incidence as well as models developed using Poisson regression with repeated measures. Because no differences in outcome were noted in these three analyses, only the results of the analyses using actual time reported, including those who seemingly over-reported time spent in farming are provided here.

The unit of sampling was the farm household with both the principal operator and spouse being interviewed. Due to the lack of independence in the household cluster, separate GEE analyses were completed for men and for women in this cohort.

Factors which had been shown in previous literature to be independently associated with farm-work injury and independently associated with depressive symptoms and/or alcohol use were investigated as potential confounding variables in the association of farm-work injury and depressive symptoms and alcohol use and the interaction of these two. These included the following demographic variables: age, education, and marital status. Age was classified as 20-29 years, 30-39 years, 40-49 years, 50-64 years, or 65 and older. Education was coded as less than high school, high school, or more than high school. Marital status was classified as married or not married. Health-related variables included health status and hearing loss. To measure health status, respondents were asked to rate their physical health within the past 12 months as excellent, very good, good, fair, or poor. Hearing loss was assessed using responses to the question "Has a doctor ever told you that you had hearing loss?" Smoking was considered a potential confounder and classified as never smoker, former smoker, or current smoker. Each potential confounding factor was entered separately into the GEE equation, first with depressive symptoms and then with drinking patterns. Confounding was defined as a variable whose addition to the equation changed the rate ratio for farm-work injury rate and depressive symptoms or for farm-work injury rate and drinking pattern by 10% or more.

## Results

A total of 872 farm residents, 485 principal operators and 387 spouses, were interviewed during the first year of the study. Table 4-1 provides information about those who were lost to follow-up. Men and principal farm operators were more likely to be lost to follow-up in years 2 and 3 than females and spouses. By year 3, close to one-third of males and principal operators were lost to follow-up compared to 18% of females and 17% of spouses. Those with less than a high school education were more likely to be lost to follow-up while those who were married were more likely to be included in all three years of the study. No differences in the distribution by age group or race and ethnic status were noted over the three year time period. Approximately 25% of those who reported an injury in the first year of the study were lost to follow-up in the second year of the study. One-third of those who reported heavy drinking in year 1 were lost to follow-up by year 3 and one-third of former smokers were also lost to follow-up by year 3. No difference in lost to follow-up was seen by hearing loss or health status.

Respondents who reported doing farm work included: 459 men and 341 women in year 1; 365 men and 307 women in year 2; and 305 men and 266 women in year 3. A total of 144 and 65 farm-work injuries were reported by men and women respectively during the 3 years of the study. The farm-work injury rate over the 3 year period was 10.4 (95% CI 8.0, 13.0) per 100 FTE among men and 11.8 (95% CI 9.0, 14.7) per 100 FTE among women. The injury rates were not statistically significantly different by year for men or for women. Figure 1 shows the injury rates for men and women by depressive symptoms status and drinking patterns. The rate of farm work injury did not vary by depressive symptoms and drinking patterns for men but did for women. The highest rates

of injuries were among women who were either moderate or heavy drinkers and also had high depressive symptoms.

Table 4- 2 presents the results of the Poisson regression analysis for the total sample of males and that limited to males with three years of data. Age was the only confounding factor in the association between depressive symptoms and injury and drinking pattern and injury among male farmers. Having high depressive symptoms and heavy or moderate drinking was not associated with farm-work injury among males for the total sample in either the univariate or multivariable analyses. However, among those respondents who participated in all three years of study, being a heavy or moderate drinker was associated with farm-work injury in the univariate analysis; among males with complete follow-up, those who drank moderately were almost 90% more likely to report having an injury in the past 12 months compared to non-drinkers. The rate ratio for the association between heavy drinking and farm-work injury increased but was not statistically significant in this sub-group. Inclusion of an interaction term for depression and drinking pattern did not change the value of the likelihood ratio test and was not statistically significant.

For women, age was found to be a confounding factor in the association between depressive symptoms and injury and between drinking patterns and injury; additionally depressive symptoms and smoking status were found to be confounding factors in the association between drinking patterns and farm work injury. Women with high depressive symptoms were approximately three times more likely to report farm-work injuries than women without high depressive symptoms in both the univariate and multivariable analysis (Table 4-3). This finding was consistent for all respondents and

for those who participated in all three years of the study (Table 4-3). Heavy drinkers and moderate drinkers had higher rates of farm-work injuries than non-drinkers, but neither was statistically significant. The interaction of high depressive symptoms and drinking pattern was not statistically significant.

## Discussion

The presence of depressive symptoms did not modify the effect of drinking pattern on farm-work injury in women or in men in this study. This study confirms results of an earlier study from the CFFHHS in that high depressive symptoms were associated with injury among female farm residents(5). We found a similar association but our adjusted estimate was smaller (Adjusted Rate Ratio (ARR) 2.77 versus 4.91). This analysis builds on the results of the previous study from the CFFHHS by adjusting for the actual number of hours worked during the year. The association between depressive symptoms and farm-work injury among women were similar for those in the sample with three complete years of data suggesting that the results were not biased due to loss of follow-up in the sample.

High depressive symptoms were not associated with farm-work injury among men and no bias was noted due to attrition. Data from other studies have not shown a consistent association between general farm-work injury and depressive symptoms in males. High depressive symptoms have been shown to be associated with low-back injuries in male farmers in Iowa(138); high depressive symptoms have also been associated with low back pain after adjusting for sex among a farmers living in northeastern Colorado counties(165). It may be that high rates of depression are associated only with specific types of injuries and conditions among male farmers.

Depressive symptoms have been linked both as a precursor and an outcome of injury. Several studies have found depressive symptoms to follow different types of injury events including motor-vehicle crashes (141), falls among the elderly (142) and occupational cumulative trauma(143) Symptoms of depression such as lack of sleep, feelings of fatigue, lack of concentration and memory problems could put one at risk for injury, and depressive symptoms have been shown prospectively to be risk factors for occupational injures in a national sample of employed persons (125), all injuries in a sample of rural residents (145) and falls in older women(146). Since the depressive symptoms were measured at the time of interview and injuries were reported for the 12 months before the interview, it is unknown from this analysis whether depressive symptoms preceded or followed the injury. Future prospective studies in which depressive symptoms are measured prior to injury are needed to clarify whether pre-existing depressive symptoms are a risk factor for injury.

The findings that association of high depressive symptoms with injury differed by sex is of interest. The results could reflect true differences in the association of high depressive symptoms with farm-work injury by sex. The difference in association by sex may reflect real differences in the types of injuries sustained. As noted in the studies by Sprince and colleagues, only injuries resulting in low back pain were associated with high depressive symptoms in Iowa male farmers(137-140). Future studies need to address whether high depressive symptoms are associated with specific types of injuries in both men and women.

Differences in the association between depressive symptoms and farm work injury between men and women may also be due to measurement error. While several

studies have confirmed the validity and reliability of the CES-D across populations (34;38;39;42), some authors have questioned whether the measurement of depressive symptoms, such as those used in the CES-D, is gender neutral (45-48). For instance, authors have noted that crying is more consistently associated with depressed affect as measured by other items on the CES-D among women than among men (46-49). Groups of symptoms rather than a score may provide more information on the differences in association between depressive symptoms and farm-work injuries by sex. Particular types of symptoms may be more likely to be associated with farm-work injuries and specific types of injuries. Future studies should investigate whether there are particular depressive symptoms or groups of symptoms that are associated with farm-work injury in men and women.

