

ORIGINAL ARTICLE

Farm work practices and farm injuries in Colorado

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Study objectives: To describe the farm work patterns and the relationship between hours spent working on specific farm tasks and task specific work related injuries among women and men.

Design: A cross sectional survey of farm operators and their spouses in an eight county area of Colorado was conducted. Personal interviews were conducted between 1993 and 1997. Interviews took between 45 minutes to two hours to complete, depending on the complexity of individuals' personal histories. Farms were selected using stratified random sampling technique.

Setting: Eight counties in Northeastern Colorado representing 47% of agricultural production in the state.

Participants: A total of 301 women and 459 men who were farm residents and involved in farm work were recruited.

Outcome measure: Self reported injuries resulting in medical attention or treatment other than first aid, or inability to do normal work activities, or loss of consciousness, or transfer to another job were assessed in relationship to the specific job task being performed at the time of the injury.

Results: Women were at higher risk for injury than men when involved with other farm chores (rate ratio 8.18). For all other task related injuries, men and women were at similar risk when compared using hours of exposure to the farm tasks.

Conclusion: Farm safety training and injury prevention programs need to include women working on farms.

Historically, women's and men's work have been differentiated by salary, job tasks, and often industrial setting.¹ Although work activities may be substantially different comparing men and women, women have been traditionally viewed as safer workers because the rate of work related injuries is lower among women than among men. Little work has been done assessing actual work hours of exposure in relation to differential risk of work related injuries, either across industries or within one particular industry. If the exposure to hazardous job tasks differs by gender, then the risk of injury linked with those tasks would be expected to follow a different pattern for women and for men.

Worldwide, 49% of the population is engaged in agriculture with women contributing substantially to agricultural production as formal and as informal workers.² Agriculture has one of the highest injury rates of all industries in North America. Both fatal and non-fatal injury rates are high among workers in agriculture. The type of farm³⁻⁸ and exposure to specific agents of injury among agricultural workers have been well documented³⁻⁹ but little has been reported related to work hours of exposure to specific tasks on farms. The percent of women participating in agricultural work has increased each year since the United States Department of Agriculture began including gender in the Census of Agriculture.¹⁰ Women have rarely been studied in farm related injury research.¹⁰ However, the studies reporting farm injury rates among women are not consistent. Stallones,⁴ Brison and Pickett,⁹ and Crandall *et al*⁶ reported lower injury rates among women than men while Zhou *et al* reported a higher injury rate among women than among men.³ None of the studies assessed the hours worked at specific farm tasks. Assessing specific work tasks and hours worked may provide a better understanding of risks associated with injuries among women and men.¹¹

Among dairy farmers, Pratt *et al* reported that women had 1.59 injuries per 1000 hours worked while men had 2.98 injuries per 1000 hours worked.¹² In a regression analysis, the authors reported no association between sex and injury risk when the type of worker (owner, hired hand, or relative) was

included in the model.¹² One group of investigators assessed the difference in farm work machinery injuries based on person-years of exposure and hours worked and reported that males had a 14-fold higher risk of injury compared with females using person-years as the denominator, however this was reduced to 5.6 when using hours of work as the denominator.¹³ Similarly, the rate of farm related falls was 2.4-fold higher among males than females using person-years as the denominator, with the ratio reduced to 0.9 when hours worked were used as the denominator.¹⁴ The purpose of this paper is to describe the farm work patterns and the relationship between hours spent working on specific farm related activities and task specific farm work related injuries among women and men in Colorado.

