

Characteristics Associated with Increased Farm Work-related Injuries Among Male Resident Farm Operators in Colorado, 1993

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Abstract

Numerous studies have reported injury risks among farmers. Few have provided detailed information related to off-farm paid work practices and pesticide exposures in relation to the risk of farm work-related injuries. This study provides estimates of the risk of injury associated with these exposures in a population-based survey of Colorado male resident farm operators. Significantly associated with the risk of farm work-related injuries were the number of days of off-farm employment (50-149 days) (odds ratio 3.25, 95% confidence interval 1.40, 7.53) and having a primary cash crop of large animals including beef, dairy, and feedlot operations (odds ratio 4.63, 95% confidence interval 1.01, 21.25). Organophosphate use and carbamate use on the farm in the previous 12 months were associated with injury but were not significantly associated when considered in a logistic regression model including age, cash crop, and the work-related variables listed above. However, in the logistic regression analysis, the risk of exposure to the neurotoxic carbamate chemicals was greater (odds ratio 2.03, 95% confidence interval 0.59, 6.94) among injured farm operators than in the univariate analysis (odds ratio 1.47, 95% confidence interval 0.35, 4.60).

Keywords. Injuries, Pesticides, Workload.

Farming is a hazardous occupation in terms of injuries with rates of 42 per 100,000 deaths and 3871 per 100,000 non-fatal injuries (NSC, 1991). In Kentucky, relative risks of nonfatal injuries by type of agriculture ranged from a high of 1.9 on animal specialty farms to a low of 0.7 on cash grain farms (Stallones, 1990). Active surveillance of fatal occupational injuries in Colorado between 1984-1989 indicated 43% of agricultural worker deaths were the result of farm equipment, usually tractors, with one third involving roll-over, and one third being caught in machinery (CDH, 1990). The importance of equipment and large animals as agents of injury among farmers has been well documented (Stallones, 1990; Zhou et al., 1994; Brison et al., 1992).

Specific farm types which have been reported to be more risky than others include dairy, forestry, and beef cattle (Zhou et al., 1994; Stallones, 1990;

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Brison et al., 1992). Whether older ages (Nordstrom et al., 1996; Brison et al., 1992) or younger ages are associated with higher risk of injury (Zhou et al., 1994) is not clear. However, hours worked per week on the farm are consistently reported to increase the risk of farm injuries (Layde et al., 1995; Nordstrom et al., 1996; Brison et al., 1992). Males are at higher risk of farm work-related injuries (Brison et al., 1992; Pickett et al., 1995; Zhou et al., 1994; Stallones, 1990) except in those studies which have assessed actual hours worked, where female and male risk is approximately the same (Nordstrom et al., 1996). Other characteristics associated with increased risk of injury are season (spring and fall are high risk seasons) (Zhou et al., 1994; Pickett et al., 1995), size of the farm (larger farms associated with increased risk of injury) (Pickett et al., 1995; Stallones, 1990) and number of years in farming (Brison et al., 1992).

Although the agents of injury have been identified, potential underlying individual characteristics associated with injuries among farm populations have been less well described. Exposures to organophosphate and carbamate pesticides, which have been reported to be associated with chronic neurological sequelae after acute poisoning episodes (Savage et al., 1988; Rosenstock et al., 1991; Steenland et al., 1994), have not been studied in relation to farm work-related injuries. Zhou et al. (1994) did report that farm chemical use was associated with severity of reported injuries, however the specific chemicals used were not described.

The purpose of this report is to assess characteristics associated with farm work-related injuries among males including exposure to organophosphates, carbamates, off-farm paid employment, age, and primary cash crop on the farm. Although number of hours worked on the farm has been used by many investigators, the role of off-farm paid employment has not and may well be an important contributor to injury risk, therefore we selected this variable as one measure of work pattern risk rather than hours worked on the farm.

Material and Methods

Study Population

The study population consisted of rural male farm residents in Colorado. Farm residences were identified by the Colorado Department of Motor Vehicle Registration list of farm trucks registered in the state of Colorado in 1991-1992. Farm truck registration is less expensive than regular truck registration, the cost of registration is based on the size and weight of the vehicle and the cost is significantly lower for larger trucks and slightly lower for standard and light weight trucks. The owner of the truck must make 51% of his or her income from farming land that he or she owns or leases. The list was used to identify the names and addresses of owners of registered farm trucks. Duplicate names and addresses were deleted from the list. A total of 94,707 farm trucks were registered in Colorado during 1991-1992. There were an estimated number of 19,934 rural farm households during the same period. A stratified probability sample of farm trucks was selected to represent approximately 2.5% of all rural farm residences with an operator living on the premises in Colorado. The sample was drawn proportional to the number of farms with resident operators in each of the six crop reporting districts identified by the Colorado Agricultural Statistics Service (Colorado Agricultural Statistics, 1990). A total of 485 farms were recruited to participate in the study which was to take place over the period 1993-1995. There were a total of 872 individuals recruited, of whom 470 were males.