Heavy drinking was associated with farm-work injury in women in the univariate analysis but not after adjusting for age, smoking, and depressive symptoms. No bias due to attrition was detected in women. The attenuation with the inclusion of depressive symptoms of the association between drinking pattern and farm-work injury in women is of interest. This indicates that depressive symptoms are a confounding factor in the relationship between drinking pattern and injury in women. This could be for two different reasons. First, depressive symptoms and drinking patterns could be independently associated with each other in a non-causal way. Secondly, high depressive symptoms could be a result of heavy drinking. Some studies have shown that increases in usual drinking are a risk factor for an increase in depressive symptoms(110;111). If heavy drinking led to high depressive symptoms which led to injury, adjusting for depressive symptoms would mask a true association since depressive symptoms would be

in the pathway between heavy drinking and injury. However, since this is a cross-sectional study, the sequence of the relationship between depressive symptoms, drinking patterns, and farm-work injury could not be determined. Future studies are needed to clarify the relationship between drinking patterns, depressive symptoms, and farm-work injuries in women.

Some have suggested that both smoking and heavy alcohol use are indicators of a propensity for risk-taking behaviors which could lead to an increase in injury(60). Based on data from the 1988 National Health Interview Survey, the odds of occupational injury among heavy drinkers decreased when smoking was taken into account suggesting that smoking, a risk-taking behavior, was a confounder in the association between heavy drinking and occupational injury. However, heavy drinking continued to increase the odds of occupational injury after adjusting for smoking suggesting further that heavy drinking was still independently associated with occupational injury even after adjusting for smoking (60). The attenuation of injury risk in the current study when taking into account both smoking and age may indicate that among women in this sample these two variables in conjunction with heavy drinking are indicators for risk-taking behavior.

Selection bias among the sample of men limits our ability to confirm or deny an association between drinking pattern and farm-work injury in men. Drinking patterns were not associated with farm-work injury in the total sample of men but moderate drinking was associated with farm-work injury when the sample was limited to those with all three years of observation. These results suggest that one assumption necessary for a valid GEE analysis, i.e, the missing data are missing completely at random, could not be met.

Moderate drinking has been associated with agricultural injuries in other studies(6-8). Theories concerning the association of drinking pattern and injury focus on the effects of heavy drinking, e.g., that heavy drinkers would more likely be to engage in risk taking behavior (60;132), that hangovers and acute effects of alcohol would more likely be found among heavy drinkers (117), that heavy drinking leads to later disability which interferes with injury-free work(126). One explanation for the increased rates of injury among moderate drinkers may be that they have lower tolerance for the effects of alcohol. In a study of neurological symptoms and agricultural injuries, those who said that they had experienced a lower tolerance for alcohol, that is that it took less alcohol to get drunk, were over 2 times more likely to report a farm-work injury than those who did not report a lower tolerance(153). Alternatively, moderate drinking may be associated with other factors that increase agricultural injury risk.

This study has both strengths and limitations. This is the first study to address the association between farm injuries and the co-occurrence of heavy or moderate drinking and high depressive symptoms. The small number of injuries in the study and the low rates of heavy drinking among women and low rates of high depressive symptoms in men may have limited our ability to test for interaction between depressive symptoms and drinking patterns. Future studies should address this question in occupational groups with higher rates of both alcohol use and depressive symptoms. Knowing if there is an interaction in other occupational groups may provide opportunities to improve occupational safety.

This study is the first to use more than one year of data taking into account all farm-work injuries and the time spent in farm-work in studying both depressive

symptoms and drinking patterns in relationship to farm injuries. Yet, there are several limitations to the measures used. Depressive symptoms and drinking patterns were measured at the time of interview and not at the time of injury; thus, no causal relationship between depressive symptoms and drinking patterns with farm-work injuries can be established from this study.

The measure of drinking pattern used in this analysis combined two frequently used measures of heavy drinking: binge drinking and average quantity consumed in a week. At the time of the survey, binge drinking was defined as 5 or more drinks at one time for both men and women. More recently, binge drinking is defined as 4 or more drinks at a sitting for women(57). Our definition of heavy drinking did not take that change into account. It is unknown if our results for women would have been different if we had used the more current definition.

The lack of association between drinking patterns and farm-work injury could be biased toward the null in several other ways in this study. Other studies have used higher alcohol use thresholds for heavy drinking(60;62). The National Household Survey on Drug Use and Health defines heavy drinking as 5 or more binge drinking episodes in one month(56). If the threshold of alcohol use was too low, the results would be biased toward the null for the heaviest drinkers. Alcohol use is also known to be underreported in surveys(64;186). It is unknown how prevalent under-reporting of alcohol use would be among farm residents. Underreporting of alcohol use could bias the results of an association between heavy drinking and farm-work injury toward the null. The association found between moderate drinking and farm-work injury in men with 3

consecutive years of data might be due to a large number of heavy drinkers being misclassified as moderate drinkers.

Injuries were probably underreported in this study. Studies have suggested that the most accurate recall of injury is between 4 weeks to 3 months and that accuracy diminishes after that time(192-195). Zwerling and colleagues suggested that using the 4 week recall period, 30,000 workers would need to be surveyed to achieve a reasonable standard error in estimation of injury incidence in an employed population(195). In this study the recall period for injury was 12 months. Our results could be biased if recall of injury varied by either depressive symptoms or drinking pattern.

Finally, the measure of time at-risk was not always consistent with the time of reporting injuries. At the first interview respondents were asked to report the number of injuries in the past 12 months and the number of farm-work hours during that same time period. During the second and third year, respondents were asked to indicate how many injuries that they had had since the last interview but the time period for the farm-work time was 12 months. The mean number of days between interviews was 329.4 (range 243-429) between years 1 and 2 and 367.2 (range 260-509) for men between years 2 and 3; for women the mean number of days between interviews was 328.9 (range 234-432) between years 1 and 2 and 365 (254-439) between years 2 and 3. The difference in time between interviews was not different by injury status, depressive symptoms, or drinking pattern for men or women (data not shown).

*Conclusions* In this study high depressive symptoms did not modify the effect of drinking pattern on farm-work injury in either men or women. High depressive symptoms were associated with farm-work injury among women. Prospective studies are

needed to address whether depressive symptoms precede farm injury in women. Such information would then be helpful in knowing whether high depressive symptoms need to be addressed in preventive programs or programs dealing with problems secondary to injury.

# TABLES AND FIGURES: CHAPTER 4

Table 4-1 Number and distribution of baseline characteristics by year of follow-up: Colorado Farm Family Health and Hazard Surveillance, 1993-1995.