SUBJECTS AND METHODS

Study population

The study population consisted of farm residents residing in eight counties in Colorado. The primary sampling unit for the study was the farm. The eight counties are in the northeastern portion of Colorado and included: Larimer, Logan, Morgan, Weld, Phillips, Sedgwick, Washington, and Yuma. These counties contained 47% of the agriculturally employed population at the time the survey was conducted. The population was selected using a multistage area sample. All of Colorado is mapped using township/range units (TRUs). Each TRU consists of 36 sections of land and covers 23 040 acres or 36 square miles. TRUs were randomly sampled from each county using a weighting formula based on the number of farms needed from each county (computed as a function of sample size required to estimate selected health indicators for the study population), the average size of the farms within the county, and the probability that a farm operator was in-residence on the sampled sections of land. Rural directories and property value assessment lists were used to locate farms on the selected TRUs. A roster of farms was developed for each selected TRU. Farms were randomly selected from this roster

Table 1 Farms, target sample, and percent of completed interviews, Colorado eight county study 1993–97

County	Total No of farms in county (1992)	Target sample size	No of farms enrolled	% Sample completed	% Participated
Sedgwick	230	20	21	105	60
Phillips	375	30	36	120	47
Yuma	932	90	77	86	61
Logan	897	65	65	100	52
Washington	784	85	76	89	54
Morgan	836	45	46	102	51
Weld	2909	130	122	94	59
Larimer	1233	35	36	103	80
Total	8196	500	479	96	56

to be contacted for the study. Farms were identified as those places where in a normal year, \$1000 or more in agricultural produce was sold. The farm operator and the spouse of the operator were asked to participate in the study. Written consent was obtained from each participant after the nature and time commitment requested were explained. Procedures were reviewed and approved by the human research committee of the university.

Interviewers were recruited from the eight counties through newspaper advertisements and through county extension offices. Training and retraining of interviewers was conducted once every year before beginning the interviewing season. A training manual was developed which included information about confidentiality, obtaining informed consent, the nature of the survey, the purpose of the questions, and techniques for obtaining accurate information. At the annual training, interviewers conducted supervised mock interviews and discussed questions that had come up during the previous interview cycle. Interviewers were allowed to choose whether they preferred to contact participants by telephone or by mail. A majority of participants were initially contacted by mail. Interviewers then called the participants to determine willingness to be interviewed and to schedule a time for the in-person interview. All data were collected by personal interviews at the farm of the participants.

Table 1 contains the target farm sample size, the number of farms enrolled, and the percent of farms participating by county. Table 2 contains a description of primary commodities on study farms compared with all farms in the eight counties.

Study variables

Questionnaires were developed in collaboration with staff from the National Institute of Occupational Safety and Health. Questions and scales used for most study variables were selected from instruments that have been used

extensively in national or international survey research conducted by telephone or in-person. Information about the farms was obtained using the same questions the United States Department of Agriculture Census of Agriculture use so comparisons could be made between study farms and farms in the study area. The total questionnaire was pilot tested on nine farm resident operators to assess clarity, wording, and ordering of questions for the total instrument. In order to maximize response, interviews were conducted during months when the farmers were less occupied with preparation of fields, planting, harvesting, calving, and breeding of animals. Interviewers worked for six months (October to March) each year to recruit and enroll participants in the study.

Farm work related injuries were obtained for the 12 months preceding the date of the interview. Individuals were asked to report any injury that required medical treatment other than first aid, that reduced the ability of the participant to do work activities, or that resulted in loss of consciousness. The total number of injuries that occurred during that 12 month period, the body part injured, the type of injury, and the farm related activity that was associated with the injury were obtained. For this report, the injuries were grouped by farm task to compute rates. Farm tasks were defined as follows: (1) animal handling included practices and facilities used for daily milking, breeding, veterinarian and animal health activities, and physical movement of animals; (2) farmstead material handling included practices related to equipment used in storage, grinding, mixing, conveying and feeding forage, grain and commercial supplements to animals, scraping and collections, storage, and loading procedures for liquid and solid manure generated by animals in confined areas; (3) crop production included use of all mechanical farm equipment utilized to produce feed and cash crops on the farm including tractors, tilling, planting, harvesting equipment, and the maintenance of that equipment; (4) farm maintenance including building repair, farm premises repair, fence repair and involved hand tools, power tools, ladders, lawn mowers, and electrical repairs; (5) transport included any transport of farm equipment, farm produce, supply purchase that involved highway or roadway travel; and (6) activities that did not fit the above categories were classified as "other". Participants were asked to specify the other farm tasks. Other farm related tasks included a wide range of activities from book keeping, to keeping computer files to track crop and animal production, and weeding. Due to very small numbers in any of the specific activities, other activities were combined into one category for purposes of these analyses. Date of injury was compared to date of interview to determine if there was a bias in reporting injuries which occurred closer to the interview or whether there was a systematic difference in reporting of injuries for women and for men in the study population.