Telephone numbers were linked to the names and addresses using directories and operator assistance. The survey was conducted by telephone and designed to take approximately 20 minutes for each participant. All participants had to make a minimum of \$1,000 in a normal year from sales of agricultural produce in order to be eligible. The definition is based on that used by the United States agricultural census to identify farms (Census of Agriculture, 1989).

The primary operator and the spouse of the operator were asked to participate in the survey. Telephone interviews were conducted separately for the operator and the spouse when both agreed to be interviewed. This report is based on the first year of the survey conducted between 1 January 1993 to 31 March 1993.

Detailed questionnaires were administered assessing general health, farm characteristics, demographics, work history, and pesticides used on the farm in the previous 12 months.

Exposure Variables

Farm residents were classified as exposed to organophosphates if the operator reported use of pesticides on crops or on livestock on the farm during the previous 12 months. Pesticides were assessed according to common trade name. A list of those commonly used in Colorado was provided to assist interviewers but the list was not used to prompt the farm operators reporting usage pattern. Farm operators were allowed to provide additional trade names when those used were not on the list.

Individuals were asked if they had worked to help friends and neighbors on a farm other than their own in the previous 12 months. In addition, the number of days of paid employment other than farm work off of the farm was grouped according to none; 1-49 days; 50-149 days; 150-199 days; and 200 or more days.

Covariates

Other variables considered potential confounders were major type of agricultural activity and age.

Outcome

Individuals were asked to report if they had experienced a farm work-related injury in the past 12 months which had resulted in seeking medical attention or treatment other than first aid, or having required a reduction in some work activities or having lost consciousness, or having had to transfer to another job. Details obtained about the injuries reported were part of body injured, date of injury, work activity at the time of injury (animal handling, farmstead material handling, crop production, farm maintenance, transport of farm equipment or produce, other), how the injury happened, type of medical attention sought, and work time lost.

Data Analysis

SAS version 11 was used to assess the relationship between self report of farm work-related injury and the exposures of interest. Crude odds ratios and 95% confidence intervals for the risk characteristics were calculated using Epiinfo. Logistic regression was used to model the independent contribution of the characteristics. Dummy variables were created for each exposure and each covariate of interest. The referent group was generally selected as the group with the lowest percentage of injuries. The exception to this were the dummy variables created for the hours worked in paid employment off of the farm, where the referent group selected were those farm operators who did not work any hours of paid employment

off of the farm. Adjusted odds ratios were calculated for exposure variables based on the logistic regression model results.

Results

A total of 485 farms, representing 872 individuals, was enrolled in the survey. This report includes only the 470 male farm resident operators who were enrolled in the survey. The response rate based on total contacted minus refusals and procedural interview failures (couldn't understand the interviewer or the questions) was 62%. The response rate based on outright refusal to participate when an eligible household was contacted was 70%. No information was obtained from those who refused to participate.

A total of 55 (11.7%) of the male resident farm operators were injured in a farm work-related injury. Table 1 contains a description of the population surveyed according to age, type of farm operation, organophosphate use, carbamate use, work involvement on other farms, and off-farm paid employment and the percentage of injuries which occurred for each group. Crude odds ratios and adjusted odds ratios for the exposures and covariates are presented in table 2. Injured male farm resident operators were significantly more likely to be involved in farm operations where

Table 1. Number and percentage injured by selected characteristic, Colorado male farm residents, 1993

Characteristic	No. in Study Sample	Percentage Injured
Age in years		
< 30	25	20.0
30-39	97	17.5
40-49	135	7.4
50-59	100	11.0
60-64	48	12.5
65+	65	9.2
Organophosphates used		
Yes	110	18.2
No	360	9.7
Carbamates used		
Yes	25	16.0
No	445	11.5
Work on other farm		
Yes	123	14.6
No	347	10.7
Off farm paid employment (days per year)		
None	267	11.2
1-49	38	7.9
50-149	39	30.8
150-199	29	6.9
200+	95	8.4
Unknown	2	0.0
Primary agricultural activity		
Field and crop production	211	10.7
Livestock (beef cattle, dairy, feedlot)	183	15.8
Livestock (sheep, hogs, goats)	18	5.6
Other (forest production, vegetable, melon, fruit, nut)	58	3.8