| Baseline Characteristic | Year 1 n=872 n (%) | Year 2 n=745 n (%) | Year 3 n=653 n (%) |
|---|---|---|---|
| Gender [a,b,c] | | | |
| Male | 466 (53.4) | 382 (51.3) | 319 (48.9) |
| Female | 406 (46.6) | 363 (48.7) | 334 (51.1) |
| Principal Operator [a,b,c] | | | |
| Yes | 485 (55.6) | 396 (53.2) | 331 (50.7) |
| No | 387 (44.4) | 349 (46.8) | 322 (49.3) |
| Time spent on farm work | | | |
| 0 | 111 (12.7) | 101 (13.6) | 88 (13.5) |
| >0-<50% FTE | 214 (24.5) | 185 (24.8) | 167 (25.5) |
| 50% - <1 FTE | 170 (19.5) | 136 (18.3) | 120 (18.4) |
| 1 FTE or more | 377 (43.3) | 323 (43.6) | 278 (42.6) |
| Age | | | |
| 20-29 | 58 ( 6.7) | 49 ( 6.6) | 39 ( 6.0) |
| 30-39 | 206 (23.7) | 183 (24.6) | 162 (24.9) |
| 40-49 | 239 (27.5) | 206 (27.7) | 189 (29.0) |
| 50-64 | 272 (31.3) | 226 (30.4) | 197 (30.3) |
| 65+ | 95 ( 10.9) | 79 (10.6) | 64 ( 9.8) |
| Race/Ethnicity | | | |
| White, non-Hispanic | 830 (95.5) | 709 (95.3) | 621 (95.2) |
| Hispanic, all races | 29 ( 3.3) | 27 ( 3.6) | 23 ( 3.5) |
| Other non-Hispanic | 10 ( 1.2) | 8 ( 1.1) | 8 ( 1.2) |
| Education [a,b] | | | |
| Less than high school | 62 ( 7.1) | 45 ( 6.1) | 36 ( 5.5) |
| High school graduate | 335 (38.5) | 290 (38.9) | 251 (38.4) |
| Beyond high school | 474 (54.4) | 410 (55.0) | 366 (56.1) |
| Marital Status [a,b] | | | |
| Married/unmarried couple | 811 (93.0) | 702 (94.2) | 619 (94.8) |
| Divorced/separated/widowed | 30 ( 3.4) | 20 ( 2.7) | 15 ( 2.3) |
| Single, never married | 31 ( 3.6) | 23 ( 3.1) | 19 (2.9) |
| Injury [a] | | | |
| Yes | 74 ( 8.5) | 55 ( 7.4) | 53 ( 8.1) |
| No | 798 (91.5) | 690 (92.6) | 600 (91.9) |
| High Rate of Depressive Symptoms | | | |
| Yes | 81 ( 9.4) | 66 ( 8.9) | 55 ( 8.5) |
| No | 782 (90.6) | 674 (91.1) | 594 (91.5) |
| Drinking Pattern [b] | | | |
| Abstinent | 418 (48.4) | 362 (48.9) | 323 (49.8) |
| Moderate | 356 (41.2) | 308 (41.6) | 269 (41.4) |
| Heavy | 90 (10.4) | 71 ( 9.6) | 57 ( 8.8) |

Table 4-1 (continued): Number and distribution of baseline characteristics by year of follow-up: Colorado Farm Family Health and Hazard Surveillance, 1993-1995.

| Baseline Characteristic | Year 1 n=872 n (%) | Year 2 n=745 n (%) | Year 3 n=653 n (%) |
|---|---|---|---|
| Smoking Status [a,b,c] | | | |
| Never | 499 (57.4) | 438 (59.0) | 397 (61.0) |
| Former | 252 (28.9) | 201 (27.0) | 168 (25.8) |
| Current | 119 (13.7) | 104 (14.0) | 86 (13.2) |
| Hearing Loss | | | |
| Yes | 100 (11.5) | 80 (10.7) | 69 (10.6) |
| No | 772 (88.5) | 665(89.3) | 584 (89.4) |
| Health Status | | | |
| Excellent/Very Good | 610 (70.0) | 527(70.7) | 458 (70.1) |
| Good | 201 (23.0) | 171(23.0) | 154 (23.6) |
| Fair/Poor | 61 ( 7.0) | 47( 6.3) | 41 ( 6.3) |

[a] Difference is statistically significant (<p.05) between years 1 and 2.
[b] Difference is statistically significant (<p.05) between years 1 and 3.
[c] Difference is statistically significant (<p.05) between years 2 and 3.

**Figure 1: Farm Work Injury Rates per 100 FTE by Sex, Depressive Symptoms, and Drinking Pattern: Cross-Sectional Analysis, CFFHHS, 1993-1995**

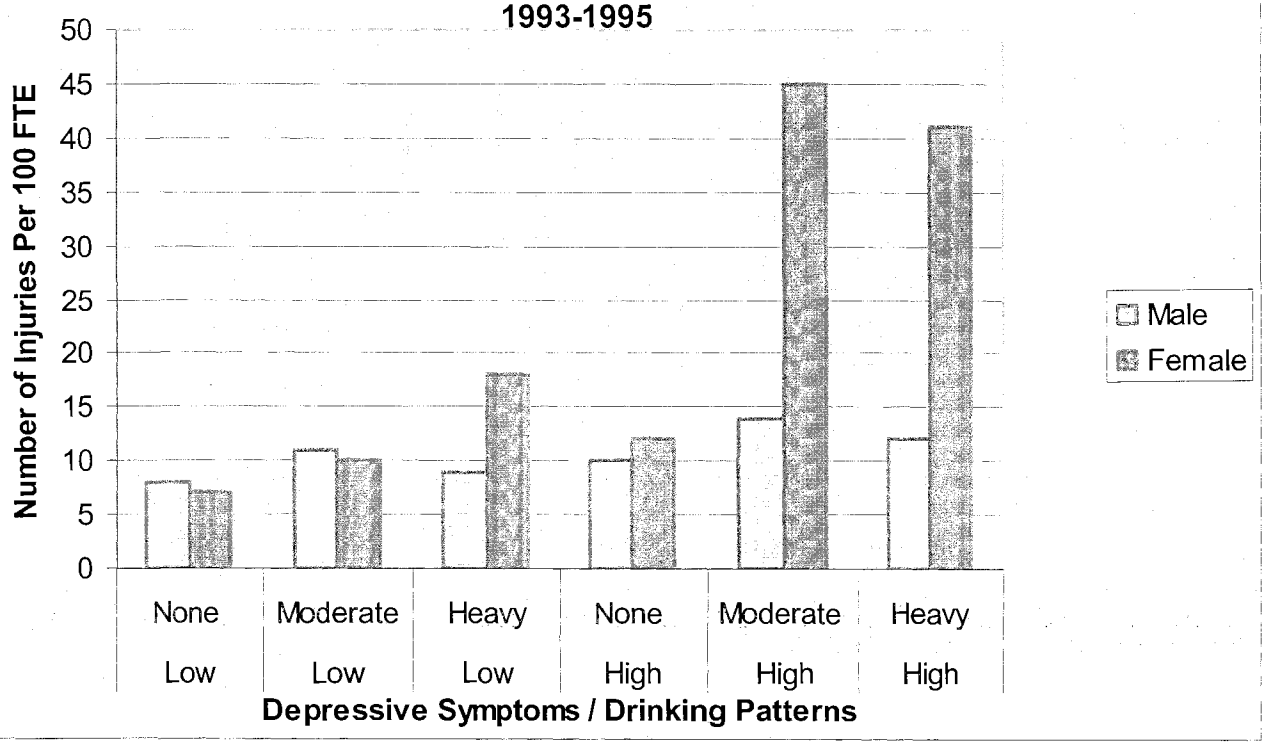

Table 4-2 Crude and Adjusted Rate Ratios for and 95% Confidence Intervals for High Rates of Depressive Symptoms and Drinking Patterns for Farm-Work Injuries for Men: A Cross-Sectional Analysis, Colorado Farm Family Health and Hazard Surveillance, 1993-1995.

| | All observations during 3 years n=1129 | | Observations with 3 years of data n=921 | |
|---|---|---|---|---|
| | Crude RRs (95% CI) | Adjusted RR* (95% CI) | Crude RRs (95% CI) | Adjusted RR* (95% CI) |
| Depressive Symptoms | | | | |
| CES-D >15 | 1.05 (0.52, 2.09) | 1.04 (0.54, 2.01) | 1.00 (0.41, 2.42) | 0.97 (0.42, 2.23) |
| CES-D <16 | Referent | Referent | Referent | Referent |
| Drinking Pattern | | | | |
| Heavy | 1.20 (0.64, 2.27) | 1.00 (0.54, 1.87) | 2.00 (1.02, 3.89) | 1.66 (0.83, 3.32) |
| Moderate | 1.33 (0.80, 2.60) | 1.25 (0.77, 2.04) | 2.05 (1.22, 3.42) | 1.89 (1.11, 3.22) |
| Non-drinker | Referent | Referent | Referent | Referent |

*adjusted for age group

Table 4-3 Crude and Adjusted Rate Ratios for and 95% Confidence Intervals for High Rates of Depressive Symptoms and Drinking Patterns for Farm-Work Injuries for Women: A Cross-Sectional Analysis Colorado Farm Family Health and Hazard Surveillance, 1993-1995.