Table 2 Percent distribution of farms in eight county area and sample by standard industrial classification (SIC) code

SIC commodity groupings	% Eight county farms, 1992	% Eight county sample farms, 1992–97
Livestock	39.2	26.2
Cash crops	41.8	47.6
Field crops	9.0	14.6
General, crops	4.5	4.8
General, livestock	1.1	5.8
Dairy	3.8	1.0
All others	0.6	0.0

Table 3 Average number of hours worked by farm activity among men and women, Colorado eight county study, 1993–97

Activity/sex	Population No (%)	Spring (March, April, May) [average hours]	Summer (June, July, August) [average hours]	Fall (September, October, November) [average hours]	Winter (December, January, February) [average hours]
Animal handling					
Men	303 (66.2)	156.2	74.7	108.0	141.0
Women	127 (43.1)	72.2	43.8	49.0	54.1
Farm materials handling					
Men	276 (60.3)	78.4	48.0	62.0	84.2
Women	75 (25.3)	21.2	13.8	14.7	20.8
Crop production					
Men	408 (89.3)	327.3	495.7	341.0	29.0
Women	110 (37.2)	41.7	72.9	51.5	2.1
Transportation					
Men	373 (81.6)	43.4	59.3	71.1	35.7
Women	185 (62.5)	22.9	37.9	29.9	13.7
Maintenance					
Men	427 (93.4)	95.0	99.0	85.2	108.7
Women	137 (46.3)	21.8	42.7	22.6	11.9
Other					
Men	42 (9.2)	5.3	5.0	5.6	11.3
Women	44 (14.9)	8.7	12.3	12.1	13.3

A detailed work history was asked of all participants in the survey. Hours spent per day, days spent per week, and weeks per season (fall, winter, spring, and summer) were asked. Seasons were classified as follows: fall included September, October, November; winter included December, January and February; spring included March, April, and May; summer included June, July and August. The total hours spent in specific activities described in detail above were asked for each season and classified as animal handling, handling of farmstead materials, crop production, farm maintenance, farm related transport, and other farm related job tasks. Average hours of work were computed by season among women and men for each of the farm related activities. The average hours worked by season and farm activity comparing injured and not injured workers were computed separately for women and men. The total number of hours worked among women and men by age and injury status were computed. The injury rates per 100 000 hours worked among women and men were computed and the ratio of those rates was computed.

Poisson regression is often used for rare events occurring over a specific period of time and allows determination of whether incidence rates vary across groups. The injury incidence rate was modeled using a log linear model in Poisson regression, with the outcome of interest being the number of injuries occurring over four seasons of the year by each farm activity based on person-hours of exposure during each season for each farm activity. Gender was used as a class variable and women were used as the reference group in the rate analysis such that the rate was modeled as the number of injuries in women compared with the number in men.

RESULTS

There were 301 women and 459 men who participated. The age distribution among women and men was similar. A higher proportion of men were involved in all farm work activities compared with women. Table 3 contains the average number of hours worked by season among women and men. For each season, women worked more hours than men on activities that were described as "other" by the participants. For all other farm work related activities, men worked a greater number of hours each season compared with women. The total hours women worked was less than half the hours worked by men for every other farm work related activity for every season.

Table 4 contains the rate of injury by farm work activity per 100 000 hours worked among women and men and the ratio of the injury rates among women and men. Women had a higher risk of injury when involved in other farm tasks. No women were injured at tasks related to crop production or transport of agricultural produce. Men were at higher risk of being injured when involved in farm maintenance compared with women. For all other farm tasks, there were no apparent differences in injury rates between women and men.