Table 2. Odds ratios and 95% confidence intervals for study characteristics associated with increased risk of farm work related injury, Colorado male resident farm operators, 1993

Characteristic	Unadjusted Odds Ratio (95% Confidence Interval)	Adjusted Odds Ratio (95% Confidence Interval)*
Age in years		
< 30	3.13 (0.75, 11.27)	2.56 (0.71, 9.39)
30-39	2.66 (1.08, 6.60)	2.38 (0.97, 5.12)
40-49	Referent	Referent
50-59	1.54 (0.58, 4.13)	1.43 (0.56, 3.66)
60-64	1.79 (0.50, 5.80)	1.99 (0.65, 6.03)
65+	1.27 (0.36, 4.07)	1.17 (0.38, 3.56)
Primary cash crop		
Field and crop production	3.30 (0.77, 29.70)	3.34 (0.74, 15.12)
Beef, dairy, feedlot	4.90 (1.08, 30.76)	4.63 (1.01, 21.25)
Hogs, chickens, sheep	1.53 (0.02, 30.92)	1.52 (0.12, 19.07)
All others	Referent	Referent
Organophosphate pesticides (used in previous 12 months on farm)		
No	Referent	Referent
Yes	2.09 (1.09, 3.90)	1.75 (0.91, 3.37)
Carbamate pesticides (used on the farm in the previous 12 months)		
No	Referent	Referent
Yes	1.47 (0.35, 4.60)	2.03 (0.59, 6.94)
Worked on someone else's farm or ranch		
No	Referent	Referent
Yes	1.93 (1.10, 3.36)	1.15 (0.59, 2.24)
Off-farm paid employment (per year)		
None	Referent	Referent
1-49 days	0.68 (0.20, 2.34)	0.70 (0.20, 2.50)
50-149 days	3.52 (1.61, 7.65)	3.25 (1.40, 7.53)
150-199 days	0.58 (0.13, 2.58)	0.68 (0.15, 3.13)
200+ days	0.72 (0.32, 1.65)	0.86 (0.36, 2.02)

* n = 466.

large animals were the primary cash activity and when they worked off the farm 50 to 149 days per year.

Discussion

Work-related injuries were associated with increased workload in this population. Male farm resident operators who worked on their own farm, on other people's farms, and who worked between 50 and 149 days in paid employment other than farm work off of the farm were at higher risk of injury than other farmers. This finding is consistent with other studies reporting farm injuries increasing with increasing hours worked (Layde et al., 1995; Brison et al., 1992; Nordstrom, et al., 1996). More work is needed to assess the nature of increased risk related to work practices. In order to prevent and control the severity of injuries, it is important to know if long work hours or if work practices off of the farm are the greatest contributor to the increased risk noted in this study.

The type of agricultural activity associated with more injuries in this population was large animals (beef, dairy, feedlot). This was expected based on reports in other

farming populations (Stallones, 1990; Zhou et al., 1992). The average size of farms in Colorado is quite large and close contact with large animals has been reported to be associated with injury risk in other studies (Boyle et al., 1997). In Colorado, with the movement of beef cattle from pasture to pasture, the risk of animal-related injuries is high. In addition, the majority of agricultural operations involve a multitude of different job activities, and those farms with a combination of equipment and large animals may provide the most hazardous work environments.

Although the use of organophosphate pesticides and carbamate pesticides increased the risk of a work related injury slightly in the univariate analysis, the risk was not significant when accounting for the other variables in the logistic regression model. This indicates that other factors are more strongly associated with injury risk or that the sample group was too small to provide a stable estimate. However, the interesting finding was that the magnitude of the association between carbamates and injury risk increased when the contribution of the other variables was accounted for in the model.

Findings related to pesticides from this cross-sectional study need to be interpreted with caution. The use of organophosphates and carbamates were assessed during the same period of time as the injuries which were reported, therefore we are unable to establish a causal association. The findings were also hampered by the small number of farms which used the specific compounds, particularly the carbamates. This problem led to an unstable statistical estimate of risk. However, the findings are intriguing and are biologically plausible. Cognitive functioning is linked with injury risk and exposures which reduce functional ability may well be related to increased risk of injury. This finding should be examined in other populations with known exposure to neurotoxic farm chemicals.

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