| | All observations during 3 years n=914 | | Observations with 3 years of data n=838 | |
|---|---|---|---|---|
| | Crude RRs (95% CI) | Adjusted RR* (95% CI) | Crude RRs (95% CI) | Adjusted RR* (95% CI) |
| Depressive Symptoms | | | | |
| CES-D >15 | 3.08 (1.51, 6.27) | 2.77 (1.38, 5.55) | 3.34 (1.52, 7.33) | 2.85 (1.38, 5.90) |
| CES-D <16 | Referent | Referent | Referent | Referent |
| Drinking Pattern | | | | |
| Heavy | 3.18 (1.40, 7.27) | 1.81 (0.68, 4.86) | 3.34 (1.52, 7.33) | 1.84 (0.63, 5.38) |
| Moderate | 1.72 (0.90, 3.31) | 1.67 (0.91, 3.07) | 1.42 (0.74, 2.75) | 1.42 (0.77, 2.59) |
| Non-drinker | Referent | Referent | Referent | Referent |

*adjusted for age group and smoking status

# CHAPTER 5: DEPRESSIVE SYMPTOMS, DRINKING PATTERNS, AND FARM-WORK INJURIES: A PROSPECTIVE ANALYSIS

## Introduction

Agriculture has one of the highest rates of injury among all occupations(2). Modifiable risk factors need to be identified in order to reduce high rates of injury among farmers. Two individual risk factors that have been studied are high depressive symptoms and drinking patterns. To date the studies have not shown consistent results as to whether there is an association between farm-work injury and these two individual factors. The majority of studies have only looked at the associations between high depressive symptoms and prior farm work injury and between drinking pattern and prior farm work injury in cross-sectional (3;6;9;134) or case control analytic designs (137-140). None of these studies could determine whether either of these individual factors occurred prior to, at the time of, or after the injury. Prospective studies are needed to address whether high depressive symptoms or drinking patterns precede farm-work injury.

The few prospective studies examining high depressive symptoms and injury have provided evidence that high depressive symptoms are a risk factor for occupational injury. Two prospective studies found that high depressive symptoms at baseline predict work-related injury at one year of follow-up: one in a study of male principal farm operators in Iowa (4); and the other in a study of older U.S. workers which excluded farming occupations (125). Iowa farm operators with high depressive symptoms at baseline were over 3 times more likely to report farm-work injury during a one year follow-up than those without high depressive symptoms(4). Zwerling and colleagues

found that respondents in a national sample of older workers who reported high depressive symptoms at baseline had a 35% increase in injury during the follow-up period(125). Other population based cohorts have shown that high rates of depressive symptoms are associated with increased rates of injury in a rural population in Iowa(145) and an increased risk of fractures in older women(146).

Prospective studies of agricultural injuries have shown either that usual drinking pattern is not associated with farm-work injuries (133) or that moderate drinking is a risk factor for such injuries(7;8). Agricultural-related injuries were not found to be associated with usual alcohol intake in a prospective study of Caucasian and African-American farm owners and African-American farm workers in Alabama and Mississippi(133). In a prospective study of migrant farm workers in northern California, workers who drank 1 to 4 drinks per week had the highest risk of agricultural injury (18.5/100 (FTE) while those who drank 10 or more had a slightly lower risk (7.8/100 FTE) than those who abstained from alcohol (8.4/100 FTE)(7). Among principal farm operators in Colorado, the combination of having alcohol 3 or more days per week and drinking 1 to 2 drinks on these days was associated with in a 60% increase risk of farm-work injuries when compared to those who did not drink alcohol in the past month(8) . The highest level of drinking (3 or more drinking days per week with 3 or more drinks per drinking day) was not associated with farm-work injuries (OR 1.08, 95% CI 0.49-2.38) (8). In a prospective study of municipal transit operators, those who reported at baseline that they usually drank 10 or more drinks a week had the highest rates of worker's compensation claims in the 3 to 5 years of follow-up(120). Zwerling and colleagues found no association

between alcohol-related problems as measured by the CAGE questionnaire at baseline and future occupational injury(125).

More prospective studies are needed to understand whether high depressive symptoms and drinking patterns are risk factors for agricultural injury. Authors have found that those who have both alcohol use disorders and depressive disorders are likely to have more severe symptoms than those with only one of these disorders(19;20). Co-morbidity has also been shown to be associated with increased problems in social relationships(21) and work lost due to emotional problems(23) compared to those with only one disorder. Only one study has been done to assess whether drinking pattern modifies the effect of depressive symptoms on farm-work injuries(196); no effect modification was found, but the study was cross-sectional(196). Prospective studies are needed to test whether the co-occurrence of high depressive symptoms and heavy or moderate drinking increases the risk of farm-work injury.

## Methods

Data for this study are from the Colorado Farm Family Health and Hazard Surveillance (CFFHHS) project, a 3 year cohort study of principal farm operators and their spouses living on farms in Colorado.

*Sample Selection* A list of all address which had a registered farm truck was obtained from the Colorado Division of Motor Vehicles' 1991 public use tape. Next, the list was stripped of duplicated addresses. The unduplicated list was sorted into the 6 crop reporting districts used by the Colorado Agricultural Statistics Service(164). Each agricultural district had a random sample proportional to size of the district. Telephone numbers were matched with addresses by using reverse telephone directories and

operator assistance. Approximately 75% of the original addresses in the original sample were matched. The numbers were called for screening. A household was eligible if the principal operator lived on the farm and the farm grossed at least $1,000 from the sale of agricultural goods in one year.

Separate interviews were conducted with up to two respondents from each farm household , i.e., the principal operator and the spouse. At the end of each interview, both parties were asked permission to contact them for follow-up interviews in the following year. The initial response rate for those farms for which telephone numbers were available was 62%; 88% of the original cohort participated in year 2 and 75% in year 3.

Baseline data was collected at year 1 with follow-up interviews in years 2 and 3 of the study from 1993-1995. Interviews lasted approximately 30 minutes. During the first year of the study, surveys were done between December and May; during the second and third year of the study, the interviews were completed from March to May. Interviews were done during these months when farmers' work was slower than in other seasons. Surveys were done by the Survey Research Unit, Colorado Department of Public Health and Environment. The study was reviewed and approved by the Colorado State University's Human Research Committee.

*Questionnaire.* The questionnaire was developed together with staff from the National Institute of Occupational Safety and Health (NIOSH) and the CFFHHS staff. Questions were drawn from existing surveys and surveillance systems (e.g., the Behavioral Risk Factor Surveillance System, the National Health Interview Survey, the USDA Census of Agriculture). Items included questions on farm characteristics, demographics, general health, hours spent farming, farm work and farm hazards, pesticide exposure, prior

pesticide poisoning injuries, behavioral risk factors, safety knowledge, medical care, insurance status, injuries experienced in the last 12 months, depressive symptoms, alcohol consumption, social support, and stressful life events. Race, ethnicity, sex, and education were asked only in the first year of the study. All other questions used in this study were asked of each respondent at year 1 of the survey and at follow-up interviews in years 2 and 3.

At each yearly interview, respondents were asked how many work-related injuries they had experienced in the last 12 months. Several questions were asked about these injuries including the type of work they were doing at the time. Farm-work injuries were defined as an injury sustained while doing farm work that required the respondent to seek medical care, other than first aid; or resulted in a loss of consciousness; or resulted in curtailing work activities; or resulted in having to transfer to another job. The same definition of farm-work injuries was used in the follow-up interviews; the time line for the follow-up interviews was the number of farm-work injuries occurring since the last interview.