The results of the Poisson regression coincided with the calculated rate ratios with standard errors and confidence intervals that were essentially identical. The results show no significant differences in injury rates between women and men using person-hours of exposure. The standard errors and confidence intervals were not computed in the Poisson regression models for the other category because the only male who reported an injury in this category did not report hours of exposure.

Table 4 Farm work activity injury rates per 100000 hours worked by farm activity among women and men, Colorado eight county study, 1993–97

Farm work activity	Women injury rate (No, SE)	Men injury rate (No, SE)	Women:men ratio (95% CI)	Poisson β (SE) (95% CI)
Animal handling	10.88 (7, 4.11)	7.29 (16, 1.82)	1.49 (0.62 to 3.60)	1.59 (1.58) (0.65 to 3.90)
Farmstead materials handling	4.79 (1, 4.79)	4.01 (5, 1.79)	1.19 (0.14 to 10.14)	1.20 (2.99) (0.14 to 10.2)
Crop production	0	1.54 (8, 0.54)	–	–
Farm maintenance	3.41 (1, 3.41)	9.59 (17, 2.33)	0.36 (0.05 to 2.87)	0.38 (2.80) (0.05 to 2.85)
Transport of agricultural produce	0	5.24 (5, 2.34)	–	–
Other farm work	66.20 (9, 22.1)	8.09 (1, 8.09)	8.18 (1.03 to 64.45)	–

CI, confidence interval.

DISCUSSION

The patterns of farm work related injuries were similar among women and men. After controlling for the hours at risk of exposure, women were at higher risk for injury than men when involved with other farm chores.

These results are consistent with other studies where the actual hours of exposure were assessed for women and for men involved in farm work.¹⁰⁻¹¹ The risk of injury among women and men is related to the actual hours of exposure to risk. In this study, the addition of specific job tasks further clarified those activities that placed women and men at risk. This provides information for injury prevention programs to design intervention targeting specific job tasks on farms. Injury rates were high for women and men when involved with animal handling. Men involved with farm maintenance had a high injury rate. Women who were involved in other farm work had a very high injury rate and work is needed to identify within this category those tasks women are doing that increase injury risk.

The study limitations are that injuries were self reported, the response rate was relatively low, and the recall period for injuries was 12 months. Based on the analysis of date of interview and date of injury, there was no evidence of clustering of injury reports except by season. The issue of self report may lead to an under-reporting of injuries and the fact that the reporting period was for a 12 month period may further compound the problem. Since the clustering of reports is seasonal, it seem likely that the injured are reporting appropriately for the activities involved, because farm tasks vary by season. The high injury seasons correspond with the farm tasks and are in accord with other studies reporting seasonal variation in farm related injuries.^{3-9, 12} The farms represented in the sample were quite similar to the farms in the eight counties based on agricultural census information. The study sample may reflect the agricultural activities in the eight county area, but the individuals who responded may differ from other farmers. However, the comparisons in this study were within the sample and no attempt was made to extrapolate the injury rates to all farm residents. The study was designed to assess farm operators and the spouses of farm operators and therefore does not provide any information about hired workers or other family members involved in farm work. If there were annual variations in injury rates over the entire study period due to circumstances such as economic disasters or drought conditions, these would have been incorporated into the overall study and may have influenced some of the reported associations between specific jobs tasks and injury rates.

Overall, women contributed a considerable number of work hours on the farms, but the tasks in which they were most often involved did not include all of the tasks that men did on the farms. Women tend not to view their farm work as active involvement in agricultural production and are likely to downplay the risks they are exposed to working on the farm.¹⁵ While women are a large portion of the agricultural work force, they have tended to be viewed as farm wives rather than farm workers.¹⁶ Occupational hazards will be underdiagnosed and appropriate training to reduce injuries will

Key points

- Contrary to the belief that women do not contribute to farm work, this study provides clear evidence that women are working many hours on farms.
- In addition, while women were at lower risk of injury for certain job tasks, they had as high of injury rates as men for others.
- When delivering injury prevention programs to farm residents, women need to be provided with the same information and safety training as men.

exclude women if the farmers' wives are not asked what they do on the farm.¹⁶

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