The Centers for Epidemiologic Studies – Depression Scale (CES-D) was used to measure depressive symptoms. While the instrument is not a measure of a depressive disorder, it has been found to be a valid instrument in detecting symptoms of depression in different populations(34;38-42). The scale is comprised of 20 questions and asks how often the respondent had experienced each of the 20 symptoms in the last week. Respondents are given four different choices and scored from 0 (never) to 3 (5-7 times in the last week). Four of the 20 questions were asked about the experience of positive affect in the past week and those questions are reversed coded. CES-D scores ranged

from 0 (no experience of depressive symptoms in the past week) to 60 (experience of all symptoms 5-7 times in the past week). A cut-point of 16 or greater, which has been used as an indicator of high depressive symptoms in other studies of farm residents (4;5;84;86;165), was used in this study. The cut point was developed based on studies that indicate that 80% of the population score below this value(38).

Respondents were asked questions about the usual frequency of alcohol consumption and the usual amount of alcohol consumed in the last 30 days. Heavy drinking was defined as an average of more than 14 drinks per week for men and more than 7 drinks per week for women. Another question was asked to measure binge drinking. Respondents were asked how often in the past 30 days they drank 5 or more drinks on one occasion. For purposes of this study, respondents who either met the definition of heavy drinking or binge drinking were defined as heavy drinkers. Non-drinkers were those who had no alcoholic beverages in the past 30 days. Moderate drinkers were those who had at least one alcoholic beverage in the past 30 days but were neither heavy nor binge drinkers.

The time at risk for farm-work injury was the number of hours spent in farm work in the previous year. Respondents were asked how many hours they spent on different farm related tasks. These tasks included animal handling, handling of farmstead materials, crop production, farm maintenance, farm related transport and a general category of "other" farm-related tasks. When asked to estimate the hours, respondents were asked to think about the task and, then for each season (fall, winter, spring, summer), estimated the average number hours per day, the average number of days per week, and the average number of weeks per season that they spent on that particular task.

The hours were summed for the total year in order to obtain the time-at risk for farm work injury for that year.

In addition to the independent and dependent variables of interest, potential confounding variables in the relationship between depressive symptoms and farm-work injury and between drinking pattern and farm-work injury were collected. These included age, marital status, general health status, hearing loss, education, and smoking status.

*Statistical Analysis.* Analytic procedures were needed that took into account the complex sampling design and the prospective design of this study. In order to conduct a prospective analysis, two observation periods were established: interviews with baseline information at year one and follow-up information at year 2 and interviews with baseline information at year two and follow-up information at year 3. Information on the independent variables, depressive symptoms and drinking patterns, were collected in the first interview and information on the dependent variable, number of farm-work injuries, and the time spent in farm work during the past year were collected in the following interview. The data set also contained observations for those who were interviewed in the second year and then completed the interview for the third year of follow-up. Farm-work injuries for these observations were ones that were reported in the 3$^{rd}$ year of follow-up and the independent variables were recorded from interviews prior to that last interview. Table 5-1 provides a summary of the variable used in the analyses and the time of data collection.

Univariate analyses were completed to describe those at risk for farm-injury during the follow-up periods: those who did farm work between years one and two and

those who did farm work between years two and three. In order to account for the complex sampling design, Proc Surveyfreq and Proc Surveymeans of SAS, Version 9.1 were used in the descriptive analysis(188).

To assess the relationship between depressive symptoms, drinking patterns, and farm work injuries, Poisson regression analysis using generalized estimating equations (GEE) with repeated measures was carried out using Proc Genmod in SAS (188). The GEE analytic method takes into account that since there is more than one observation per person and thus the observations are not independent(189-191). The Huber-White sandwich correction was used by the Genmod procedure to implement the GEE equations with empirically calculated standard errors(189). All GEE equations were tested for over- and under-dispersion using the log likelihood chi-square statistic and the Lagrange multiplier test for dispersion. When over- or under-dispersion did occur, the scale parameter was estimated by the square root of Pearson's chi-square divided by the degrees of freedom resulting in a scaled Pearson's chisquare equal to 1.

In addition to the non-independence of observations due to repeated measures on individual respondents, non-independence of observations also occurred due to the interviews with both the principal operator and spouse within each household. In order to account for this clustering effect, separate analyses were completed for males and females.

Not all respondents had data for the first and second observations periods. While GEE methods are robust for respondents having missing observations, these methods assume that the observations are missing completely at random(189). To evaluate whether the results were consistent with this assumption, analyses were also completed

including those respondents who had data for both observation periods. The results of this subsample were compared to the total sample to assess the effect of attrition on the initial results.

The logarithm of the number of hours of farm-work time was used as the offset variable in the Poisson regression analysis. The regression analysis proceeded in three steps. First, Poisson regression was done to estimate the effect of depressive symptoms on farm-work injuries and to test for possible effects of confounding variables of the estimate of association between depressive symptoms and farm-work injury; second, this same process was completed to arrive at an estimate of the association between drinking pattern and farm-work injury; the third step included a regression model with both independent variables of interest (i.e., depressive symptoms and drinking pattern), an interaction term of depressive symptoms and drinking pattern, and variables found to be confounding variables in the estimates between depressive symptoms and farm-work injury and drinking pattern and farm-work injury. In the first two steps, potential confounders in an association between depressive symptoms and farm-work injuries and drinking pattern and farm-work injuries were entered one at a time into the GEE equation to test whether the potential confounding variable changed the crude rate ratio by 10 percent or more. If it did, that variable was deemed to be a confounding variable..

## Results

There were 365 male farm residents and 307 female farm residents who spent time at farm work during the second year of the study and 305 males and 266 females in the third year (Table 5-2). Thirty males experienced injuries in the first study period resulting in 37 injuries, and 11 females experienced injuries resulting in 12 injuries. In

the second observation period, 33 of the 305 males had a total of 37 injuries; 13 of the 266 females had a total of 15 injuries. There was 16% attrition among male respondents from the first to the second observation period, and 13% of females were lost to follow-up from the first to the second observation period.

Males and females differed on several of the variables of interest in both the first and second observation periods (Table 5-2). A higher proportion of males had a farm-work injury and also spent more hours at farm tasks. Men tended to be older than the women, had higher rates of smoking, and higher rates of hearing loss. In the first observation period, men were less likely to be married than were women but this difference decreased in the second observation period. Women were more likely to have high rates of depressive symptoms and be non-drinkers than men; men were more likely to be both moderate and heavy drinkers than women.

In this sample there were too few observations to assess whether there was an increased effect of risk of injury with co-occurring high depressive symptoms and heavy or moderate drinking. There were 3 injuries among the 7 men with co-occurring high depressive symptoms and heavy drinking and 1 injury among the 9 women with both. The Poisson regression using the Genmod procedure could not find a solution for the interaction term. Rate ratios for both depressive symptoms and drinking patterns were calculated. Age was the only confounding variables in the association between drinking pattern and farm-work injury for men. Table 5- 3 presents the results of the Poisson regression for the association of both drinking status and depressive symptoms adjusted for age in men. Men with high depressive symptoms were almost twice as likely to experience a farm-work injury compared to men who did not have high depressive

symptoms although the rate ratio was not statistically significant. The rate ratio for heavy drinking (0.44, 95% CI 0.10, 1.97) was in the opposite direction of the risk ratio for moderate drinking (1.40, 95% CI 0.73, 2.68). Again, neither of these rate ratios was statistically significant. The results were similar for the sub-sample limited to those that had observations in both time periods thereby indicating that attrition did not change the results.

For women, age and drinking pattern were found to be confounding variables in the estimate of association between depressive symptoms and farm-work injury. Table 5-4 presents the results of the analysis for women. Neither high depressive symptoms nor drinking patterns were associated with farm-work injuries. The results did not differ when the sample was limited to those who had observations in both time periods.

## Discussion

The results of this prospective analysis are equivocal. Because of the small number of injuries the effect of co-occurring high levels of depressive symptoms with different levels of drinking patterns could not be assessed in this sample. Heavy drinking was not found to be a risk factor for farm-work injury for either men or women. The small number of injuries and the low prevalence of heavy drinking may have limited the power to detect an effect of heavy drinking on farm-work injuries among women. A cross-sectional analyses of these data suggested that heavy drinking among women was associated with an 80% increase in the farm-work injury rate compared to women who did not drink (196); this prospective analysis also found an increased risk for injury among heavy drinkers compared to non-drinkers. However, neither of these estimates was statistically significant. A sample size calculation suggests that approximately 2800

independent observations would be needed to find these estimates statistically significant at the 5% level in a population in which heavy drinking occurs among 6% of the population (197).

The lack of power also may have limited our ability to confirm that high depressive symptoms are a risk factor for farm-work injury among male farmers. The injury rate for males with high depressive symptoms was 19.2 per 100 full time equivalents (FTEs) compared to 9.5 for males with low depressive symptoms. However, the adjusted rate ratio was not statistically significant. Sample size calculations suggest that with only 5% of the males having high depressive symptoms in this study, the sample would need to be more than doubled to have 80% power to detect a statistically significant difference between the injury rate for those with high depressive symptoms compared to the rate for those with low depressive symptoms(197).

Park and colleagues found that high depressive symptoms at baseline increased the risk of agricultural injury threefold during follow-up compared to low depressive symptoms among male farmers(4). Differences between that study and this one may account for our inability to confirm those findings. Iowa male farmers have been shown to have higher rates of high depressive symptoms than Colorado farmers(86) thus having more power to study depressive symptoms as a risk factor for injury. Secondly, our analysis used a prospective statistical design accounting for the number of farm-work hours worked. Park and colleagues used only dichotomous variables to account for usual time spent at risk tasks such as animal handling(4). This study took into account the actual time spent at farm work. The differences in type of farm work done or the types of injuries experienced between the two groups of respondents could also account for the

differences in findings between the two studies. Studies of male farmers in Iowa and Colorado both suggest that high depressive symptoms are associated with injuries resulting in low back pain(138;165). Future prospective studies should investigate whether high depressive symptoms increase the risk for injury equally among all farm tasks and equally among different types of injury.

High depressive symptoms did not increase the risk of farm-work injury in women. The results of this prospective analysis are in contrast to a cross-sectional analysis of the data from the CFFHHS in which respondents were asked about their depressive symptoms at the time of interview and then asked about the occurrence of injury in the last 12 months (196). Those analyses found that depressive symptoms were not associated with agricultural injuries in men but were in women(196). Several alternative explanations could account for the difference in results between the cross-sectional design and this prospective analysis in farm women. The samples differed. The prospective sample did not include those women who were lost to follow-up although no bias due to loss of follow-up was found in the cross-sectional analysis (196) or in this analysis. Depression has been shown to be both a precursor (4;120;125) and a result of occupational injury(143). The evidence from this prospective study and the cross-sectional study (196) suggests that high depressive symptoms are more likely to follow farm-work injury in women than precede them. No difference in the rate of farm-work injury by level of depressive symptoms was found in the cross-sectional analysis for men(196). The question arises as to why high depressive symptoms may follow farm-work injury in women but not in men.

It may be that injuries reported had more consequences for farm women than men. We investigated this possibility by looking at the consequences of the injuries reported by both men and women. Men reported that they sought medical care for 87% of the injuries that were reported; for women, 65% of the injuries incurred were seen for medical care. Another question asked whether, as a result of the injury, the respondent had to curtail work activities for more than 4 hours. Forty-six percent of the injuries led to work curtailment for men; 35% for women. Based on these questions, it does not appear that women had more severe injuries. However, these two questions only put the injury into limited context without understanding the impact of injury on the different roles assumed by men and women farmers. Studies have shown that farm women continue to have major responsibility for house work and caring for children, as well as employment off the farm(198). The work of farm women has been characterized as a third shift phenomenon in which farm women carry multiple roles including work involving home and family and employed work off the farm as well as work on the farm(199). For women with multiple roles, the impact of farm-work injury may have consequences beyond limiting work time or seeking medical care. Future studies using more dimensions to measure actual impact of injuries are needed to understand the consequences of farm-work injury for both men and women and if high depressive symptoms are likely to follow such injuries in women.

The study had several limitations. Injury was self-reported. Studies have found that the best time period for accurate recall of injuries is from a 4 to 12 weeks after the injury event(192-195) suggesting that the number of injuries in this study may have been

underreported. Future studies should have the capacity to contact respondents to update data on injuries at least every three months.

Alcohol consumption was also self-reported. Studies of self-reported alcohol consumption show that alcohol use is under-reported(64;186). This would suggest that any estimate of heavy alcohol consumption and farm work injury is biased towards the null with heavy drinkers being included in the moderate drinking category. A combiniation of measures that include both heavy drinking and a measure of alcohol related problems, such as the CAGE questionnaire (200), may help in designating those persons who may be at risk for alcohol-related injury.

The purpose of this study was to investigate whether usual drinking pattern and high depressive symptoms were associated with farm-work injury. The exposure variables were measured at baseline and assumed to be constant over the time at risk of injury. This assumption may not be accurate. To investigate this assumption in this data set, the change rate over time for both depressive symptoms and drinking patterns was estimated. We found that between one interview and the next the following year, there was a 7% change in categories between levels of depressive symptoms and a 25% change in drinking pattern. This suggests that depressive symptoms over time are more stable than drinking pattern. Misclassification of these risk factors due to changes prior to the occurrence of injury could have biased the results. If the misclassification was random and not related to injury, then the results could have been biased towards the null. Usual drinking pattern may not be the most sensitive measure to increases in farm-work injury due to alcohol use. Studies have long recognized that the acute effects of alcohol are a major contributor to injury(127). In addition, the hangover effects from heavy alcohol

use, such as fatigue, headache, decreased sleep, decreased attention, lengthened reaction time and lack of concentration. may also increase risk of injury(129-131). However, both the acute effects of alcohol and the effects of hangover are transient and may not be captured in prospective analyses. Prospective designs such as this are more likely to capture associations between the chronic effects of alcohol use and injury.

In conclusion, in this prospective analysis high depressive symptoms, moderate, or heavy drinking were found to be risk factors for farm-work injury among men and women when taking the actual time of farm work into account. These findings were affected by the limited power to detect differences because of the small number of injuries and the low prevalence of both high depressive symptoms in farm men and heavy drinking in farm women.

TABLES: CHAPTER 5

Table 5-1: Time-line of data collection for independent and dependent variables in prospective analysis: CFFHHS, 1993-1996.

A. 1st observation

| Variable | Data Collected |
|---|---|
| CES-D score/ depressive symptoms | Year 1 |
| Alcohol use/drinking pattern | Year 1 |
| Sex | Year 1 |
| Age | Year 1 |
| Education | Year 1 |
| Marital status | Year 1 |
| Hearing loss | Year 1 |
| Smoking status | Year 1 |
| General health status | Year 1 |
| Limited activity due to poor health | Year 1 |
| Number of injuries since last interview | Year 2 |
| Number of farm-work hours in the past year | Year 2 |

B. 2nd Observation

| Variable | Data Collected |
|---|---|
| CES-D score/ depressive symptoms | Year 2 |
| Alcohol use/drinking pattern | Year 2 |
| Sex | Year 1 |
| Age | Year 2 |
| Education | Year 1 |
| Marital status | Year 2 |
| Hearing loss | Year 2 |
| Smoking status | Year 2 |
| General health status | Year 2 |
| Limited activity due to poor health | Year 2 |
| Number of injuries since last interview | Year 3 |
| Number of farm-work hours in the past year | Year 3 |

Table 5-2: Characteristics of farm residents who did farm-work for prospective analysis by year of follow-up and gender: Colorado Farm Family Health and Hazard Surveillance, 1993-1995.

| | Years 1-2 Observations | | Years 2- 3 Observations | |
|---|---|---|---|---|
| | Male n=365 | Female n=307 | Male n=305 | Female n=266 |
| Farm-work injury[a,b] | | | | |
| Yes | 30( 8.2%) | 11 ( 3.6%) | 33 (10.8%) | 13 ( 4.9%) |
| No | 335 (91.8%) | 296 (96.4%) | 272 (89.2%) | 253 (95.1%) |
| Average hours spent on farm-work[a,b] | 2350.2 (SE 84.9) | 1162.8 (SE 71.2) | 2082.3 (SE 88.0) | 817.4 (SE 59.4) |
| Age[a,b] | | | | |
| 20-29 | 16 ( 4.4%) | 28 (9.1%) | 7 ( 2.3%) | 20 ( 7.5%) |
| 30-39 | 80 (22.0%) | 90 (29.3%) | 64 (21.1%) | 67 (25.2%) |
| 40-49 | 110 (30.2%) | 82 (26.7%) | 100 (32.9%) | 81 (30.5%) |
| 50-64 | 108 (29.7%) | 90 (29.3%) | 88 (28.9%) | 81 (30.5%) |
| 65+ | 50 (13.7%) | 17 ( 5.5%) | 45 (14.8%) | 17 ( 9.4%) |
| Education | | | | |
| Less than high school | 25 ( 6.9%) | 14 ( 4.6%) | 19 (6.2%) | 12 ( 4.5%) |
| High school graduate | 148 (40.5%) | 117 (38.1%) | 122 (40.0%) | 103 (38.7%) |
| Beyond high school | 192 (52.6%) | 176 (57.3%) | 164 (53.8%) | 151 (56.8%) |
| Marital status[a] | | | | |
| Married/unmarried couple | 336 (92.1%) | 299 (97.4%) | 279 (92.7%) | 233 (96.7%) |
| Currently not married/never married | 29 ( 7.9%) | 8 ( 2.6%) | 22 ( 7.3%) | 8 ( 3.3%) |
| High Rate of Depressive Symptoms[a,b] | | | | |
| Yes | 23 ( 6.3%) | 34 (11.2%) | 7 ( 2.3%) | 22 ( 8.3%) |
| No | 341 (93.7%) | 270 (88.8%) | 296 (97.7%) | 244 (91.7%) |
| Drinking Pattern[a,b] | | | | |
| Non-drinker | 151 (41.5%) | 169 (55.4%) | 113 (37.4%) | 136 (51.1%) |
| Moderate | 167 (45.9%) | 116 (38.0%) | 152 (50.3%) | 118 (44.4%) |
| Heavy | 46 (12.6%) | 20 ( 6.6%) | 37 (12.3%) | 12 ( 4.5%) |

Table 5-2 (continued): Characteristics of farm residents who did farm-work for prospective analysis by year of follow-up and gender: Colorado Farm Family Health and Hazard Surveillance, 1993-1995.

| | Year 1-2 Observations | | Year 2- 3 Observations | |
|---|---|---|---|---|
| | Male N=365 | Female n=307 | Male n=305 | Female n=266 |
| Smoking Status [a,b] | | | | |
| Never | 176 (84.4%) | 211 (68.7%) | 149 (49.2%) | 186 (70.2%) |
| Former | 127 (34.9%) | 58 (18.9%) | 104 (34.3%) | 52 (19.6%) |
| Current | 61 (16.6%) | 38 (12.4%) | 50 (16.5%) | 27 (10.2%) |
| Hearing Loss [a,b] | | | | |
| Yes | 59 (16.1%) | 15 ( 4.9%) | 55 (18.1%) | 14 ( 5.3%) |
| No | 306 (83.8%) | 292 (95.1%) | 249 (81.9%) | 252 (94.7%) |
| Health Status | | | | |
| Excellent/Very Good/Good | 339 (92.9%) | 294 (95.8%) | 278 (91.4%) | 248 (95.2%) |
| Fair/Poor | 26 ( 7.1%) | 13 ( 4.2%) | 26 ( 8.6%) | 18 ( 6.8%) |

[a] Difference is statistically significant (<p.05) between males and females in time period 1;
[b] Difference is statistically significant (p<.05) between males and females in time period 2;

Table 5-3: Crude and Adjusted Rate Ratios for and 95% Confidence Intervals for High Rates of Depressive Symptoms and Drinking Patterns for Farm-Work Injuries for Men: A Prospective Analysis, Colorado Farm Family Health and Hazard Surveillance, 1993-1995.

| | All observations N=670 | | Observations with complete follow-up n=609 | |
|---|---|---|---|---|
| | Crude RRs (95% CI) | Adjusted RR* (95% CI) | Crude RRs (95% CI) | Adjusted RR* (95% CI) |
| Depressive Symptoms | | | | |
| CES-D >15 | 1.42 (0.36, 5.53) | 1.94 (0.67, 5.60) | 1.14 (0.26, 5.09) | 1.79 (0.51, 6.26) |
| CES-D <16 | Referent | Referent | Referent | Referent |
| Drinking Pattern | | | | |
| Heavy | 0.59 (0.14, 2.59) | 0.44 (0.10, 1.97) | 0.63 (0.15, 2.62) | 0.47 (0.11, 2.06) |
| Moderate | 1.41 (0.75, 2.64) | 1.40 (0.73, 2.68) | 1.40 (0.74, 2.63) | 1.36 (0.70, 2.67) |
| Non-drinker | Referent | Referent | Referent | Referent |

*adjusted for age group

Table 5-4: Crude and Adjusted Rate Ratios for and 95% Confidence Intervals for High Rates of Depressive Symptoms and Drinking Patterns for Farm-Work Injuries for Women: A Prospective Analysis Colorado Farm Family Health and Hazard Surveillance, 1993-1995.

| | All observations N=573 | | Observations with complete follow-up n=553 | |
|---|---|---|---|---|
| | Crude RRs (95% CI) | Adjusted RR* (95% CI) | Crude RRs (95% CI) | Adjusted RR* (95% CI) |
| Depressive Symptoms | | | | |
| CES-D >15 | 0.78 (0.23, 2.72) | 0.66 (0.17, 2.49) | 0.82 (0.23, 2.83) | 0.66 (0.18, 2.47) |
| CES-D <16 | Referent | Referent | Referent | Referent |
| Drinking Pattern | | | | |
| Heavy | 1.68 (0.49, 5.73) | 1.46 (0.34, 6.32) | 1.67 (0.15, 2.62) | 1.66 (0.38, 7.20) |
| Moderate | 1.01 (0.44, 2.34) | 1.00 (0.41, 2.44) | 0.89 (0.38, 2.12) | 0.88 (0.35, 2.25) |
| Non-drinker | Referent | Referent | Referent | Referent |

*adjusted for age group and smoking status

# CHAPTER 6: SUMMARY AND CONCLUSIONS

The original goal of this dissertation was to study the impact of the co-occurrence of heavy drinking and high depressive symptoms on farm work injury. Several studies of farm-work injury and depressive symptoms and farm-work injury and alcohol use have been completed with mixed results. Most of these studies had been cross-sectional in design. One prospective study had shown a relationship between high levels of depressive symptoms in men and farm-work injury(4). In two prospective studies, moderate alcohol use, not heavy use, had been shown to be associated with farm-work injury in samples that included both men and women (7;8). With inconclusive results from cross-sectional studies and limited information from prospective studies, the question left to be answered was whether heavy alcohol use in the presence of high depressive symptoms might show more consistent association with farm-work injuries. Alcohol use disorders and depressive disorders are found in the general population more often than would be expected by chance (10-18). When found together symptoms are more severe (19;20); co-morbid disorders result in reduced social functioning (21) and more often interfere with functioning at work than those who only (23) have one disorder. Little has been written about those who have co-occurring heavy drinking and high depressive symptoms. One study found that high depressive symptoms modified the effect of alcohol consumption on all cause mortality(24). One goal of this study was to explore how those with heavy alcohol consumption and high depressive symptoms were similar or different from those who did not drink heavily and did not have high depressive symptoms and how they also differed from those who drank heavily without high depressive symptoms and those who did not drink heavily but had high depressive

symptoms. The other goal was to investigate whether depressive symptoms may modify the effect of alcohol consumption on farm-work injury.

Only 1.6% of this population of Colorado farm residents was estimated to have co-occurring high rates of depressive symptoms and heavy drinking. Those with co-occurrence were similar to those with high rates of depressive symptoms only and heavy drinkers only in that all 3 groups were younger and unmarried compared to farmers who had neither high rates of depressive symptoms nor were heavy drinkers. Males were more likely to be heavy drinkers only and females were more likely to have high depressive symptoms only. No significant difference by sex was noted for those who were both heavy drinkers and had high depressive symptoms. Those with depressive symptoms only had characteristics commonly found in studies of depressive symptoms among farmers: poor or fair health, lack of close family and friends, and higher numbers of stressful life events. Self-reported poor or fair health was also more often found among those with co-occurring heavy drinking and high depressive symptoms than those with neither of these. The most interesting findings in the comparisons of these groups were those involving time spent on farm-work and smoking. Results showed that working more than half-time but less than full time at farm-work during the year was associated with both those with high depressive symptoms only and those with co-occurring depressive symptoms and heavy drinking, but in opposite directions. Farm residents who worked these hours were approximately 3 times more likely to have co-occurring high depressive symptoms and heavy drinking than those who worked full time. Farm residents who worked these same hours were also less likely to have high depressive symptoms than those who worked full time. This finding needs to be

confirmed in other studies. More work is needed to understand what factors could account for these results. In other studies, smoking has been associated with heavy drinking and with depressive symptoms. However in this analysis, current smoking was associated only with those who reported both heavy drinking and high depressive symptoms. It could be that those who are heavy drinkers and also have high depressive symptoms are those with the highest level of anxiety in this study group. Because anxiety was not measured in this study, this hypothesis would need to be tested in other studies. The role of the co-occurrence of heavy drinking and high depressive symptoms should be explored further, and the result may provide useful information for planning smoking prevention and cessation efforts.

Based on results from this study, co-occurring high depressive symptoms and heavy alcohol use was not a problem in this population and was not a contributor to farm-work injuries. In completing this analysis, we found an association between farm-work injuries and high depressive symptoms was found in farm women but not in farm men. This association was seen only in a cross-sectional analysis in which the information on alcohol use and depressive symptoms was collected after the injuries had occurred. In the prospective analysis, in which alcohol consumption and depressive symptom information was collected prior to the injury, no association was found. This suggests that high depressive symptoms may be an outcome of farm-work injury among women but not men. Drinking pattern, either no drinking, moderate drinking, or heavy drinking were not found to be associated with farm work injury either in the cross-sectional or prospective analyses for either men or women.

Little work has been done to understand farm-work injury among women farmers(198). Most studies either focus on male farmers or do not look at farm-work injury separately for men and women as was done in this study. This study confirmed earlier findings that although women have fewer numbers of injuries than men, the rate of farm-work injury is similar for men and women when taking the number of farm work hours into account(157). The findings from this study suggest that differences in factors associated with farm work injury differ for males and females. Futures studies are needed to understand if risk factors for injury differ for men and women. Other studies are needed to understand how the impact of farm-work injury may differ for men and women farmers in the context of their daily lives.

There were several factors that limited definitive findings from this study. The first was the lack of statistical power. The low prevalence of heavy drinking among women and low prevalence of high depressive symptoms among men limited the ability to test for statistical significance of findings. Future studies of depressive symptoms and alcohol use and occupational injury should be done in occupations that have higher rates of both of these, e.g., construction workers, transport workers. The interaction of depressive symptoms and drinking patterns could better be studied in populations with higher prevalence of these factors.

Measurement issues also limited this study. Respondents were asked how many farm-work injuries they had had in the last 12 months. Studies suggest that recall of injuries is accurate from 3 weeks to 4 months after the injury event. Future studies should be structured to collect injury information at least every 3 months. Alcohol use was also gathered by asking respondents about the number of alcoholic beverages used in

the past month. Alcohol use is known to be under-reported in surveys such as this. A number of heavy drinkers were probably misclassified as moderate drinkers making any association between heavy drinking and farm-work injury biased toward the null. The drinking measure may have not been specific enough to categorize those whose usual drinking patterns may put them at risk for injury. Future studies should be done which use not only a measure of alcohol consumption but other measures which ask about problems related to alcohol use. By using both instruments, information on the level of current drinking and history of alcohol-related problems would be more specific.

The study did have strengths. This is the first study to address the question of what distinguishes those with both heavy drinking and high depressive symptoms from those with neither of these or only one of these. Future studies should address what other, if any, impacts the co-occurrence of heavy drinking and high depressive symptoms have on health outcomes especially in occupational settings with higher rates of both depressive symptoms and heavy drinking. The study cohort allowed for both cross-sectional and prospective analyses and comparison of findings between the two methods. Few studies have been able to use actual work time as time at risk in the study of risk factors for farm-work injury. The time of farm-work was used in both the cross-sectional and prospective study to understand the impact of depressive symptoms and drinking pattern on injury rates. Finally, this study separately investigated these issues for men and women and exhibits the need to study farm-work injuries experienced by women farmers.

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Appendix A: Center for Epidemiological Studies – Depression Scale

| How often **in the past week** have you: | Rarely or none of the time (<1 day) | Some or a little of the time (1-2 days) | Occasionally or a moderate amount of time (3-4 days) | Most or all of the time (5-7 days) |
|---|---|---|---|---|
| 1. Felt bothered by things that don't usually bother you. | 0 | 1 | 2 | 3 |
| 2. Not felt like eating; had a poor appetite. | 0 | 1 | 2 | 3 |
| 3. Felt you could not shake off the blues even with help from your family and friends. | 0 | 1 | 2 | 3 |
| 4. Felt you were as good as other people. | 0 | 1 | 2 | 3 |
| 5. Had trouble keeping your mind on what you were doing. | 0 | 1 | 2 | 3 |
| 6. Felt depressed. | 0 | 1 | 2 | 3 |
| 7. Felt that everything you did was an effort. | 0 | 1 | 2 | 3 |
| 8. Felt hopeful about the future. | 0 | 1 | 2 | 3 |
| 9. Thought your life had been a failure. | 0 | 1 | 2 | 3 |
| 10. Felt fearful. | 0 | 1 | 2 | 3 |
| 11. Slept restlessly. | 0 | 1 | 2 | 3 |
| 12. Felt happy. | 0 | 1 | 2 | 3 |
| 13. Talked less than usual. | 0 | 1 | 2 | 3 |
| 14. Felt lonely. | 0 | 1 | 2 | 3 |
| 15. Felt people were unfriendly. | 0 | 1 | 2 | 3 |
| 16. Enjoyed life. | 0 | 1 | 2 | 3 |
| 17. Had crying spells. | 0 | 1 | 2 | 3 |
| 18. Felt sad. | 0 | 1 | 2 | 3 |
| 19. Felt that people disliked you. | 0 | 1 | 2 | 3 |
| 20. Felt that you could not get going. | 0 | 1 | 2 | 3 |